IEC 60942

Edition 4.0 2017-11
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Electroacoustics – Sound calibrators

IEC 60942:2017-11 RLV(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 17.140.50; 33.100.20

ISBN 978-2-8322-5135-5

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROACOUSTICS – SOUND CALIBRATORS

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60942 has been prepared by IEC technical committee 29: Electroacoustics, in cooperation with the International Organization of Legal Metrology (OIML).

This fourth edition cancels and replaces the third edition published in 2003, of which it constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) deletion of the class designations, class LS/C, class 1/C and class 2/C;
b) addition of two further class designations, class LS/M and class 1/M, specifically for pistonphones;
c) addition of an amended criterion for assessing conformance to a specification: conformance is now demonstrated when (a) measured deviations from design goals do not exceed the applicable acceptance limits and (b) the uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty;
d) modification to the short-term level fluctuation test of the sound pressure level stability;
e) change to some environmental test conditions to avoid icing;
f) addition of an alternative test for immunity to radio-frequency fields using transverse electromagnetic (TEM) waveguides.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
29/962/FDIS	29/969/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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

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INTRODUCTION

Sound calibrators are designed to produce one or more known sound pressure levels at one or more specified frequencies when coupled to specified models of microphone in specified configurations, for example, with or without protective grid. The sound pressure level generated by ~~a~~ some sound calibrators ~~may~~ depends on ~~environmental conditions such as~~ the static pressure~~, air temperature and relative humidity~~.

Sound calibrators have two principal applications:

a) the determination of the electroacoustical pressure sensitivity of specified models of microphone in specified configurations;

b) checking or adjusting the overall sensitivity of acoustical measuring devices or systems.

ELECTROACOUSTICS – SOUND CALIBRATORS

1 Scope

This document specifies the performance requirements for three classes of sound calibrator: class LS (Laboratory Standard), class 1 and class 2. ~~Tolerance~~ Acceptance limits are smallest for class LS and greatest for class 2 instruments. Class LS sound calibrators are normally used only in the laboratory; class 1 and class 2 are considered as sound calibrators for field use. A class 1 sound calibrator is primarily intended for use with a class 1 sound level meter and a class 2 sound calibrator primarily with a class 2 sound level meter, as specified in IEC 61672-1.

The ~~tolerance~~ acceptance limits for class LS sound calibrators are based on the use of a laboratory standard microphone, as specified in IEC 61094-1, for demonstrations of conformance to the requirements of this document. The ~~tolerance~~ acceptance limits for class 1 and class 2 sound calibrators are based on the use of a working standard microphone, as specified in IEC 61094-4, for demonstrations of conformance to the requirements of this document.

~~A multi-level and multi-frequency sound calibrator has the same class designation for all sound pressure level and frequency combinations for which the instruction manual states that the instrument conforms to the requirements of this standard.~~

To promote consistency of testing of sound calibrators and ease of use, this document contains three normative annexes – Annex A "Pattern evaluation tests", Annex B "Periodic tests", Annex C "Pattern evaluation report", and two informative Annexes – Annex D "Relationship between tolerance interval, corresponding acceptance interval and the maximum-permitted uncertainty of measurement" and Annex E "Example assessments of conformance to specifications of this document".

This document does not include requirements for equivalent free-field or random-incidence sound pressure levels, such as ~~may~~ can be used in the overall sensitivity adjustment of a sound level meter.

A sound calibrator ~~may~~ can provide other functions, for example, tonebursts. Requirements for these other functions are not included in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-801:1994, *International Electrotechnical Vocabulary – Chapter 801: Acoustics and electroacoustics*

IEC 61000-4-2:~~1995~~ 2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*~~. Basic EMC Publication~~

IEC 61000-4-3:~~2002~~ 2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test* ~~Basic EMC Publication~~

IEC 61000-4-20:2010, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61000-6-1:~~1997~~ 2005, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*[1]

IEC 61000-6-2:2005, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*[2]

IEC 61000-6-3:2006, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environment*
IEC 61000-6-3:2006/AMD1:2010

IEC 61094-1:2000, *Measurement microphones – Part 1: Specifications for laboratory standard microphones*

~~IEC 61094-2:1992, *Measurement microphones – Part 2: Primary method for pressure calibration of laboratory standard microphones by the reciprocity technique*~~

IEC 61094-4:1995, *Measurement microphones – Part 4: Specifications for working standard microphones*

IEC 61094-5~~:2001~~, *Electroacoustics – Measurement microphones – Part 5: Methods for pressure calibration of working standard microphones by comparison*

IEC 61672-1~~:2002~~, *Electroacoustics – Sound level meters – Part 1: Specifications*

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

CISPR 16-2-3:2016, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*

CISPR 22:~~1997~~ 2008, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*[3]

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

~~ISO/IEC Guide:1995, *Guide to the expression of uncertainty in measurement*~~

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1 2nd edition (2005). This 2nd edition has been replaced in 2016 by a 3rd edition IEC 61000-6-1:2016, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*, but to ensure consistency with other TC 29 standards this 3rd edition has not been used or referenced in this document, but will be considered prior to the next revision of this document.

2 2nd edition (2005). This 2nd edition has been replaced in 2016 by a 3rd edition IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*, but to ensure consistency with other TC 29 standards this 3rd edition has not been used or referenced in this document, but will be considered prior to the next revision of this document.

3 6th edition (2008). This 6th edition has been replaced in 2015 by CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements,* but to ensure consistency with other TC 29 standards CISPR 32:2015 has not been used or referenced in this document, but will be considered prior to the next revision of this document.

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO 266:1997, *Acoustics – Preferred frequencies*

ISO/IEC Guide 99, *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*

~~ISO Publication:1993, ISBN 92-67-01075-1, *International vocabulary of Basic and general terms in metrology*~~

~~OIML International Recommendation R 97:1990, *Barometers*~~

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-801 and the ~~ISO Publication *International Vocabulary of Basic and General Terms in Metrology*~~ ISO/IEC Guide 99, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

NOTE Definitions for other relevant quantities are given in the documents referenced in Clause 2.

3.1
sound calibrator
device that generates a sinusoidal sound pressure of specified sound pressure level and frequency when coupled to specified models of microphone in specified configurations

3.2
pistonphone
sound calibrator in which the sound pressure is generated in a fixed air volume by the motion of one or more pistons, creating a well-defined volume velocity

3.3
specified sound pressure level
sound pressure level(s) generated under reference environmental conditions for use with a particular microphone model and configuration, valid for either an individual sound calibrator (in the case of a class LS calibrator) or all sound calibrators of the same model (in the case of a class 1 or class 2 calibrator)

Note 1 to entry: Specified sound pressure level is expressed in decibels (dB).

Note 2 to entry: The reference value is 20 μPa.

3.4
nominal sound pressure level
close approximation to the specified sound pressure level(s), valid for all sound calibrators of the same model, rounded to the nearest decibel (intended for marking)

Note 1 to entry: Nominal sound pressure level is expressed in decibels (dB).

Note 2 to entry: The reference value is 20 μPa.

3.5
specified frequency
frequency(ies) of the sound generated by the sound calibrator under reference environmental conditions, valid for either an individual sound calibrator (in the case of a class LS calibrator) or all sound calibrators of the same model (in the case of a class 1 or class 2 calibrator)

Note 1 to entry: Specified frequency is expressed in hertz (Hz).

3.6
nominal frequency
close approximation to the specified frequency, often rounded according to ISO 266 (intended for marking)

Note 1 to entry: Nominal frequency is expressed in hertz (Hz).

3.7
principal sound pressure level
nominal sound pressure level specified in the instruction manual as principal

Note 1 to entry: Where the sound calibrator produces more than one sound pressure level, the manufacturer identifies one nominal sound pressure level as principal.

Note 2 to entry: Principal sound pressure level is used during demonstration of conformance of the sound calibrator to the requirements of this document.

Note 3 to entry: Principal sound pressure level is expressed in decibels (dB).

Note 4 to entry: The reference value is 20 μPa.

3.8
principal frequency
nominal frequency specified in the instruction manual as principal

Note 1 to entry: Where the sound calibrator produces more than one frequency, the manufacturer identifies one nominal frequency as principal.

Note 2 to entry: Principal frequency is used during demonstration of conformance of the sound calibrator to the requirements of this document.

Note 3 to entry: Principal frequency is expressed in hertz (Hz).

3.9
replication
repeat of a measurement involving coupling the microphone to the sound calibrator and then completely removing the microphone from the sound calibrator

3.10
total distortion + noise
ratio of the root-mean-square of the total distortion and noise components, including any harmonics and sub-harmonics, to the root-mean-square of the entire signal

Note 1 to entry: Distortion is the correlated component of the signal due to non-linearity, and noise is the uncorrelated component.

Note 2 to entry: Total distortion + noise is expressed in per cent (%).

3.11
reference orientation
orientation of a sound calibrator such that the principal axis of the opening of the cavity (the axis along which the microphone is inserted into the cavity) coincides with the principal direction of an emitter or receiver of radio-frequency fields, the opening of the cavity facing away from the emitter or receiver

3.12
reference plane
plane of contact between the microphone and the sound calibrator

3.13
effective load volume of a microphone
volume of air at reference environmental conditions that has the same acoustic compliance as the cavity bounded by the reference plane, the microphone diaphragm and the outer cylindrical surface of the microphone at the reference plane, including the equivalent volume of the microphone (described in IEC 61094-1)

Note 1 to entry: Effective load volume is generally expressed in cubic millimetres (mm^3) and may change with frequency.

3.14
coverage probability
probability that the set of true quantity values of a measurand is contained within a specified coverage interval

[SOURCE: ISO/IEC Guide 98-4:2012, 3.2.8]

3.15
acceptance limit
specified upper or lower bound of permissible measured quantity values

Note 1 to entry: Acceptance limits in this document are analogous to the allowances for design and manufacturing in IEC 60942:2003.

[SOURCE: ISO/IEC Guide 98-4:2012, 3.3.8, modified – Note 1 to entry has been added.]

4 Reference environmental conditions

Reference environmental conditions for specifying the performance of a sound calibrator are:

– air temperature: 23 °C;
– static pressure: 101,325 kPa;
– relative humidity: 50 %.

5 Requirements

5.1 General

5.1.1 A sound calibrator conforming to the requirements of this document shall have the characteristics described in Clause 5. Adaptors may be provided to accommodate more than one model of microphone. For the purpose of this document, any such adaptor is an integral part of the sound calibrator.

5.1.2 The sound calibrator shall conform to the requirements of this document for one or more of the sound pressure level and frequency combinations available. ~~All the combinations conforming to the requirements given in this standard shall conform to the same class designation.~~ A multi-level and multi-frequency sound calibrator shall conform to the requirements for the same class designation for all sound pressure level and frequency combinations for which the instruction manual states that the instrument conforms to the requirements of this document. Conformance to the requirements of this document shall not be stated for sound pressure level and frequency settings for which this document provides no ~~tolerance~~ acceptance limits.

5.1.3 Throughout this document, where reference is made to a specific class of sound calibrator, this includes all the designations under that class, unless otherwise stated.

5.1.4 Class LS sound calibrators shall be supplied with an individual calibration chart containing the information required by 6.2. For class 1 and class 2 sound calibrators, the specified sound pressure level(s) and specified frequency(ies) shall be given in the instruction manual. Each specified level shall be defined in terms of an absolute level.

5.1.5 Class LS and class 1 ~~sound calibrators~~ pistonphones that require corrections for the influence of static pressure to conform to the specifications for the appropriate class shall have the letter "~~C~~ M" added to their class designation. ~~Class LS and class 1 sound calibrators shall not require corrections for any of the other environmental conditions to achieve the requirements specified for the appropriate class. Class 2 sound calibrators that require corrections for any of the environmental conditions to conform to the specified requirements shall have the letter 'C' added to their class designation. Where appropriate, the class designation shall be described as class LS/C, class 1/C, class 2/C. Where corrections are permitted, and are necessary to conform to the specified requirements as an environmental condition varies, these corrections shall be stated in the instruction manual.~~ The permissible classes and designations are described in Table 1. Sound calibrators designated class LS/M and class 1/M shall not require corrections for any of the other environmental conditions to achieve the requirements specified for the appropriate class. For class LS/M and class 1/M sound calibrators, the corrections for static pressure, necessary for the sound calibrator to conform to the requirements of this document, shall be stated in the instruction manual, together with the uncertainties of measurement corresponding to a coverage probability of 95 %.

~~**5.1.5** Class 1 sound calibrators that require a correction for the influence of static pressure to conform to the specifications of this standard shall be supplied with a barometer. The barometer shall enable the static pressure to be measured so that the ability of a sound calibrator to conform to the requirements for the class is not affected. Class 2 sound calibrators that require a correction for the influence of static pressure to conform to the specifications of this standard shall be supplied with a barometer (which shall enable the static pressure to be measured in such a way that the ability of a sound calibrator to conform to the requirements for the class is not affected), unless the corrections are sufficiently small that for any change in static pressure of ±6,0 kPa the uncorrected measured sound pressure levels conform to the specifications of this standard. In this case, the corrections to be applied for the influence of variations in static pressure shall be stated in the instruction manual, together with information on how to calculate the relevant correction when operating the sound calibrator at different heights above sea-level.~~

~~NOTE 1 A class LS sound calibrator is normally used only in the laboratory where a suitable device should be available for measuring static pressure if the sound calibrator has a class 'C' designation. Hence, there is no requirement to supply a barometer for this class.~~

~~NOTE 2 The barometer may provide the data directly in the form to be used to correct measured sound pressure levels to the reference static pressure.~~

~~**5.1.6** Where a class 2 sound calibrator, that requires a correction for the influence of temperature or relative humidity to conform to the specifications of this standard, is supplied with the means to measure the relevant environmental condition, the supplied means shall enable the condition to be measured in such a way that the ability of a sound calibrator to conform to the requirements for the class is not affected.~~

~~NOTE The 'supplied means' may provide the data directly in the form to be used to correct measured sound pressure levels to the reference environmental conditions.~~

~~**5.1.7** The design of the sound calibrator and the materials used in the construction should be such as to provide long-term stability for the operation of the sound calibrator.~~

5.1.6 Sound calibrators designated class LS/M may also claim conformance to the requirements for a sound calibrator designated class 1/M if they meet the full specifications described in this document for both classes of sound calibrator.

5.1.7 Sound calibrators, other than those designated class LS/M or class 1/M, shall not require corrections for any of the environmental conditions to conform to the requirements for the relevant class.

5.1.8 Sound calibrators designated class LS/M and class1/M shall either be supplied with a barometer, or the manufacturer shall state the specifications in the instruction manual for any barometer to be used. A statement shall be included in the instruction manual giving the uncertainty of the measurement of static pressure required, for a coverage probability of 95%, so that the ability of a class LS/M or class 1/M sound calibrator to conform to the requirements for the relevant class is not affected.

NOTE 1 A class LS/M sound calibrator is normally used only in the laboratory where a suitable device is likely to be available for measuring static pressure.

NOTE 2 Some barometers provide the data directly in the form to be used to correct measured sound pressure levels to the reference static pressure.

Table 1 – Sound calibrator classes and designations

Class	Designation	Description
LS	LS	Sound calibrator designed to meet the specifications of this document for a class LS device with no corrections for the influence of environmental conditions
	LS/M	Pistonphone designed to meet the specifications of this document for a class LS device with the application of corrections for the influence of static pressure only
1	1	Sound calibrator designed to meet the specifications of this document for a class 1 device with no corrections for the influence of environmental conditions
	1/M	Pistonphone designed to meet the specifications of this document for a class 1 device with the application of corrections for the influence of static pressure only
2	2	Sound calibrator designed to meet the specifications of this document for a class 2 device with no corrections for the influence of environmental conditions

5.1.9 If a specific orientation of the sound calibrator is to be used to conform to the requirements of this document, this orientation shall either be indicated on the sound calibrator, or the indication on the sound calibrator shall refer to the instruction manual, which shall state the required orientation.

5.1.10 All performance requirements relate to the operation of the sound calibrator following stabilizing of the coupling of the microphone and sound calibrator, and after the sound pressure level and frequency have stabilized. The elapsed time necessary for stabilization of the sound pressure level and frequency, which begins once the sound calibrator is switched on with the microphone coupled to it, shall be stated in the instruction manual, and shall not exceed 30 s for any applicable combination of environmental conditions specified in 5.5. Where this stabilization time exceeds 10 s, an indicator shall be provided to demonstrate when the output from the sound calibrator has stabilised. Information on the operation of this indicator shall be given in the instruction manual. Following the stabilization time, the sound pressure level and frequency shall remain stable within the acceptance limits of Table 2 and Table 4, or Table 5 and Table 6, as applicable, whilst switched on, which shall be for a period

of at least 70 s. The sound calibrator and microphone shall be allowed to reach equilibrium with the prevailing environmental conditions before coupling.

NOTE 1 A period of at least 70 s is chosen as the measurement of short-term level fluctuation described in 5.3.3 requires measurement over a period of 60 s of operation of the sound calibrator.

NOTE 2 The stabilization time required following the coupling of the microphone to the sound calibrator ~~may~~ can vary considerably depending on the model of microphone and sound calibrator in use.

NOTE 3 It is important that the sound calibrator is designed such that the static pressure inside the sound calibrator is equal to the static pressure outside the sound calibrator.

5.1.11 If the tests described in Annex A require the sound calibrator to operate for longer than the normal operating time, the manufacturer shall provide information in the instruction manual to describe how this can be achieved.

5.1.12 Those components of a sound calibrator that are not intended to be accessible to the user shall be protected by ~~seals or~~ markings or a mechanism that makes those components inaccessible.

~~**5.1.11** The tolerance limits in this standard include the associated expanded uncertainty of measurement calculated for a coverage factor of 2 corresponding to a level of confidence of approximately 95 %, in accordance with the guidelines given in the ISO/IEC *Guide to the expression of uncertainty in measurement*. For testing laboratories the maximum permitted expanded uncertainties of measurement are stated in Annexes A and B of this document. Sound calibrator manufacturers may calculate the proportion of the tolerance limits available for design and manufacturing purposes by subtracting the maximum permitted expanded uncertainties of measurement from the appropriate tolerance limit.~~

~~**5.1.12** Conformance to the requirements of this standard is demonstrated when the result of a measurement or the absolute value of the difference between the result and the design goal, as appropriate, extended by the actual expanded uncertainty of measurement of the testing laboratory, lies fully within the specified tolerance limits for the appropriate class. For legal metrology purposes, the tolerance limits stated in this standard are considered to be the maximum permissible errors for pattern evaluation, initial verification and subsequent verification.~~

~~**5.1.13** If the actual expanded uncertainty of a measurement performed by the test laboratory exceeds the maximum permitted value given in Annexes A and B, the measurement shall not be used to demonstrate conformance to the requirements of this standard.~~

5.1.13 In 5.3 to 5.9, acceptance limits are provided for allowable values of measured deviations from design goals. For testing laboratories, the maximum-permitted uncertainties of measurement for a coverage probability of 95 % are stated in Annex A. Annex D describes the relationship between tolerance interval, corresponding acceptance interval and the maximum-permitted uncertainty of measurement.

5.1.14 The acceptance limits given for class LS sound calibrators also apply to those sound calibrators designated as class LS/M. The acceptance limits given for class 1 sound calibrators also apply to those sound calibrators designated as class 1/M.

5.1.15 Conformance to a performance specification is demonstrated when the following criteria are both satisfied: (a) measured deviations from design goals do not exceed the applicable acceptance limit AND (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in Annex A for a coverage probability of 95 %.

5.1.16 If the actual uncertainty of a measurement performed by the test laboratory, calculated for a coverage probability of 95 %, exceeds the maximum-permitted value given in

Annex A, the measurement shall not be used to demonstrate conformance to the requirements of this document.

5.1.17 Annex E gives examples of evaluation of conformance to specifications of this document.

5.1.18 Full conformance to this document is only demonstrated when the model of sound calibrator has been shown to conform to the requirements of this document for pattern evaluation when tested according to Annex A, and the individual specimen of sound calibrator has been shown to conform to the requirements of this document for periodic testing when tested according to Annex B.

5.2 Adaptors

The instruction manual for the sound calibrator may provide information to allow design of adaptors to be used with the sound calibrator. This design data shall include all the information necessary to create an adaptor that can be used with the specified sound calibrator in a manner that maintains the specified performance class. Where this design data is supplied, the instruction manual shall specify the insertion distance and minimum diameter of the microphone at which sealing will occur.

5.3 Sound pressure level

5.3.1 General

5.3.1.1 All specified sound pressure level(s) generated shall be stated in the instruction manual with a resolution better than, or equal to, 0,1 dB.

5.3.1.2 All the requirements and ~~tolerance~~ acceptance limits specified in this document relate to the level of the sound pressure produced at the diaphragm of the inserted microphone.

5.3.1.3 The principal sound pressure level of the sound calibrator shall be at least 90 dB re 20 μPa when the sound calibrator is applied to the models of microphone in the configurations specified in the instruction manual.

5.3.2 Generated sound pressure level

~~The sound pressure level generated by the sound calibrator shall be measured as an average over 20 s of operation.~~ The absolute value of the difference between a measured sound pressure level and the corresponding specified sound pressure level~~, extended by the expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 2 for the class of sound calibrator. For sound calibrators with ~~letter 'C'~~ class designation LS/M or 1/M, the measured level shall be corrected for static pressure, if necessary, to the reference ~~environmental conditions~~ static pressure given in Clause 4. These ~~tolerance~~ acceptance limits apply to measurements made at and around reference environmental conditions within the following ranges: 97 kPa to 105 kPa, 20 °C to 26 °C and 40 %to 65 % relative humidity.

5.3.3 Short-term level fluctuation

The fluctuation in the sound pressure level shall be measured with time-weighting F (nominal time constant of 125 ms as specified in IEC 61672-1), by ~~making a minimum of 10 measurements at regular intervals during a period of 20 s of operation of the sound calibrator~~ determining the mean and the maximum and minimum levels generated over a period of 60 s of operation of the sound calibrator, by sampling at least 30 times. ~~One-half of the difference between the maximum and minimum levels measured, extended by the expanded uncertainty of measurement, shall not exceed the short-term level fluctuation limits given in Table 1 for the class of sound calibrator. These short-term level fluctuation limits apply to measurements~~

~~made at and around reference environmental conditions within the following ranges: 97 kPa to 105 kPa, 20 °C to 26 °C and 40 % relative humidity to 65 % relative humidity.~~ The absolute value of the difference between each of the maximum and minimum levels measured, and the mean value shall each not exceed the short-term level fluctuation acceptance limits given in Table 2 for the class of sound calibrator. These short-term level fluctuation acceptance limits apply to measurements made at and around reference environmental conditions within the ranges specified in 5.3.2.

Where a sound calibrator is operated over a period of greater than 60 s, for example in measuring the performance of other instruments such as sound level meters, it is necessary to establish the level fluctuation over the longer time period.

NOTE 1 No specifications are provided in this document for a greater time period of operation.

NOTE 2 At lower frequencies, even for a stable signal, a short-term level fluctuation greater than zero will be indicated by the specified method of measurement. This is caused by the variation in the instantaneous sound pressure and the limited time averaging by the specified F time-weighting. The acceptance limits for short-term level fluctuation are increased at lower frequencies to allow for this phenomenon.

Table 2 – ~~Tolerance~~ Acceptance limits for sound pressure level and short-term level fluctuation, at and around reference environmental conditions

Range of nominal frequencies Hz	Sound pressure level ~~tolerance~~ acceptance limits dB			Short-term level fluctuation limits dB		
	Class LS	Class 1	Class 2	Class LS	Class 1	Class 2
~~31,5 to <160~~	~~–~~	~~0,50~~	~~–~~	~~–~~	~~0,20~~	~~–~~
~~160 to 1 250~~	~~0,20~~	~~0,40~~	~~0,75~~	~~0,05~~	~~0,10~~	~~0,20~~
~~>1 250 to 4 000~~	~~–~~	~~0,60~~	~~–~~	~~–~~	~~0,10~~	~~–~~
~~>4 000 to 8 000~~	~~–~~	~~0,80~~	~~–~~	~~–~~	~~0,10~~	~~–~~
~~>8 000 to 16 000~~	~~–~~	~~1,00~~	~~–~~	~~–~~	~~0,10~~	~~–~~
31,5 to 63	–	0,30	–	–	0,20	–
> 63 to < 160	–	0,30	–	–	0,10	–
160 to 1 250	0,10	0,25	0,40	0,03	0,07	0,15
> 1 250 to 4 000	–	0,35	–	–	0,07	–
> 4 000 to 8 000	–	0,45	–	–	0,07	–
> 8 000 to 16 000	–	0,50	–	–	0,07	–

~~NOTE 1~~ Sound pressure level ~~tolerance~~ acceptance limits are for the absolute value of the difference between the sound pressure level generated by the sound calibrator and the specified sound pressure level~~, extended by the expanded uncertainty of measurement~~.

~~NOTE 2 Short-term level fluctuation limits are for the corresponding measured short-term level fluctuation, extended by the expanded uncertainty of measurement.~~

~~NOTE 3~~ For a class LS or class 2 sound calibrator the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no ~~tolerance~~ acceptance limits.

5.3.4 Sound pressure level over range of supply voltage

The absolute value of the difference between the sound pressure level generated by the sound calibrator, determined according to 5.3.2 over the range of supply voltages specified in the instruction manual, and the sound pressure level measured at the nominal supply voltage under reference environmental conditions~~, extended by the expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 3 for the class of sound calibrator. Also, the ~~tolerance~~ acceptance limits given in Table 2 for the absolute value of the difference between the measured sound pressure level and the specified sound pressure level shall not be exceeded for any supply voltage within the range.

Table 3 – ~~Tolerance~~ Acceptance limits for the effect of supply voltage on sound pressure level, under reference environmental conditions

~~Tolerance~~ Acceptance limits dB		
Class LS	**Class 1**	**Class 2**
~~0,05~~ 0,02	~~0,10~~ 0,06	~~0,20~~ 0,16
~~NOTE Tolerance~~ Acceptance limits are for the absolute value of the difference between the sound pressure level generated by the sound calibrator over the range of operating voltage, and the sound pressure level measured at the nominal supply voltage~~, extended by the expanded uncertainty of measurement~~.		

5.4 Frequency

5.4.1 General

5.4.1.1 The principal frequency of the sound generated by the sound calibrator shall be in the range from 160 Hz to 1 250 Hz. Specified frequencies shall be calculated from the equation for exact frequency given in 3.1 of ISO 266:1997, or taken from Table 1 of ISO 266:1997 which gives the calculated frequency.

5.4.1.2 The principal sound pressure level shall be available at the principal frequency.

5.4.2 Frequency of sound generated by the sound calibrator

The absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator and the corresponding specified frequency~~, extended by the expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 4 for the class of sound calibrator. These ~~tolerance~~ acceptance limits apply to measurements made at and around reference environmental conditions within the ranges specified in 5.3.2~~: 97 kPa to 105 kPa, 20 °C to 26 °C and 40 % relative humidity to 65 % relative humidity~~.

Table 4 – ~~Tolerance~~ Acceptance limits for frequency, at and around reference environmental conditions

~~Tolerance~~ Acceptance limits %		
Class LS	**Class 1**	**Class 2**
~~1,0~~ 0,7	~~1,0~~ 0,7	~~2,0~~ 1,7
~~NOTE 1 Tolerance~~ Acceptance limits are for the absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator and the specified frequency~~, extended by the expanded uncertainty of measurement~~. ~~NOTE 2 Tolerance~~ Acceptance limits are expressed as a percentage of the specified frequency.		

5.5 Influence of static pressure, air temperature and humidity

~~**5.4.1**~~ For environmental conditions outside the ranges specified in 5.3.2 ~~of 97 kPa to 105 kPa, 20 °C to 26 °C and 40 % relative humidity to 65 % relative humidity~~, sound calibrators shall operate within the ~~tolerance~~ acceptance limits given in Tables 5 and 6 relative to the values measured under reference environmental conditions, and shall not exceed the ~~tolerance~~ acceptance limits for Table 7, for the class of sound calibrator, over any combination of the range of environmental conditions given below.

Class LS Static pressure: 65 kPa to 108 kPa

	Air temperature:	+16 °C to +30 °C
	Relative humidity:	25 % to 90 %
Class 1	Static pressure:	65 kPa to 108 kPa
	Air temperature:	–10 °C to +50 °C
	Relative humidity:	25 % to 90 %

Combinations of air temperature and relative humidity that would yield a dewpoint greater than +39 °C are excluded from the tests of conformance with these specifications.

Class 2	Static pressure:	65 kPa to 108 kPa
	Air temperature:	0 °C to +40 °C
	Relative humidity:	25 % to 90 %

NOTE The range of environmental conditions for class 1 and class 2 sound calibrators is the same as specified in IEC 61672-1 for class 1 and class 2 sound level meters.

~~**5.4.2** Class LS and class 1 sound calibrators that conform to the requirements of Tables 4, 5 and 6 for the given class of sound calibrator, over the appropriate range of environmental conditions specified in 5.4.1, but which require corrections for the influence of static pressure to achieve conformance to the requirements specified in Table 4 and Table 5, shall be designated class LS/C or class 1/C sound calibrator, as appropriate. Similarly, class 2 sound calibrators that conform to the requirements of Tables 4, 5 and 6 for the class of sound calibrator, over the appropriate range of environmental conditions specified in 5.4.1, but which require corrections for any of the environmental conditions to achieve conformance to the requirements specified in Tables 4 and 5, shall be designated class 2/C sound calibrators. All relevant corrections, together with their associated expanded uncertainties of measurement corresponding to a confidence level of approximately 95 %, shall be given in the instruction manual. A statement shall be included in the instruction manual giving the maximum expanded uncertainty of the measurement of environmental conditions required so that the ability of a sound calibrator to conform to the requirements for the relevant class is not affected.~~

Table 5 – ~~Tolerance~~ Acceptance limits for sound pressure level, over the specified range of environmental conditions

Range of nominal frequencies Hz	~~Tolerance~~ Acceptance limits dB		
	Class LS	Class 1	Class 2
31,5 to < 160	–	~~0,50~~ 0,25	–
160 to 1 250	~~0,20~~ 0,10	~~0,40~~ 0,25	~~0,60~~ 0,40
> 1 250 to 4 000	–	~~0,60~~ 0,30	–
> 4 000 to 8 000	–	~~0,80~~ 0,45	–
> 8 000 to 16 000	–	~~1,00~~ 0,60	–

~~NOTE 1 Tolerance~~ Acceptance limits are for the absolute value of the difference between the sound pressure level generated by the sound calibrator over the specified range of environmental conditions (excluding the conditions covered by Table 2) and the sound pressure level measured under reference environmental conditions~~, extended by the expanded uncertainty of measurement~~.

~~NOTE 2~~ For a class LS or class 2 sound calibrator the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no ~~tolerance~~ acceptance limits.

Table 6 – ~~Tolerance~~ Acceptance limits for frequency, over the specified range of environmental conditions

~~Tolerance~~ Acceptance limits %		
Class LS	Class 1	Class 2
~~1,0~~ 0,7	~~1,0~~ 0,7	~~2,0~~ 1,7

~~NOTE 1 Tolerance~~ Acceptance limits are for the absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator over the specified range of environmental conditions (excluding the conditions covered by Table 4) and the frequency measured under reference environmental conditions~~, extended by the expanded uncertainty of measurement~~.

~~NOTE 2 Tolerance~~ Acceptance limits are expressed as a percentage of the specified frequency.

5.6 Total distortion ~~+~~ noise

The total distortion ~~+~~ noise, measured over the frequency range from ~~at least 22, 5 Hz to 20 kHz~~ 22,4 Hz (nominal frequency) to 22,4 kHz (nominal frequency)~~, extended by the expanded uncertainty of measurement,~~ shall not exceed the maximum values given in Table 7, for the applicable range of environmental conditions specified in 5.5.

NOTE 1 ~~A~~ Some distortion meters ~~may~~ indicate the ratio of the magnitude of the unwanted components, including any harmonics and subharmonics, to the magnitude of the fundamental component of the signal. For the maximum total distortion + noise limits specified in this document, the difference between distortion measured as a ratio of the root-mean-square of the total distortion component~~s~~ + noise to the root-mean-square of the entire signal, or to the root-mean-square of the fundamental, is insignificant compared with the uncertainty of measurement. An instrument that measures total harmonic distortion only is not suitable.

NOTE 2 The aim is to ensure all noise contributions are included across the specified frequency range.

Table 7 – Maximum total distortion + noise

Range of nominal frequencies Hz	Total distortion + noise %		
	Class LS	Class 1	Class 2
31,5 to < 160	–	~~4,0~~ 3,0	–
160 to 1 250	~~2,5~~ 2,0	~~3,0~~ 2,5	~~4,0~~ 3,0
> 1 250 to 16 000	–	~~4,0~~ 3,0	–

~~NOTE 1 Tolerance~~ Acceptance limits are for the maximum total distortion + noise generated by the sound calibrator~~, extended by the expanded uncertainty of measurement~~.

~~NOTE 2~~ For a class LS or class 2 sound calibrator, the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no ~~tolerance~~ acceptance limits.

5.7 Power supply requirements

The sound calibrator shall include as an integral part some means of ~~checking~~ indicating that the supply voltage is sufficient to operate the sound calibrator in accordance with the requirements of this document, or shall ensure that the sound calibrator ceases to produce any sound output when the supply voltage falls below that required to operate the sound calibrator in accordance with the requirements of this document.

5.8 Specification and calibration of microphones

5.8.1 Microphone models and adaptors

5.8.1.1 The instruction manual for the sound calibrator shall either state the microphone configurations as designated in IEC 61094-1 or IEC 61094-4 with which the sound calibrator is specified to operate in conformity with the requirements of this document or alternatively, and in addition if desired, state the name of the manufacturer or supplier, model designation and configurations (for example, with or without protective grid) of those microphones with which the sound calibrator is specified to operate in conformity with the requirements of this document. In each case, the instruction manual shall state the required adaptor configuration (if any). This information may also be given on the manufacturer's webpage.

5.8.1.2 For class LS sound calibrators, at least one of the microphone configurations or models specified shall be a laboratory standard microphone as specified in IEC 61094-1.

5.8.1.3 For class 1 and class 2 sound calibrators, at least one of the microphone models specified shall be a working standard microphone as specified in IEC 61094-4.

NOTE A measurement microphone that conforms to the requirements of IEC 61094-1 for laboratory standard microphones also conforms to the requirements of IEC 61094-4 for working standard microphones.

5.8.1.4 A microphone model shall be used for which the electroacoustical characteristic is designated by the letter P in IEC 61094-1 or IEC 61094-4.

5.8.2 Microphone sensitivity level

For the microphone models specified, it shall be possible to determine the pressure sensitivity level of the microphone by at least one of the following:

a) a method specified in IEC 61094-2; or

b) a method specified in IEC 61094-5, or by an alternative comparison method.

5.9 Electromagnetic compatibility

5.9.1 General

Sound calibrators shall conform to the requirements of this document for radio-frequency emissions, and immunity to electrostatic discharges and power- and radio-frequency fields.

5.9.2 Radio-frequency emissions

5.9.2.1 The upper limits for the electromagnetic field strength of radio-frequency emissions from the sound calibrator are 30 dB (re 1 µV/m) quasi-peak, measured at 10 m, for frequencies in the range from 30 MHz to 230 MHz, and 37 dB (re 1 µV/m) quasi-peak, measured at 10 m, for frequencies in the range from 230 MHz to 1 GHz.

NOTE 1 The upper limits are defined for compatibility with many different standards. The limits given in Table 1 of ~~CISPR/~~IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010 form the basic requirements for sound calibrators.

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

5.9.2.2 The instruction manual shall state the mode of operation of the sound calibrator that produces the greatest radio-frequency emissions.

5.9.3 Electrostatic discharges

5.9.3.1 Sound calibrators shall withstand contact discharges up to 4 kV and air discharges up to 8 kV, for both positive and negative voltages relative to earth ground as specified in IEC 61000-6-1:2005, Table 1, requirement 1.5.

~~NOTE The requirements are as specified in 1.4 of Table 1 in IEC 61000-6-1:2005.~~

5.9.3.2 Performance criterion B as specified in IEC 61000-6-1 applies during and after these electrostatic discharge tests.

5.9.3.3 Following the completion of the electrostatic discharge tests, the sound calibrator shall be fully operational and in a configuration identical to that set before the start of the tests.

5.9.4 Immunity to power- and radio-frequency fields

5.9.4.1 Sound calibrators shall exhibit, as a minimum, immunity over the following ranges of power- and radio-frequencies and field strengths:

– frequency range from 26 MHz to 1 000 MHz; root-mean-square ~~electromagnetic~~ electric field strength up to and including 10 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 900 Hz~~; frequency range from 26 MHz to 1 GHz~~;

– frequency range from 1 400 MHz to 2 000 MHz; root-mean-square electric field strength up to and including 3 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 900 Hz;

– frequency range from 2 000 MHz to 2 700 MHz; root-mean-square electric field strength up to and including 1 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 900 Hz;

– uniform root-mean-square alternating magnetic field strength of 80 A/m; frequency 50 Hz and 60 Hz.

~~NOTE~~ The requirements are those specified in 1.1 of Table 1 of IEC 61000-6-1:2005, and 1.2, 1.3 and 1.4 of Table 1 in IEC 61000-6-2:2005 with minor amendments. These amendments extend the range of radio-frequency fields to cover from 26 MHz to 1 GHz, change the modulation frequency from 1 kHz to 900 Hz, increase the field strength for the power-

frequency field to 80 A/m, and exclude the reduced field strength requirements listed in Table 1, Note c, of IEC 61000-6-2:2005.

~~NOTE~~ ~~A~~ Some sound calibrators ~~may~~ conform to the specifications of this document at an unmodulated root-mean-square electromagnetic field strength greater than ~~10 V/m~~ those specified above. If this is the case, the applicable field strength should be stated in the instruction manual for each range of frequencies.

NOTE The latest editions of IEC 61000-6-1 and IEC 61000-6-2, published 2016, will be considered prior to the next revision of this document.

5.9.4.2 With the sound calibrator in the reference orientation and with the opening of the cavity where the microphone is inserted facing away from the emitter of the power or radio-frequency field, when the field is applied no change in operating state shall occur. The absolute value of the difference between the measured sound pressure level generated by the sound calibrator in the presence of the field, and in the absence of the field, shall not exceed ~~0,15~~ 0,10 dB for a class LS sound calibrator, ~~0,3~~ 0,25 dB for a class 1 sound calibrator, and ~~0,5~~ 0,45 dB for a class 2 sound calibrator. For multi-level or multi-frequency sound calibrators, or both, the requirements apply for each combination of frequency and sound pressure level for which the instruction manual states that the sound calibrator conforms to the requirements of this document.

5.9.4.3 Tests for immunity to radio-frequency fields may be performed at discrete frequencies in accordance with Clause 8 of IEC 61000-4-3:2006, 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. Dwell time at each frequency shall be appropriate. Testing at a limited number of discrete frequencies does not eliminate the need to conform to the requirements of 5.9.4.1 and 5.9.4.2 at all frequencies within the specified ranges.

5.9.4.4 Tests of immunity to radio-frequency fields shall either be performed as described in Clause 8 of IEC 61000-4-3:2006 or shall use an alternative test method using transverse electromagnetic (TEM) waveguides. The requirements that shall be applied for the TEM waveguide are specified in IEC 61000-4-20, and Annex B of IEC 61000-4-20:2010 defines methods of implementing the testing. The performance requirements for the instrument under test are unchanged including the range of frequencies to be tested and the step size.

5.9.4.5 The instruction manual for the sound calibrator shall state the configuration and the connecting devices (if any) that produce the minimum immunity (maximum susceptibility) to power- and radio-frequency fields.

6 Instrument marking and documentation

6.1 Marking of the sound calibrator

A space shall be allowed for marking on the sound calibrator, and sound calibrators conforming to the requirements of this document shall be supplied with the following minimum information. Items a), b), c) and d) shall be marked on the sound calibrator. The remaining items shall be marked on, or displayed during operation of, the sound calibrator:

a) manufacturer's or supplier's name or trade mark;

b) model designation and serial number;

c) reference to this document by number and year of publication;

d) the class of instrument, including the letter "~~C~~ M" designation, where applicable and ~~the environmental condition(s) for which corrections need to be applied, for example,~~ that this corresponds to a need for corrections for static pressure;

e) a clear indication of all available combinations of sound pressure level and frequency that conform to the requirements of the class;

f) the nominal sound pressure level or sound pressure levels;

g) the nominal frequency or frequencies;

h) where possible, and if required for the sound calibrator, an indication of the orientation required for installation on a microphone;

i) if the sound calibrator is battery operated, the preferred battery type;

j) model ~~designations~~ number of adaptors shall be marked on the adaptors, where provided;

k) where appropriate, firmware and software version numbers.

6.2 Individual calibration chart for a class LS sound calibrator

A class LS sound calibrator shall be supplied with an individual calibration chart from the manufacturer or supplier. The chart shall state the specified sound pressure level(s) and frequency(ies) for the models and configuration of microphone for which the sound calibrator conforms to the requirements of this document.

6.3 Instruction manual

The sound calibrator shall be supplied with an instruction manual which shall contain the information required by Clause 5 and by 6.1. It shall also contain the following information:

a) either identification of the microphone ~~models~~ configuration(s) as designated in IEC 61094-1 or IEC 61094-4, or alternatively (and in addition if desired), the name of the manufacturer or supplier, model designation and configurations ~~in which they are used~~ (for example, with or without protective grid) and of the relevant adaptors required, together with detailed instructions which need to be followed to ensure that the sound calibrator functions as intended when used as described in the instruction manual;

b) for class LS sound calibrators, at least the nominal sound pressure level(s) and frequency(ies), and for class 1 and class 2 sound calibrators the specified sound pressure level(s) and frequency(ies) of the output signal when the sound calibrator is coupled to the specified microphone models and configurations;

c) where appropriate, details of relevant firmware and software, including, where applicable, version numbers;

d) if a specific orientation of the sound calibrator is to be used to conform to the requirements of this document, this orientation shall be stated;

e) the elapsed time, and details of operation of any indicator if required, before the specified sound pressure level and frequency stabilize, for any available combination of sound pressure level and frequency, once the sound calibrator is switched on with the microphone coupled to it. In addition, the instruction manual shall give information on the elapsed time necessary to stabilize the microphone and sound calibrator combination, after they are coupled together;

f) If the environmental tests, described in Annex A, require the sound calibrator to operate for longer than the normal operating time, information describing how this can be achieved;

g) the principal sound pressure level. For a sound calibrator with only one available sound pressure level, this is the principal sound pressure level;

h) the principal frequency. For a sound calibrator with only one available frequency, this is the principal frequency;

i) the range of ~~environmental conditions~~ static pressure over which the sound calibrator is specified to operate, and the correction data, if applicable, specified in 5.5, together with the ~~expanded~~ uncertainties of measurement ~~corresponding to a confidence level of approximately~~ for a coverage probability of 95 % associated with the correction data; ~~for class 2 sound calibrators with letter 'C' designation that are not required to be supplied with a barometer, information on how to calculate the correction when operating the calibrator at different heights above sea-level;~~

j) identification of the available combinations of sound pressure level and frequency that conform to the requirements of this document for the class;

~~i) a recommended procedure to ensure that the ambient sound level is sufficiently low during operation of the sound calibrator so that the calibrator operates as intended at each level setting;~~

k) ~~for class LS sound calibrators, including those with letter designation 'C',~~ the typical change in sound pressure level produced by the sound calibrator with changes in the effective load volume of the inserted microphone, as applicable;

l) types of battery which ~~may~~ can be used, if applicable, together with the typical operation lifetime, details of any battery status indicator and its operation, and the nominal, maximum and minimum supply voltages; method of connection to an external power supply, where applicable;

m) for sound calibrators with letter "~~C~~ M" designation, a statement giving the ~~maximum expanded~~ uncertainty of the measurement, for a coverage probability of 95 %, of ~~environmental conditions~~ the static pressure so that the ability of a sound calibrator to conform to the requirements of the relevant class is not affected; where a barometer is supplied with the sound calibrator, the ~~expanded~~ uncertainty of measurement, for a coverage probability of 95 %, of the static pressure when using the barometer;

n) for ~~class LS~~ sound calibrators with letter "M" designation where a barometer is required but not supplied, details of a suitable device to measure static pressure;

o) a statement of the configuration for the normal mode of operation;

p) the cables and accessories, if any, for use with the sound calibrator with which the calibrator conforms to the electromagnetic compatibility requirements of 5.9;

q) a description of the reference orientation for testing the effects of exposure to radio-frequency fields;

r) if applicable, the unmodulated root-mean-square ~~electromagnetic~~ electric field strength greater than ~~10 V/m~~ the specified requirements for which the sound calibrator conforms to the specifications of this document;

s) the configuration, sound pressure level and frequency settings for greatest radio-frequency emissions;

t) the configuration and connecting devices, if any, that produce minimum immunity (maximum susceptibility) to power- and radio-frequency fields;

u) if design data for adaptors is included, this data shall include the insertion distance and minimum diameter of the microphone at which sealing will occur;

v) details of the combinations of sound pressure level and frequency that do not conform to the requirements for the class, together with a description of their acoustical characteristics, and a statement of the nominal ~~tolerance~~ acceptance limits maintained about the design goals.

~~NOTE~~ Where a sound calibrator has additional features not specified in this document, the instruction manual should include a statement to this effect together with a description of the manufacturer's design goals for the additional features and a statement of the corresponding nominal ~~tolerance~~ acceptance limits, ~~including the expanded uncertainties of measurement~~ together with the maximum-permitted uncertainty of measurement for a coverage probability of 95 %.

Annex A
(normative)

Pattern evaluation tests

A.1 ~~Introduction~~ General

A.1.1 Annex A gives details of the tests necessary to demonstrate conformance to all the requirements specified in this document for a model of sound calibrator. The tests are applicable to class LS, class 1 and class 2 sound calibrators, and aim to ensure that pattern evaluation tests are performed in a consistent manner at all testing laboratories. All applicable tests described in Annex A shall be performed.

A.1.2 Conformance to ~~the requirements of this standard is demonstrated when the result of a measurement or the absolute value of the difference between the result and the design goal, as appropriate, extended by the actual expanded uncertainty of measurement of the testing laboratory, does not exceed the specified tolerance limit~~ a performance specification is demonstrated when the following criteria are both satisfied: (a) a measured deviation from a design goal does not exceed the applicable acceptance limit and (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in this document for the same coverage probability of 95 %.

A.1.3 Laboratories performing ~~these~~ pattern evaluation tests shall calculate ~~the~~ all uncertainties ~~associated with all the~~ of measurements in accordance with the guidelines given in the ISO/IEC Guide ~~*to the expression of uncertainty in measurement*~~ 98-3. Actual ~~expanded~~ measurement uncertainties shall be calculated for a ~~level of confidence~~ coverage probability of 95 %~~, using the necessary coverage factor~~. Where a testing laboratory is only required to make a single measurement, it is necessary for the laboratory to make an estimate of the random contribution to the total uncertainty, using an earlier evaluation based on several measurements for a similar sound calibrator.

~~NOTE Generally, a coverage factor of 2 approximates to a level of confidence of 95 %, unless the contributions are such that is necessary to use a different coverage factor to maintain the 95 % level of confidence.~~

A.1.4 The ~~expanded~~ uncertainties of measurement for a coverage probability of 95 % given in Annex A are the maximum permitted for demonstration of conformance, under Annex A, to the requirements of this document. If the actual ~~expanded~~ uncertainty of a measurement performed by the test laboratory, calculated for a coverage probability of 95 %, exceeds the maximum-permitted value, the measurement shall not be used to demonstrate conformance to the requirements of this document.

A.1.5 In Annex A, tables are given for the maximum-permitted ~~expanded~~ uncertainties of measurement for a coverage probability of 95 %. For sound calibrators at and around reference environmental conditions, Table A.1 gives the ~~data~~ maximum-permitted uncertainty for the generated sound pressure level and short-term level fluctuation, and Table A.2 gives the ~~data~~ maximum-permitted uncertainty for the frequency of the sound generated. Table A.3 gives the ~~data~~ maximum-permitted uncertainty for the total distortion + noise in the output signal over the specified range of environmental conditions. For sound calibrators over the specified range of environmental conditions, Table A.4 gives the ~~data~~ maximum-permitted uncertainty for the generated sound pressure level, and Table A.5 gives the ~~data~~ maximum-permitted uncertainty for the frequency of the sound generated.

A.1.6 The test laboratory shall use instruments with current calibrations for the appropriate quantities. The calibrations shall be traceable to national standards, as required.

A.2 Submission for test

A.2.1 Five specimens of the same pattern of sound calibrator shall be submitted for pattern evaluation testing. As a minimum, the testing laboratory shall select two of the five specimens for testing. At least one of these two specimens shall then be tested fully according to the procedures given in Annex A. The testing laboratory shall decide whether the full tests shall also be performed on the second specimen, or whether limited testing is adequate to provide approval of the pattern.

~~NOTE Depending on the number of specimens tested, the pattern approval may be limited to two years so that further experience with the pattern may be gained.~~

A.2.2 Each sound calibrator, together with all relevant accessories (such as adaptors or barometer), shall be submitted for test together with a copy of the instruction manual. Each class LS sound calibrator shall also be supplied with an individual calibration chart.

A.3 Principal values

A.3.1 It shall be confirmed that the principal sound pressure level of the sound calibrator conforms to the requirement of 5.3.1.3.

A.3.2 It shall be confirmed that the principal frequency of the sound calibrator conforms to the requirement of 5.4.1.1.

A.4 Marking of the sound calibrator and supplied documentation

It shall be verified that the markings on the sound calibrator and the information in the instruction manual supplied conform to the requirements and contain all the information specified in 6.1 and 6.3. For class LS sound calibrators, it shall be verified that the individual calibration chart contains all the information required by 6.2.

A.5 Performance tests at and around reference environmental conditions

A.5.1 General

A.5.1.1 All tests in Clause A.5 shall be performed within the ranges of environmental conditions specified in 5.3.2.

A.5.1.2 For ~~class LS and class 1~~ sound calibrators ~~with a letter designation 'C'~~ designated class LS/M or class 1/M, where appropriate, data supplied in the instruction manual shall be applied for the influence of static pressure, to correct measured sound pressure levels to the reference ~~environmental conditions~~ static pressure. If a barometer is supplied with the sound calibrator, it shall be used to measure the static pressure, and then the data supplied in the instruction manual shall be applied, where appropriate, to correct measured sound pressure levels to the reference environmental conditions.

~~**A.4.1.3** For class 2 sound calibrators with a letter designation 'C', data supplied in the instruction manual, for the influence of static pressure, temperature and relative humidity, shall be applied, where appropriate, to correct measured sound pressure levels to the reference environmental conditions. If a means of measuring the relevant environmental condition is supplied with the sound calibrator, the means shall be used to measure the relevant environmental condition and then the data supplied in the instruction manual shall be applied, where appropriate, to correct measured sound pressure levels to the reference environmental conditions.~~

A.5.1.3 Except for the tests described in A.5.5.6, A.5.5.7, A.5.5.8, A.5.7.2, A.5.7.4 and A.5.8.2, all measurements shall be performed at an operating voltage within 20 % of the nominal operating voltage and without exceeding the specified maximum or minimum operating voltage.

A.5.1.4 Where the manufacturer claims that a pistonphone conforms to the specifications for both class LS/M and class 1/M, the measurements performed shall cover all tests required for each class designation.

A.5.2 Orientation

If a specific orientation for application of the sound calibrator is stated in the instruction manual, this orientation shall be used for testing. If no specific orientation is prescribed, at least 3 different orientations shall be used for the measurements of sound pressure level described in A.5.5.3.

A.5.3 Ambient noise

To avoid ambient noise affecting any measurements, tests shall only be performed where the sound pressure level measured by the microphone after coupling to the sound calibrator, but before switching on, is at least 40 dB below the specified level being measured.

A.5.4 Microphone specification

For class LS, class 1 and class 2 sound calibrators, the microphone used for testing shall be one of the microphones specified for the relevant class in 5.8.1.

A.5.5 Sound pressure level

A.5.5.1 The sound pressure level generated by the sound calibrator shall be measured, as an average over a period between 20 s and 25 s of operation, at the principal sound pressure level specified in the instruction manual at each of the frequency settings for which the instruction manual states that the instrument conforms to the requirements of this document.

A.5.5.2 ~~For class LS sound calibrators the microphone shall be a laboratory standard microphone as specified in IEC 61094-1. For class 1 and class 2 sound calibrators the microphone shall be a working standard microphone as specified in IEC 61094-4.~~

~~NOTE A measurement microphone that conforms to the requirements of IEC 61094-1 for laboratory standard microphones also conforms to the requirements of IEC 61094-4 for working standard microphones.~~

~~NOTE~~ It is recommended that the sound pressure levels be measured using the insert voltage technique (described in 5.3 of IEC 61094-2:2009) or by an equivalent method to measure the open-circuit voltage from the microphone.

~~NOTE Where a choice of microphone model is available, a microphone model should be used for which the electroacoustical characteristic is designated by the letter P in IEC 61094-1 or IEC 61094-4.~~

A.5.5.3 ~~The measurement of sound pressure level shall be replicated twice to give a total of three tests.~~ The sound pressure level shall be measured at least three times. The microphone shall be coupled to the sound calibrator before each measurement and uncoupled after each measurement. The microphone shall be rotated around its axis at each coupling so that the rotational orientation of the microphone is evenly distributed over the measurements. The absolute value of the difference between the mean measured sound pressure level and the corresponding specified sound pressure level~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 2 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.1 for the class of sound calibrator.

A.5.5.4 Measurements of sound pressure level as described in A.5.5.3 shall be repeated for at least one other specimen of the same model of laboratory standard or working standard microphone as applicable, for each frequency setting of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this document.

A.5.5.5 For multi-level sound calibrators, the sound pressure level generated by the sound calibrator shall also be measured as described in A.5.5.3, at each level setting at each of the frequency settings for which the instruction manual states that the instrument conforms to the requirements of this document, using one specimen of the model of microphone.

~~**A.4.3.6** The procedure given in the instruction manual shall be followed to ensure that the level of ambient sound reaching the microphone during testing is sufficiently low that the sound calibrator operates as intended.~~

A.5.5.6 The measurement(s) of the sound pressure level shall be repeated (excluding replications) within 5 % of the minimum operating voltage of the power supply, internal or external, consistent with operation of any battery condition indicator or acoustic signal cut-off facility supplied as an integral part of the sound calibrator, using one specimen of microphone. Measurements shall be made for the following combinations of sound pressure level and frequency, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the principal sound pressure level and principal frequency;
– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;
– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.5.5.7 The measurements shall be performed in terms of the variation of the level of the output voltage from the microphone at the reduced operating voltage for the sound calibrator, relative to the level of the output voltage from the microphone at the nominal supply voltage for the sound calibrator under reference environmental conditions. For each combination, the absolute value of the difference between the sound pressure level generated at the reduced operating voltage and the sound pressure level generated by the sound calibrator at the nominal supply voltage at reference environmental conditions~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 3. The actual ~~expanded~~ uncertainty of measurement of the difference, calculated for a coverage probability of 95 %, shall not exceed 0,02 dB for class LS sound calibrators, and shall not exceed 0,04 dB for class 1 and class 2 sound calibrators. Also, the absolute value of the difference between the measured sound pressure level and the specified level~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 2.

NOTE The uncertainty specified in A.5.5.7 is included in the maximum-permitted ~~expanded~~ uncertainty given in Table A.1.

A.5.5.8 Where the sound calibrator is designed to be connected to an external power supply, the measurement(s) of sound pressure level shall be repeated (excluding replications) at the principal sound pressure level and principal frequency at the maximum-permitted supply voltage. The measurements shall be performed in terms of the variation of the level of the output voltage from the microphone at the maximum-permitted supply voltage for the sound calibrator, relative to the level of the output voltage from the microphone at the nominal supply voltage for the sound calibrator under reference environmental conditions. The absolute value of the difference between the sound pressure level generated at the maximum-permitted supply voltage and the sound pressure level generated by the sound calibrator at

the nominal supply voltage at reference environmental conditions~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 3. The actual ~~expanded~~ uncertainty of measurement of the difference, calculated for a coverage probability of 95 %, shall not exceed 0,02 dB for class LS sound calibrators, and shall not exceed 0,04 dB for class 1 and class 2 sound calibrators. Also, the absolute value of the difference between the measured sound pressure level and the specified level~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 2.

NOTE The uncertainty specified in A.5.5.8 is included in the maximum-permitted ~~expanded~~ uncertainty given in Table A.1.

A.5.5.9 Where the instruction manual states that the sound calibrator conforms to the requirements of this document for the same class when used with microphone models or microphone configurations other than that used in A.5.4, the measurements described in A.5.5 shall be repeated for those microphone models or configurations, unless the testing laboratory is satisfied that it has reliable, justifiable evidence of the equivalence of various models of microphone, or of corrections to be applied. In these cases, ~~it may not be necessary for~~ the laboratory will decide whether it is necessary to perform measurements using all models and configurations of microphones, ~~but~~ or whether to use a representative sample of these equivalent models.

A.5.6 Sound pressure level stability – Short-term level fluctuation

A.5.6.1 Short-term fluctuation of the sound pressure level in the cavity of the sound calibrator shall be determined at the principal sound pressure level and principal frequency, with the microphone used in A.5.4. ~~A minimum of ten measurements at regular intervals using time weighting F (specified in IEC 61672-1) shall be made over a period of 20 s of operation of the sound calibrator, to find the maximum and minimum output sound pressure level. One-half of the difference between the maximum and minimum measured sound pressure levels, extended by the actual expanded uncertainty of measurement, shall not exceed the applicable tolerance limits given in Table 1 for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in Table A.1 for the class of sound calibrator.~~ The mean level, and the maximum and minimum levels, measured using time-weighting F (nominal time constant of 125 ms as specified in IEC 61672-1), shall be determined over a period of 60 s of operation of the sound calibrator, by sampling at least 30 times at random time intervals. The absolute value of the difference between each of the maximum and minimum levels measured, and the mean value shall each not exceed the applicable acceptance limits given in Table 2 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 % shall not exceed those given in Table A.1 for the class of sound calibrator.

NOTE A sound level meter with resolution of at least 0,01 dB would meet the requirements for these measurements.

A.5.6.2 Short-term level fluctuation shall be measured with one microphone only.

A.5.6.3 For multi-level sound calibrators, the measurement of short-term level fluctuation as described in A.5.6.1 and A.5.6.2 shall be repeated at the principal frequency and at the minimum sound pressure level setting, and at the minimum frequency and principal sound pressure level setting, for which the instruction manual states that the instrument conforms to the requirements of this document.

Table A.1 – Maximum-permitted ~~expanded~~ uncertainty of measurement for a coverage probability of 95 %, for sound pressure level and short-term level fluctuation at and around reference environmental conditions

Range of nominal frequencies Hz	Uncertainty of measurement for generated sound pressure level dB			Uncertainty of measurement for short-term level fluctuation dB		
	Class LS	Class 1	Class 2	Class LS	Class 1	Class 2
31,5 to 63	–	0,20	–	–	0,15	–
> 63 to < 160	–	0,20	–	–	0,10	–
160 to 1 250	0,10	0,15	0,35	0,02	0,03	0,05
> 1 250 to 4 000	–	0,25	–	–	0,03	–
> 4 000 to 8 000	–	0,35	–	–	0,03	–
>8 000 to 16 000	–	0,50	–	–	0,03	–
~~NOTE~~ For a class LS or class 2 sound calibrator, the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no ~~tolerance~~ acceptance limits.						

A.5.7 Frequency

A.5.7.1 The frequency of the sound generated by the sound calibrator shall be measured, as an average over a period of between 20 s and 25 s of operation, with the microphone ~~used~~ specified in A.5.4, at the principal sound pressure level, for each frequency setting of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this document. The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 4 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.2 for the class of sound calibrator.

A.5.7.2 Measurements of frequency shall be repeated within 5 % of the minimum operating voltage of the power supply, internal or external, consistent with operation of any battery condition indicator or acoustic signal cut-off facility supplied as an integral part of the sound calibrator. The measurements shall be for the following combinations of sound pressure level and frequency, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the principal sound pressure level and principal frequency;
– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;
– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.5.7.3 The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 4 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.2 for the class of sound calibrator.

A.5.7.4 Where the sound calibrator is designed to be connected to an external power supply, the measurement of frequency shall be repeated at the principal sound pressure level and

principal frequency at the maximum-permitted supply voltage. The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 4 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.2 for the class of sound calibrator.

Table A.2 – Maximum-permitted ~~expanded~~ uncertainty of measurement for a coverage probability of 95 % for frequency, at and around reference environmental conditions

Uncertainty of measurement for frequency %		
Class LS	**Class 1**	**Class 2**
~~0,3~~ 0,2	~~0,3~~ 0,2	~~0,3~~ 0,2
~~NOTE Expanded~~ Uncertainties of measurement are expressed as a percentage of the specified frequency.		

A.5.8 Total distortion + noise

A.5.8.1 ~~Total distortion of the sound pressure signal generated by the sound calibrator shall be measured, over the frequency range from at least 22,5 Hz to 20 kHz, with the microphone used in A.4.3.2 at each frequency setting, at the maximum and minimum sound pressure level setting for which the instruction manual states that the instrument conforms to the requirements of this standard. The measured total distortion, extended by the actual expanded uncertainty of measurement, shall not exceed the limit given in Table 6 for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in Table A.3 for the class of sound calibrator.~~ The total distortion + noise of the sound pressure signal generated by the sound calibrator shall be measured over a bandwidth of 22,4 Hz (nominal frequency) to 22,4 kHz (nominal frequency), as an average over a period of between 20 s and 25 s of operation, with the microphone specified in A.5.4 at each frequency setting, at the maximum and minimum sound pressure level setting for which the instruction manual states that the instrument conforms to the requirements of this document. The total distortion + noise can be measured using a rejection filter device (distortion factor meter) or an appropriate FFT analyser, and the method of measurement shall be reported. The measured total distortion + noise shall not exceed the acceptance limit given in Table 7 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.3 for the class of sound calibrator. An instrument that measures total harmonic distortion only is not suitable.

NOTE For one-octave and one-third-octave filters that are base 10, 22,4 Hz is the lower band edge of the 31,5 Hz one-octave filter and the lower band edge of the 25 Hz one-third-octave filter. The frequency 22,4 kHz is the upper band edge of the 16 kHz one-octave filter and the upper band edge of the 20 kHz one-third-octave filter.

A.5.8.2 Total distortion + noise measurements shall be repeated within 5 % of the minimum operating voltage of the power supply, internal or external, consistent with operation of any battery condition indicator or acoustic signal cut-off facility supplied as an integral part of the sound calibrator. The measurements shall be for the following combinations of sound pressure level and frequency, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;

– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;

– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;

– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.5.8.3 The measured total distortion + noise~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the limit given in Table 7 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.3 for the class of sound calibrator.

~~NOTE 1 The total distortion may be measured using a rejection filter device (distortion factor meter) or an appropriate analyser.~~

~~NOTE 2 Where a choice of microphone model is available, a microphone model should be used for which the electroacoustical characteristic is designated by the letter P in IEC 61094-1 or IEC 61094-4.~~

Table A.3 – Maximum-permitted ~~expanded~~ uncertainty of measurement for a coverage probability of 95 % for total distortion + noise, over the appropriate range of environmental conditions

Range of nominal frequencies Hz	Uncertainty of measurement for total distortion + noise %		
	Class LS	Class 1	Class 2
31,5 to < 160	–	1,0	–
160 to 1 250	0,5	0,5	1,0
> 1 250 to 16 000	–	1,0	–

~~NOTE 1~~ The above uncertainties are expressed in percentage distortion.

~~NOTE 2~~ For a class LS or class 2 sound calibrator, the "–" symbols in the table indicate nominal frequency ranges for which this document provides no ~~tolerance~~ acceptance limits.

A.6 Environmental tests

A.6.1 General

A.6.1.1 If the instruction manual specifies a battery of particular model and type, such a battery shall be fitted to the sound calibrator for the tests of the influence of variation in environmental conditions.

A.6.1.2 In order to reduce the time for testing the influence of air temperature and humidity on the sound pressure level output of the sound calibrator, A.6.4 describes a set of abbreviated tests shorter than the full tests given in A.6.5, A.6.6 and A.6.7. These abbreviated tests measure the influence on the output of the sound calibrator of air temperature and humidity combined. For the abbreviated tests, conformance to the requirements of this document shall be demonstrated within ~~tolerance~~ acceptance limits smaller than those given in Tables 5 and 6. If a sound calibrator conforms to these reduced ~~tolerance~~ acceptance limits (described in A.6.4.7) at all the test conditions then it shall be deemed to conform to the requirements of this document, and the tests described in A.6.5, A.6.6 and A.6.7 shall not be performed. If the sound calibrator fails to conform within the reduced ~~tolerance~~ acceptance limits for any of the tests described in A.6.4, then the full tests of A.6.5, A.6.6 and A.6.7 shall be performed to determine whether the sound calibrator conforms to the requirements of this document within the ~~tolerance~~ acceptance limits given in Tables 5 and 6.

A.6.1.3 For class LS/M and class 1/M sound calibrators ~~with a letter designation 'C'~~, where appropriate, data supplied in the instruction manual shall be applied for the influence of static pressure, to correct measured sound pressure levels to reference environmental conditions. If a barometer is supplied with the sound calibrator, it shall be used to measure the static pressure.

NOTE ~~The~~ Some barometers ~~may~~ provide the data directly in the form to be used to correct measured sound pressure levels to the reference static pressure.

~~**A.5.1.4** For class 2 sound calibrators with a letter designation 'C', data supplied in the instruction manual, for the influence of static pressure, temperature and relative humidity, shall be applied, where appropriate, to correct measured sound pressure levels to the reference environmental conditions. If a means of measuring the relevant environmental condition is supplied with the sound calibrator, the means shall be used to measure the relevant environmental condition.~~

~~NOTE The 'supplied means' may provide the data directly in the form to be used to correct measured sound pressure levels to the reference environmental conditions.~~

A.6.2 Influence of static pressure

A.6.2.1 The sound pressure level generated by the sound calibrator shall be measured over the applicable range of static pressure at the principal sound pressure level and at the principal frequency and all higher frequencies for which the instruction manual states that the instrument conforms to the requirements of this document. Sound pressure levels shall be measured using one specified model and configuration of microphone for which the pressure and air temperature coefficients over the required range are known. During the measurements, the air temperature shall be kept constant as far as possible, preferably within ±2 °C of the reference air temperature. The relative humidity at the reference static pressure shall be within ±20 % relative humidity of the reference relative humidity.

NOTE In a given volume of humid air, when the static pressure of the air in the volume is reduced by removing, or increased by adding, a quantity of humid air, the amount of water vapour in the volume will be reduced or increased in proportion. The relative humidity will therefore decrease or increase from the initial relative humidity. For practical reasons, this test for the influence of static pressure does not compensate for variations in relative humidity caused by removal, or addition, of quantities of air from the initial volume.

A.6.2.2 Sound pressure levels shall be measured at a minimum of 5 static pressures, in terms of the variation of the level of the output voltage from the microphone as the static pressure is changed, relative to the level of the output voltage from the microphone under reference environmental conditions. These static pressures shall include the reference static pressure and the minimum and maximum static pressure applicable for the class of sound calibrator. The sound calibrator shall be left to acclimatize for at least 10 min at each static pressure prior to performing a measurement. The static pressure shall be measured using a device for which the calibration is traceable to national standards, which shall enable the static pressure to be measured with an actual ~~expanded~~ uncertainty not exceeding 0,2 kPa for a ~~confidence level~~ coverage probability of 95 %.

A.6.2.3 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference ~~environmental conditions~~ static pressure, using the method described in A.6.1.3 where appropriate, for the class of sound calibrator. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in microphone sensitivity level with changing pressure, air temperature and relative humidity.

A.6.2.4 The range of static pressure over which the absolute value of the difference between the measured sound pressure level (corrected where applicable ~~if the sound calibrator has a letter 'C' designation~~ for static pressure for sound calibrators designated class LS/M or class 1/M) and the sound pressure level determined under reference environmental conditions~~, extended by the actual expanded uncertainty of measurement,~~ does not exceed the ~~tolerance~~ acceptance limits given in Table 2 or Table 5, as appropriate for the static pressure and for the class of sound calibrator, shall be at least as wide as that stated in the instruction manual. This range of static pressure shall include that specified in 5.5 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.4 for the class of sound calibrator.

A.6.2.5 The total distortion + noise of the sound pressure signal generated by the sound calibrator shall be measured, according to A.5.8.1, at the lowest static pressure, for the

principal frequency and the maximum sound pressure level setting for which the instruction manual states that the instrument conforms to the requirements of this document.

Table A.4 – Maximum-permitted ~~expanded~~ uncertainty of measurement for a coverage probability of 95 %, for sound pressure level, over the specified range of environmental conditions

Range of nominal frequencies Hz	Uncertainty of measurement for sound pressure level dB		
	Class LS	Class 1	Class 2
31,5 to < 160	–	0,25	–
160 to 1 250	0,10	0,15	0,20
> 1 250 to 4 000	–	0,30	
> 4 000 to 8 000	–	0,35	–
> 8 000 to 16 000	–	0,40	–

~~NOTE 1~~ These uncertainties of measurement are for the difference between the measured sound pressure level over the specified range of environmental conditions and the ~~measurement of~~ measured sound pressure level under reference environmental conditions.

~~NOTE 2~~ These uncertainties include the uncertainty in manufacturer-supplied corrections, where applicable.

~~NOTE 3~~ These uncertainties do not include the uncertainty of measurement at reference environmental conditions, given in Table A.1.

~~NOTE 4~~ For a class LS or class 2 sound calibrator, the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no ~~tolerance~~ acceptance limits.

A.6.3 Acclimatization requirements for tests of the influence of variations in air temperature and relative humidity

A.6.3.1 The sound calibrator and measurement microphone shall be placed in an environmental chamber to test the influence of variations in air temperature and relative humidity on the sound pressure level, frequency and total distortion + noise generated by the sound calibrator.

A.6.3.2 For tests of the influence of variations in air temperature and relative humidity, the measurement microphone shall not be coupled to the sound calibrator, and the power to the sound calibrator shall be switched off during all acclimatization periods.

A.6.3.3 Prior to any measurements, the sound calibrator shall be left, switched off, to stabilize at approximately reference conditions for 12 h.

A.6.3.4 Following this stabilization, for tests of the effects of air temperature and humidity combined and for tests of the effect of relative humidity alone, at each measurement condition the sound calibrator and microphone shall be left to acclimatize for at least an additional 7 h prior to measurements. For tests of the effect of air temperature alone, this additional acclimatization period shall be at least 3 h.

A.6.3.5 Where the testing laboratory has the facility to couple the microphone to the sound calibrator without affecting the relative humidity, measurements ~~may~~ can be performed following the time required for pressure equalization due to coupling of the microphone and calibrator. If this capability is not available, a further acclimatization period of 3 h shall be allowed before commencing measurements.

A.6.4 Abbreviated test of influence of air temperature and humidity combined

A.6.4.1 The sound pressure level and frequency of sound generated by the sound calibrator at the principal sound pressure level and the principal frequency shall be measured for the

following combinations of air temperature and relative humidity, applicable to the class of sound calibrator:

Class LS Reference air temperature and relative humidity:

– an air temperature of 16 °C and relative humidity of 25 %;

– an air temperature of 30 °C and a relative humidity of 90 %.

Class 1 Reference air temperature and relative humidity:

– an air temperature of −10 °C and ~~relative humidity of 65 %~~ in the absence of icing;

– an air temperature of 5 °C and ~~relative humidity of 25 %~~ in the absence of icing;

– an air temperature of 40 °C and relative humidity of 90 %;

– an air temperature of 50 °C and a relative humidity of 50 %.

Class 2 Reference air temperature and relative humidity:

– an air temperature of 0 °C and ~~relative humidity of 30 %~~ in the absence of icing;

– an air temperature of 40 °C and a relative humidity of 90 %.

During the measurements, the static pressure shall be kept constant as far as possible, preferably within +2,0 kPa to −4,0 kPa of the reference static pressure.

The ~~tolerance~~ acceptance limits on the specified test conditions are ±2,5 °C and ±10 % relative humidity.

Sound pressure levels and frequencies shall be measured using one specified model and configuration of microphone for which the pressure, air temperature and relative humidity coefficients over the required range are known. The air temperature and relative humidity shall be measured using devices for which the calibrations are traceable to national standards. These devices shall enable the relevant environmental condition to be measured in such a way that the ability of a sound calibrator to conform to the requirements for the relevant class is not affected. The actual ~~expanded~~ uncertainties of measurement shall not exceed 0,5 °C and 5 % relative humidity respectively, for a coverage probability of 95 %.

~~NOTE The tolerance limits on the specified test conditions include the actual expanded uncertainties of measurement.~~

Following an initial measurement of sound pressure level and frequency at the reference air temperature and relative humidity, measurements shall be performed in decreasing order of the specified air temperatures, starting with the highest specified air temperature. A final measurement shall then be made at the reference air temperature and relative humidity.

NOTE The indicated combinations of air temperature and relative humidity were chosen in consideration of the dewpoints that were obtainable within available environmental test facilities. The combinations also reflect the range of environmental conditions for general applications of class LS, class 1 and class 2 sound calibrators.

A.6.4.2 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the output voltage and frequency of the signal from the microphone as the air temperature and relative humidity are changed,

relative to the output voltage and frequency of the signal from the microphone for the first measurement at the reference air temperature and relative humidity.

A.6.4.3 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference ~~environmental conditions~~ static pressure, using the method described in A.6.1.3 where appropriate, for the class of sound calibrator. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in microphone sensitivity level with changing air temperature, relative humidity and static pressure.

A.6.4.4 For multi-level or multi-frequency sound calibrators, or both, additional measurements of sound pressure level and frequency shall be performed at the reference air temperature and relative humidity for the following combinations of sound pressure level and frequency, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;

– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level:

– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;

– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.6.4.5 For multi-level or multi-frequency sound calibrators, or both, further measurements shall be performed at the maximum and minimum air temperature and associated relative humidity given in A.6.4.1 for the appropriate class. The following combinations of sound pressure level and frequency shall be used, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the principal sound pressure level and principal frequency;

– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;

– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;

– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;

– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.6.4.6 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the output voltage and frequency of the signal from the microphone as the air temperature and relative humidity are changed, relative to the output voltage and frequency of the signal from the microphone for the measurement at the reference air temperature and relative humidity.

A.6.4.7 The absolute value of the difference between the measured sound pressure levels (corrected where applicable ~~if the sound calibrator has a letter 'C' designation~~ for static pressure for sound calibrators designated class LS/M or class 1/M) and the first measurement of the corresponding sound pressure level at the appropriate sound pressure level and frequency at the reference air temperature and relative humidity~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the reduced ~~tolerance~~ acceptance limits derived from those given in Table 5 as follows: for class LS and class 1 sound calibrators, the applicable ~~tolerance~~ acceptance limits are those given in Table 5 reduced by 0,05 dB, and for class 2 sound calibrators the applicable acceptance limits are those given in Table 5 reduced by 0,10 dB. The absolute value of the difference in per cent between the measured frequencies and the first measurement of the corresponding frequency at the

reference air temperature and relative humidity~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the reduced ~~tolerance~~ acceptance limits derived from those in Table 6 as follows: for class LS, class 1 and class 2 sound calibrators, the applicable ~~tolerance~~ acceptance limits are ~~0,8 %, 0,8 % and 1,6 %~~ 0,5 %, 0,5 % and 1,3 % respectively. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.4 and Table A.5 for the class of sound calibrator.

Table A.5 – Maximum-permitted ~~expanded~~ uncertainty of measurement for a coverage probability of 95 % for frequency, over the specified range of environmental conditions

Uncertainty of measurement for frequency %		
Class LS	**Class 1**	**Class 2**
~~0,3~~ 0,2	~~0,3~~ 0,2	~~0,3~~ 0,2
~~NOTE Expanded~~ Uncertainties of measurement are expressed as a percentage of the specified frequency.		

A.6.5 Influence of air temperature

A.6.5.1 If required by the results of the tests described in A.6.4, the sound pressure level and frequency of the sound generated by the sound calibrator shall be measured over the applicable range of air temperature at the principal sound pressure level and principal frequency. Where the sound calibrator is a multi-level or multi-frequency sound calibrator, or both, measurements shall be repeated ~~at~~ for the following combinations of sound pressure levels and frequencies, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the maximum sound pressure level and the minimum, principal and maximum frequencies available at that sound pressure level;

– the minimum sound pressure level and the minimum, principal and maximum frequencies available at that sound pressure level;

– the minimum frequency and the minimum, principal and maximum sound pressure levels available at that frequency;

– the maximum frequency and the minimum, principal and maximum sound pressure levels available at that frequency.

Measurements of sound pressure level and frequency shall be performed using one specified model and configuration of microphone for which the air temperature, pressure and relative humidity coefficients over the required range are known. During the measurements, the static pressure shall be kept constant as far as possible, preferably within +2,0 kPa to −4,0 kPa of the reference static pressure, and the relative humidity shall be kept constant as far as possible at a stated humidity within ±20 % relative humidity of the reference relative humidity.

~~NOTE~~ It is important to monitor the relative humidity each time the air temperature is changed to ensure that it remains within the acceptance limits specified in A.6.5.1. Rapid changes of air temperature in the chamber should be avoided and care should be taken to avoid condensation as the temperature of the air in the environmental chamber is changed.

~~NOTE~~ If the testing laboratory considers that the 3 h acclimatization time is inadequate, this time may be increased.

A.6.5.2 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the output voltage and frequency of the signal from the microphone as the air temperature is changed, relative to the output voltage and frequency of the signal from the microphone under reference environmental

conditions. Measurements shall be performed at a minimum of five air temperatures. These shall include the reference air temperature and the minimum and maximum air temperature applicable for the class of sound calibrator, and two other air temperatures outside the range from 20 °C to 26 °C. The air temperature shall be measured using a device for which the calibration is traceable to national standards. This device shall enable the air temperature to be measured such that the ability of a sound calibrator to conform to the requirements for the relevant class is not affected. Actual ~~expanded~~ uncertainty of measurement, for a coverage probability of 95 %, for this device shall not exceed 0,5 °C.

A.6.5.3 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference ~~environmental conditions~~ static pressure, using the method described in A.6.1.3 where appropriate~~, for the class of sound calibrator~~. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in the microphone sensitivity level with changing air temperature, pressure and relative humidity.

A.6.5.4 The range of air temperature over which

– the absolute value of the difference between the measured sound pressure level (corrected where applicable ~~if the sound calibrator has a letter "S" designation~~ for static pressure for sound calibrators designated class LS/M or class 1/M) and the corresponding sound pressure level determined under reference environmental conditions~~, extended by the actual expanded uncertainty of measurement,~~ does not exceed the ~~tolerance~~ acceptance limits given in Table 5, and

– the absolute value of the difference in per cent between the measured frequency and the frequency determined under reference environmental conditions~~, extended by the actual expanded uncertainty of measurement,~~ does not exceed the ~~tolerance~~ acceptance limits given in Table 6

shall be at least as wide as that specified in the instruction manual, which shall include the range given in 5.5 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Tables A.4 and A.5 respectively for the class of sound calibrator.

A.6.6 Influence of relative humidity

A.6.6.1 If required by the results of the tests described in A.6.4, the sound pressure level generated by the sound calibrator at the principal sound pressure level and the principal frequency shall be measured over the applicable range of relative humidity. Where the sound calibrator is a multi-level or multi-frequency sound calibrator, or both, measurements shall be repeated at the following combinations of sound pressure levels and frequencies, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the maximum sound pressure level and the minimum, principal and maximum frequencies available at that sound pressure level;

– the minimum frequency and the maximum sound pressure level available at that frequency;

– the maximum frequency and the maximum sound pressure level available at that frequency.

Measurements of sound pressure level and frequency shall be performed using one specified model and configuration of microphone for which the pressure, air temperature and humidity coefficients over the required range are known. During the measurements, the static pressure and air temperature shall be kept constant as far as possible, preferably within +2,0 kPa to −4,0 kPa of the reference static pressure, and within ±2 °C of the reference air temperature.

A.6.6.2 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the level of the output voltage

and frequency of the signal from the microphone as the relative humidity is changed, relative to the level of the output voltage and frequency of the signal from the microphone under reference environmental conditions, at a minimum of five relative humidities. These shall include the reference relative humidity and the minimum and maximum relative humidity applicable for the class of sound calibrator as specified in 5.5, and two other relative humidities outside the range from 40 % to 65 %. The relative humidity shall be measured using a device for which the calibration is traceable to national standards. This device shall enable the relative humidity to be measured such that the ability of a sound calibrator to conform to the requirements for the relevant class is not affected. Actual ~~expanded~~ uncertainty of measurement, for a coverage probability of 95 %, for this device shall not exceed 5 % relative humidity.

A.6.6.3 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference ~~environmental conditions~~ static pressure, using the method described in A.6.1.3 where appropriate~~, for the class of sound calibrator~~. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in microphone sensitivity level with changing relative humidity, pressure and air temperature.

A.6.6.4 The range of relative humidity over which

– the absolute value of the difference between the measured sound pressure level (corrected where applicable ~~if the sound calibrator has a letter 'C' designation~~ for static pressure for sound calibrators designated class LS/M or class 1/M) and the corresponding sound pressure level determined under reference environmental conditions~~, extended by the actual expanded uncertainty of measurement,~~ does not exceed the ~~tolerance~~ acceptance limits given in Table 5, and

– the absolute value of the difference in per cent between the measured frequency and the frequency determined under reference environmental conditions~~, extended by the actual expanded uncertainty of measurement,~~ does not exceed the ~~tolerance~~ acceptance limits given in Table 6

shall be at least as wide as that specified in the instruction manual, which shall include the range given in 5.5 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Tables A.4 and A.5 respectively for the class of sound calibrator.

A.6.7 Influence of air temperature and humidity combined

A.6.7.1 If required by the results of the tests described in A.6.4, the sound pressure level and frequency of the sound generated by the sound calibrator at the principal sound pressure level and the principal frequency shall be measured at the following combinations of air temperature and relative humidity, applicable to the class of sound calibrator.

For class LS sound calibrators:

– the reference air temperature and relative humidity;
– an air temperature of 16 °C and relative humidity of 25 %;
– an air temperature of 30 °C and a relative humidity of 90 %.

For class 1 sound calibrators:

– the reference air temperature and relative humidity;
– an air temperature of −10 °C and ~~relative humidity of 65 %~~ in the absence of icing;
– an air temperature of 40 °C and a relative humidity of 90 %.

For class 2 sound calibrators:

– the reference air temperature and relative humidity;

– an air temperature of 0 °C and ~~relative humidity of 30 %~~ in the absence of icing;
– an air temperature of 40 °C and a relative humidity of 90 %.

The ~~tolerance~~ acceptance limits on the nominal air temperatures are ±2,5 °C and on nominal relative humidity are ±10 % relative humidity.

A.6.7.2 Measurements of sound pressure level and frequency shall be performed using one specified model and configuration of microphone for which the pressure, air temperature and humidity coefficients over the required range are known. During the measurements, the static pressure shall be kept constant as far as possible, preferably within +2,0 kPa to −4,0 kPa of the reference static pressure. The ~~actual expanded~~ uncertainties of the devices used to measure air temperature and relative humidity shall not exceed 0,5 °C and 5 % relative humidity respectively for a coverage probability of 95 %.

~~NOTE The tolerance limits on the specified test conditions include the actual expanded uncertainties of measurement.~~

A.6.7.3 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the output voltage and frequency of the signal from the microphone as the air temperature and relative humidity are changed, relative to the output voltage and frequency of the signal from the microphone under reference environmental conditions. The air temperature and relative humidity shall be measured using devices for which the calibrations are traceable to national standards. These devices shall enable the relevant environmental conditions to be measured adequately so that the ability of a sound calibrator to conform to the specifications for the relevant class is not affected.

A.6.7.4 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference ~~environmental conditions~~ static pressure, using the method described in A.6.1.3 where appropriate ~~for the class of sound calibrator~~. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in microphone sensitivity level with changing air temperature, relative humidity and pressure.

A.6.7.5 The absolute value of the difference between each measured sound pressure level (corrected where applicable ~~if the sound calibrator has a letter 'C' designation~~ for static pressure for sound calibrators designated class LS/M or class 1/M) and the corresponding sound pressure level determined under reference environmental conditions~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 5 for the class of sound calibrator. The absolute value of the difference in per cent between each measured frequency and the corresponding frequency determined under reference environmental conditions~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 6 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.4 and Table A.5 for the class of sound calibrator.

A.7 Electromagnetic compatibility

A.7.1 General

A.7.1.1 The tests described in Clause A.7 shall be performed unless the particular configuration of the sound calibrator renders them inappropriate, in which case equivalent tests shall be substituted.

A.7.1.2 During testing, the sound calibrator shall be set to the mode of operation specified in the instruction manual as appropriate for the test being performed. It shall be operating and powered by the preferred power supply specified in the instruction manual.

A.7.1.3 Full details of the equipment necessary to perform the tests and the detailed test methods are mostly contained in other International Standards, with additional requirements given in Clause A.7. These other International Standards, listed in Clause 2, shall be referred to for all relevant tests.

A.7.1.4 Uncertainties of measurement of the electromagnetic and electrostatic characteristics shall be as specified in the appropriate International Standards. The actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, of the testing laboratory for the sound calibrator shall not exceed those given in Clause A.7.

A.7.2 Radio-frequency emissions

A.7.2.1 The sound calibrator shall be configured and set as specified in the instruction manual to produce the greatest radio-frequency emissions in the frequency range being investigated.

A.7.2.2 Radio-frequency field-strength emission~~s~~ levels, in decibels relative to 1 µV/m, shall be measured ~~as described in Clauses 6 and 10 of CISPR 22:1997~~ by the method of CISPR 16-2-3:2016. The quasi-peak detector instrument shall be as specified in CISPR 16-1-1 for the frequency ranges specified in this document.

A.7.2.3 Measuring receivers, antennas and test procedures shall be as described in Clauses 6 and 10 of CISPR 22:2008. All measured emissions shall conform to the requirements for enclosure ports in Table 1 of ~~CISPR/~~IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010.

A.7.2.4 The sound calibrator shall initially be tested in the reference orientation stated in the instruction manual. A microphone of a model specified in the instruction manual for use with the sound calibrator shall be inserted into the cavity of the sound calibrator.

A.7.2.5 Maintaining the configuration of A.7.2.1 and A.7.2.4, the sound calibrator shall be tested for radio-frequency emissions in at least one other plane approximately orthogonal to the reference orientation, within the limits of suitable positioning for the radio-frequency measuring system employed.

A.7.2.6 Any fixtures and fittings used to maintain the position of the sound calibrator (including the microphone and cable, if appropriate) shall be such as to have no significant influence on the measurement of any radio-frequency emissions from the sound calibrator.

A.7.2.7 If the sound calibrator is fitted with any connection device that allows interface or interconnection cables to be attached to it, then all tests of radio-frequency emissions shall be performed with cables connected to all available connection devices. All cables shall be left unterminated and shall be arranged as described in 8.2 of CISPR 22:~~1997~~ 2008, unless the manufacturer of the sound calibrator also supplies the device connected to the sound calibrator by this cable, in which case all items shall be tested when connected together.

A.7.2.8 The radio-frequency test results shall comply with the requirements of 5.9.2.1.

A.7.3 Electrostatic discharges

A.7.3.1 The equipment required and methods of testing for electrostatic discharges shall be as described in IEC 61000-4-2.

A.7.3.2 If the sound calibrator 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 tests. Discharges shall not be made to pins on connectors that are recessed behind the exterior surface of either the connector or the sound calibrator.

A.7.3.3 Any supports or other items used to maintain the position of the sound calibrator during testing shall not obscure any part of the sound calibrator required for access for electrostatic discharge testing, nor shall they influence the testing of the sound calibrator. A microphone of a model specified for use with the sound calibrator shall be inserted into the cavity of the sound calibrator. The sound calibrator shall be set in accordance with the instruction manual for normal usage at the principal frequency and principal sound pressure level.

A.7.3.4 Contact and air discharges at the maximum voltage of both polarities shall each be applied 10 times to all appropriate parts of the sound calibrator.

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

A.7.3.5 After a discharge, the sound calibrator shall return to the same operating state as before the discharge. During the test, unquantified changes in performance are permitted.

A.7.3.6 If the instruction manual specifies a performance degradation or loss of function after the discharge tests, this degradation or loss of function shall not result in any permanent reduced operation or change of configuration.

A.7.4 Immunity to power- and radio-frequency fields

A.7.4.1 The equipment required and methods of testing for radio-frequency fields shall either be as described in IEC 61000-4-3, or shall use an alternative test method using transverse electromagnetic (TEM) waveguides. The requirements for the TEM waveguide are specified in IEC 61000-4-20, and Annex B of IEC 61000-4-20:2010 defines methods of implementing the testing. The performance requirements for the instrument under test are unchanged including the range of frequencies to be tested and the step size.

A.7.4.2 Testing shall first be performed for the reference orientation stated in the instruction manual with a microphone or "remote-microphone" adaptor inserted into the cavity of the sound calibrator. The sound calibrator shall be set to operate at the principal sound pressure level and principal frequency. The sound pressure level generated in the absence of the electromagnetic field shall be recorded.

~~NOTE~~ In order to avoid possible effects of electromagnetic fields on the microphone, a "remote-microphone" adaptor including a non-metallic tube ~~may~~ can be used between the sound calibrator cavity and a microphone located in an area where the electric field strength is less than that to which the sound calibrator is subjected.

A.7.4.3 Tests for immunity to radio-frequency fields shall be performed either as a continuous frequency sweep or at discrete frequencies in accordance with IEC 61000-4-3:2006, Clause 8, except that increments of up to 4 % for frequencies less than 500 MHz and up to 2 % for all other frequencies ~~may~~ can be substituted for the 1 % specified in IEC 61000-4-3:2006. Dwell time at each frequency shall be appropriate to the sound calibrator under test. Testing at a limited number of discrete frequencies does not remove the need for the sound calibrator to conform to the requirements of this document at all frequencies within the specified range.

NOTE ~~The~~ Other standards and requirements require 1 % frequency increments as specified in IEC 61000-4-3 ~~may be required for demonstrating conformance with other standards or requirements~~.

A.7.4.4 If the sound calibrator is fitted with any 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 22:1997~~ 7.3 of IEC 61000-4-3:2006, unless the manufacturer of the sound calibrator

also supplies the device connected to the sound calibrator by this cable, in which case all items shall be tested when connected together.

A.7.4.5 Power-frequency fields shall be as specified in 5.9.4.1. Tests of susceptibility to power-frequency fields shall be performed with the sound calibrator applied to a microphone in a manner that has no influence on the power-frequency field. The microphone shall be of a model stated in the instruction manual for use with the sound calibrator.

A.7.4.6 Maintaining the configuration of A.7.4.2 and A.7.4.4, the sound calibrator shall be tested in at least one other plane, approximately orthogonal to the plane containing the principal axis of the reference orientation, within the limits of suitable positioning for the radio-frequency transmitting system employed.

A.7.4.7 ~~The procedure given in the instruction manual shall be followed to ensure that the level of ambient sound reaching the microphone during testing is sufficiently low that the sound calibrator operates as intended.~~ During testing, the sound calibrator shall remain fully operational and in the same configuration as it was before testing commenced.

A.7.4.8 The absolute value of the difference between the measured sound pressure level and the sound pressure level measured in the absence of the power-frequency or radio-frequency field~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the requirements of 5.9.4.2. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed 0,05 dB for all classes of sound calibrator. This uncertainty does not include any contribution from measurement of the electromagnetic field.

A.7.4.9 If the instruction manual states that the sound calibrator conforms to the requirements of this document for any other combinations of sound pressure level and frequency, in addition to the principal sound pressure level and principal frequency, the tests for immunity to power- and radio-frequency fields shall be repeated as follows:

– for multi-level single-frequency sound calibrators, all sound pressure levels for which the instruction manual states that the instrument conforms to the requirements of this document shall be tested;

– for multi-frequency single-level sound calibrators, all frequencies for which the instruction manual states that the instrument conforms to the requirements of this document shall be tested;

– for multi-level, multi-frequency sound calibrators, all frequencies for which the instruction manual states that the instrument conforms to the requirements of this document shall be tested at the minimum sound pressure level for which conformance with this document is stated;

– for multi-level, multi-frequency sound calibrators, all sound pressure levels for which the instruction manual states that the instrument conforms to the requirements of this document shall be tested at the principal frequency.

A.7.4.10 In each case, the absolute value of the difference between the measured sound pressure level and the sound pressure level measured in the absence of the power-frequency or radio-frequency field~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the requirements of 5.9.4.2. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed 0,05 dB for all classes of sound calibrator. This uncertainty does not include any contribution from measurement of the electromagnetic field.

Annex B
(normative)

Periodic tests

B.1 ~~Introduction~~ General

B.1.1 Annex B gives details of the periodic tests applicable to class LS, class 1 and class 2 sound calibrators. It aims at ensuring that testing is performed in a consistent manner at all testing laboratories. All applicable tests described in Annex B shall be performed.

B.1.2 For multi-level and multi-frequency calibrators, a limited number of sound pressure level and frequency settings may be tested if this is specified by, and agreed with, the customer, but these agreed combinations shall include the principal sound pressure level at the principal frequency. Where testing is limited in this way the sound calibrator shall be marked to show that only limited tests have been performed. Wording shall be added to the certificate to indicate that full testing according to this document has not been performed, so no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of this document.

B.1.3 Conformance to the requirements of Annex B is demonstrated when the ~~result of a measurement or the absolute value of the difference between the result and the design goal, as appropriate, extended by the actual expanded uncertainty of measurement of the testing laboratory, does not exceed the specified tolerance limit~~ following criteria are both satisfied: (a) a measured deviation from a design goal does not exceed the applicable acceptance limit and (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in this document for the same coverage probability of 95 %.

Laboratories performing these tests shall calculate the uncertainties associated with all the measurements in accordance with the guidelines given in ISO/IEC Guide ~~*to the expression of uncertainty in measurement*~~ 98-3. Actual ~~expanded~~ measurement uncertainties shall be calculated for a ~~level of confidence of 95 %, using the necessary~~ coverage ~~factor~~ probability of 95 %.

Where a testing laboratory is only required to make a single measurement, it is necessary for the laboratory to make an estimate of the random contribution to the total uncertainty, using an earlier evaluation based on several measurements for a similar sound calibrator.

~~NOTE Generally a coverage factor of 2 approximates to a level of confidence of 95 %, unless the contributions are such that is necessary to use a different coverage factor to maintain the 95 % level of confidence.~~

B.1.4 The ~~expanded~~ uncertainties of measurement for a coverage probability of 95 % given for the corresponding tests in Annex A are also the maximum-permitted for demonstration of conformance to the requirements of Annex B. If the actual ~~expanded~~ uncertainty of a measurement performed by the test laboratory, calculated for a coverage probability of 95 %, exceeds the maximum-permitted value, the measurement shall not be used to demonstrate conformance to the requirements of Annex B.

B.1.5 For legal metrology purposes, the relevant periodic tests are those described in Annex B. These tests apply to both initial and subsequent verification. Following successful testing to Annex B, if desired, the sound calibrator may be marked with a verification mark in accordance with national regulations.

B.1.6 Where the manufacturer claims that a pistonphone conforms to the specifications for both class LS/M and class1/M, full tests for each class designation shall be performed, unless testing against the specifications of only class LS/M or only class 1/M has been specified by,

and agreed with, the customer. In this case, the sound calibrator shall be marked to show that only limited tests have been performed. Wording shall be added to the certificate to indicate that full testing to both class LS/M and class 1/M according to this document has not been performed, so no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of this document for the class not tested.

B.1.7 The test laboratory shall use instruments with current calibrations for the appropriate quantities. The calibrations shall be traceable to national standards, as required.

B.2 Submission for test

The sound calibrator, together with all relevant accessories (such as adaptors or barometer), shall be submitted for test together with a copy of the instruction manual, if required by the testing laboratory. A class LS sound calibrator shall also be supplied with an individual calibration chart. Where a class LS sound calibrator requires repair, the first re-calibration following the repair gives the new specified level.

B.3 Preliminary inspection

Prior to any measurements, the sound calibrator and all accessories shall be visually inspected, and any controls operated to ensure that they are in working order. It shall be established that the power supply of the instrument is within the operating limits specified in the instruction manual, by using the method specified in the instruction manual.

B.4 Performance tests

B.4.1 Orientation

If a specific orientation for application of the sound calibrator is stated in the instruction manual, this orientation shall be used for testing.

B.4.2 Ambient noise

To avoid ambient noise affecting any measurements, tests shall only be performed where the sound pressure level measured by the microphone after coupling to the sound calibrator, but before switching on, is at least 30 dB below the specified level being measured.

B.4.3 Environmental conditions

B.4.3.1 All tests in Clause B.4 shall be carried out within the following ranges of environmental conditions:

– static pressure: 80 kPa to 105 kPa;
– air temperature: 20 °C to 26 °C;
– relative humidity: 25 % to ~~70~~ 90 %;

unless the location of the laboratory is such that static pressure is not within the range specified. In this case, a pressure chamber shall be used enabling static pressure within the range specified to be achieved. The specifications in Table 2 apply for the measurement of sound pressure level.

B.4.3.2 For ~~class LS and class 1~~ sound calibrators ~~with a letter designation 'C'~~ designated class LS/M or class 1/M, where appropriate, data supplied in the instruction manual shall be applied for the influence of static pressure, to correct measured sound pressure levels to the reference ~~environmental conditions~~ static pressure. If a barometer is supplied with the sound calibrator, it shall be used to measure the static pressure.

NOTE ~~The~~ Some barometers ~~may~~ provide the data directly in the form to be used to correct measured sound pressure levels to the reference static pressure.

~~**B.3.2.3** For class 2 sound calibrators with a letter designation 'C', data supplied in the instruction manual, for the influence of static pressure, temperature and relative humidity, shall be applied, where appropriate, to correct measured sound pressure levels to the reference environmental conditions. If a means of measuring the relevant environmental condition is supplied with the sound calibrator, the means shall be used to measure the relevant environmental condition.~~

~~NOTE The 'supplied means' may provide the data directly in the form to be used to correct measured sound pressure levels to the reference environmental conditions.~~

B.4.4 Additional equipment

If a barometer is provided with the sound calibrator, prior to making any measurements of the sound pressure level generated by the sound calibrator, the indication of the barometer shall be checked by comparison with that of a calibrated precision barometer at the prevailing static pressure. The reading of the barometer under test shall be recorded, and if ~~tolerances~~ acceptance limits for the measurement of static pressure are provided in the instruction manual for the sound calibrator, the indicated static pressure shall be within the ~~limits of the tolerances~~ acceptance limits given in the instruction manual. If the indicated static pressure is not within any acceptance limits given in the instruction manual, then the periodic testing of the sound calibrator shall not be performed. If acceptance limits are not provided, and the correction is used, this may cause the sound calibrator to fail the periodic testing if the correction is incorrect.

NOTE A single-point pressure check of a barometer gives no information about performance at other static pressures. It is therefore good practice to compare the indication of the supplied barometer with that of a calibrated precision barometer over the applicable pressure range. OIML International Recommendation R 97 gives information on suitable test procedures.

B.4.5 Microphone specification

For class LS, class 1 and class 2 sound calibrators, the microphone used for testing shall be one of the microphones specified for the relevant class in 5.8.1.

B.4.6 Sound pressure level

B.4.6.1 General

Following coupling of the microphone to the sound calibrator, the time specified in the instruction manual shall be allowed for the microphone and sound calibrator to stabilize. The sound pressure level generated by the sound calibrator shall then be measured, as an average over a period of between 20 s and 25 s of operation, at the principal sound pressure level and principal frequency. ~~For class LS sound calibrators the microphone shall be a laboratory standard microphone as specified in IEC 61094-1. For class 1 and class 2 sound calibrators the microphone shall be a working standard microphone as specified in IEC 61094-4.~~

~~NOTE A measurement microphone that conforms to the requirements of IEC 61094-1 for laboratory standard microphones also conforms to the requirements of IEC 61094-4 for working standard microphones.~~

~~**B.3.4.2** The procedure given in the instruction manual shall be followed to ensure that the level of ambient sound reaching the microphone during testing is sufficiently low that the sound calibrator operates as intended.~~

~~**B.3.4.3** Sound pressure levels shall be measured using one of the two following methods.~~

B.4.6.2 Methods for measurement of sound pressure level

B.4.6.2.1 Microphone method

B.4.6.2.1.1 The sound pressure level generated by the sound calibrator under test shall be measured using a calibrated microphone or microphone system. The insert voltage technique (described in IEC 61094-2) or an equivalent method may be used.

B.4.6.2.1.2 ~~NOTE~~ It is recommended that the testing laboratory maintain two independent lines of traceability to national standards, by use of the microphone or microphone system and a calibrated ~~in-house artefact~~ device, such as a sound calibrator. The performance of the calibrated microphone or microphone system should be verified using the ~~in-house artefact~~ calibrated device before and after making any measurements of conformance according to Annex B. In selecting the calibrated device, consideration shall be given to the uncertainty requirements of this document.

B.4.6.2.2 Sound calibrator comparison method

B.4.6.2.2.1 The sound pressure level generated by the sound calibrator under test shall be measured by comparison with the sound pressure level generated by a calibrated sound calibrator.

B.4.6.2.2.2 ~~NOTE~~ When the calibrated sound calibrator does not operate at the same sound pressure level and frequency as the sound calibrator under test, it will be necessary for the testing laboratory to establish the level linearity and frequency response of the measurement system at all frequencies of interest.

B.4.6.2.2.3 ~~NOTE~~ It is recommended that the testing laboratory maintain two independent lines of traceability to national standards, by use of the calibrated sound calibrator and a calibrated ~~in-house artefact~~ device, such as another sound calibrator, or a microphone or microphone system. The performance of the calibrated sound calibrator should be verified using the ~~in-house artefact~~ calibrated device before and after making any measurements of conformance according to Annex B. In selecting the calibrated device, consideration shall be given to the uncertainty requirements of this document.

B.4.6.3 Measurements

B.4.6.3.1 Using the method described in B.4.6.2.1 or B.4.6.2.2, ~~the measurement of~~ the principal sound pressure level at the principal frequency shall be ~~replicated twice to give a total of three tests~~ measured at least three times. The microphone shall be coupled to the sound calibrator before each measurement and uncoupled after each measurement. The microphone shall be rotated around its axis at each coupling so that the rotational orientation of the microphone is evenly distributed over the measurements. The absolute value of the difference between the mean measured sound pressure level and the specified sound pressure level~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the acceptance limits given in Table 2 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.1 for the class of sound calibrator.

B.4.6.3.2 For multi-frequency sound calibrators, unless not required by the customer (under B.1.2) measurements of the principal sound pressure level, as described in B.4.6.3.1, shall be repeated for the maximum and minimum frequency settings of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this document.

B.4.6.3.3 The measurement of sound pressure level shall be repeated (excluding replications) for all other combinations of sound pressure level and frequency settings for which the instruction manual states that the instrument conforms to the requirements of this document, or for those combinations required by the customer (as described in B.1.2). The absolute value of the difference between each measured sound pressure level and the

corresponding specified sound pressure level~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 2 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.1 for the class of sound calibrator. It is recommended that testing is normally performed for one model of microphone only.

~~NOTE 1 Testing will normally be performed for one model of microphone only.~~

~~NOTE 2 The model of microphone used for each subsequent periodic verification test of the same sound calibrator should preferably be the same model as for any previous periodic verification. Provided no sensitivity adjustments have been made to the sound calibrator, this test procedure provides information on long-term stability.~~

B.4.7 Frequency

The frequency of the sound generated by the sound calibrator coupled to the microphone used in B.4.6 shall be measured as an average over a period of between 20 s and 25 s of operation, at the principal sound pressure level, for each frequency setting of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this document, or for the principal frequency and for any other combinations of sound pressure level setting and frequency setting specified by the customer. The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency~~, extended by the actual expanded uncertainty of measurement,~~ shall not exceed the ~~tolerance~~ acceptance limits given in Table 4 for the class of sound calibrator. Actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.2 for the class of sound calibrator.

B.4.8 Total distortion + noise

~~Total distortion of the sound pressure signal generated by the sound calibrator shall be measured over the frequency range from at least 22,5 Hz to 20 kHz, with the microphone used in B.3.4, at the maximum and minimum sound pressure level settings available at each frequency for which the instruction manual states that the instrument conforms to the requirements of this standard. The measured total distortion, extended by the actual expanded uncertainty of measurement, shall not exceed the tolerance limits given in Table 6 for the class of sound calibrator. Actual expanded uncertainties of measurement shall not exceed those given in Table A.3 for the class of sound calibrator.~~

~~NOTE 1 The total distortion may be measured using a rejection filter device (distortion factor meter) or an appropriate analyser.~~

~~NOTE 2 Where a choice of microphone model is available, a microphone model should be used for which the electroacoustical characteristic is designated by the letter P in IEC 61094-1 or IEC 61094-4.~~

The total distortion + noise of the sound pressure signal generated by the sound calibrator shall be measured over a bandwidth of 22,4 Hz (nominal frequency) to 22,4 kHz (nominal frequency), as an average over a period of between 20 s and 25 s of operation with the microphone used in B.4.6, at the maximum and minimum sound pressure level settings available at each frequency for which the instruction manual states that the instrument conforms to the requirements of this document, or for the principal sound pressure level and principal frequency and for any other combinations of sound pressure level setting and frequency setting specified by the customer. The total distortion + noise can be measured using a rejection filter device (distortion factor meter) or an appropriate FFT analyser, and the method of measurement shall be reported. The measured total distortion + noise shall not exceed the acceptance limits given in Table 7 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.3 for the class of sound calibrator. An instrument that measures total harmonic distortion only is not suitable.

B.5 Calibration of the sound calibrator with other models of microphone

Clause B.4 provides details of the full tests necessary to demonstrate conformance of a sound calibrator to the requirements given in Annex B for periodic testing, using a particular microphone model. In addition to these tests, it is possible that a calibration of the sound calibrator with other models of microphone ~~may be~~ is required by the customer. For these additional tests, the measured sound pressure level, frequency and total distortion + noise ~~are to~~ should be stated in the test documentation. In this case, the measurements ~~shall~~ should be performed using the required model(s) of microphone and the test methods described in Clause B.4. Any additional model(s) of microphone for which a calibration of the sound calibrator is required ~~shall~~ should be model(s) intended for use with the particular model of sound calibrator. The method of measurement used, the measured values obtained and the corresponding actual ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, ~~shall~~ should be given in the test documentation.

B.6 Documentation

Clause B.6 is only a recommendation, with the exception of Clause B.6 a), b), c), f), i), j), k), l), p), and q), which shall be stated where applicable. The extent and content of the documentation provided by the test laboratory will vary depending on national regulations. However, following testing of a sound calibrator, the testing laboratory should issue a document containing, as a minimum, the following information:

a) the name and location of the laboratory performing the tests;

b) the name of the manufacturer or supplier and the model designation of the sound calibrator;

c) the serial number of the sound calibrator, together with details of any adaptors used;

d) the name of the manufacturer or supplier and the model and configuration of the microphone(s) used;

e) a statement as to the availability to the public of evidence, from a testing organization responsible for performing pattern evaluation tests, to demonstrate that the model of sound calibrator submitted for periodic testing had successfully completed the pattern evaluation tests of Annex A;

f) a statement that the sound calibrator has been tested as specified in Annex B;

g) where public evidence of conformance of the model of sound calibrator to the requirements of Annex A for pattern evaluation ~~was~~ is available, and the results of the tests according to Annex B are satisfactory, a statement as follows: "As public evidence was available from a testing organization responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:~~2003~~ 2017, the sound calibrator tested is considered to conform to all the class X requirements of IEC 60942:~~2003~~ 2017." A reference should be given to the source of the publicly available evidence that allowed this conclusion to be stated;

h) where public evidence of conformance of the model of sound calibrator to the requirements of Annex A for pattern evaluation ~~was~~ is not available and the results of the tests according to Annex B are satisfactory, a statement as follows: "The sound calibrator has been shown to conform to the class X requirements for periodic testing, described in Annex B of IEC 60942:~~2003~~ 2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed. However, as public evidence was not available, from a testing organization responsible for pattern approval, to demonstrate that the model of sound calibrator conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:~~2003~~ 2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:~~2003~~ 2017.";

i) the date(s) on which the periodic verification tests were performed;

j) a description of the methods used for the measurements, including the method used to measure total distortion + noise;

k) the measured sound pressure level(s), corrected to ~~the~~ reference ~~environmental conditions~~ static pressure if the sound calibrator has a letter "~~C~~ M" designation, together with associated uncertainty(ies) calculated for a coverage probability of 95 %, and the information on the source (instruction manual or instrument, for example, a barometer) of the ~~environmental~~ static pressure correction data used, if any;

l) the measured frequency(ies) and total distortion(s) + noise, together with associated ~~expanded~~ uncertainty(ies) of measurement, calculated for a coverage probability of 95 %, as appropriate;

m) the environmental conditions at the time the tests were performed;

n) if any adjustments were made to the sound calibrator or a supplied barometer, all indications observed, or sound pressure levels measured, prior to adjustment;

o) where the sound calibrator does not conform to the requirements of Annex B for the designated class for the conditions under which the tests were performed, a statement indicating which tests did not conform;

p) for multi-level and multi-frequency calibrators where testing of a limited number of sound pressure level and frequency settings has been specified by, and agreed with, the customer, the documentation shall include a statement as follows: "As the customer did not require full periodic testing as specified in Annex B of IEC 60942:2017 for the range of sound pressure level and frequency settings for which the instruction manual states that the instrument conforms to the requirements of IEC 60942:2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017". A full description of the sound pressure level and frequency settings tested shall be given;

q) where the manufacturer claims that a pistonphone conforms to the specifications for both class LS/M and class1/M, and testing against the specifications of only class LS/M or only class 1/M has been specified by, and agreed with, the customer, the documentation shall include a statement as follows: "As the customer only required testing of the sound calibrator, as specified in Annex B of IEC 60942:2017, against the specifications for class LS/M or class 1/M (delete as appropriate), and the manufacturer claims that the sound calibrator conforms to the specifications for both class LS/M and class1/M, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017 for class LS/M or class 1/M (delete as appropriate) as this has not been tested.";

r) where applicable, additional values of sound pressure level, frequency and total distortion + noise, together with the ~~expanded~~ uncertainties of measurement, calculated for a coverage probability of 95 %, measured using other model(s) of microphone according to Clause B.5.

Annex C
(normative)

~~Format for the~~ Pattern evaluation report

C.1 ~~Introduction~~ General

C.1.1 Sound calibrators that are submitted to the control of legal metrology services shall conform to the requirements given in this document.

C.1.2 For legal metrology purposes, the ~~tolerance~~ acceptance limits stated in this document are considered as the maximum permissible errors for pattern evaluation.

C.1.3 ~~The~~ A pattern evaluation report ~~given in this Annex C presents, together in a standardized format,~~ shall give full details of all the tests performed and the results of the various tests to which a pattern of a sound calibrator shall be submitted with a view to its approval. The tests are described in Annex A. All specified tests shall be performed, as applicable.

C.1.4 It is recommended that information on models of sound calibrator which have successfully undergone pattern evaluation be made publicly available by the testing laboratory.

C.2 Marking

Following successful testing to the requirements of Annex A, sound calibrators of the model tested ~~may~~ can be marked with a pattern approval sign in accordance with national regulations, in addition to the markings required by 6.1.

C.3 Submission for test

C.3.1 The number of specimens of the same pattern of sound calibrator submitted for pattern evaluation testing shall conform to the requirement of A.2.1. As a minimum, the testing laboratory shall select two of the specimens of sound calibrator for pattern evaluation testing. At least one of these two specimens shall then be tested fully according to the procedures given in Annex A. The testing laboratory shall decide whether the full tests shall also be performed on the second specimen, or whether limited testing is adequate to provide approval of the pattern.

~~NOTE Depending on the number of specimens tested, the pattern approval may be limited to two years so that further experience with the pattern may be gained.~~

C.3.2 All accessories (for example, a barometer or connecting leads) described in the instruction manual shall be supplied with the sound calibrator.

C.3.3 An individual calibration chart containing all the information required by 6.2 shall be supplied with each class LS sound calibrator.

C.3.4 An instruction manual shall be supplied with the sound calibrator.

C.4 Pattern evaluation report content

C.4.1 ~~The following pages constitute the~~ A pattern evaluation report ~~format~~ shall be generated for reporting the testing of a pattern of sound calibrator to the requirements of

Annex A. This pattern evaluation report shall consists of two parts. Part 1 gives a summary of the content of the report and statements on conformity, and verifies that all information required by this document was is available. Part 2 gives detailed test results. The two parts of the report may be completed by different organizations within the same country. Also, it is possible that all the tests in part 2 may not cannot be performed by one laboratory, and that additional laboratories may be are involved in the testing. In either of these cases, each organization or laboratory shall be responsible for completing the relevant parts of the pattern evaluation report. The full name and address of each organization and laboratory involved shall be supplied. For part 2, the tests that each laboratory performed shall be clearly identified in the pattern evaluation report. The pattern evaluation report may be supplied in electronic form.

C.4.2 In addition to the content given in the following pages, Each pattern evaluation report shall display a header on each page giving the following information: reference to IEC 60942:2003 2017, Annex C, the page number of the report, identification of the observer or operator, the date when the test was performed and a unique report identification number. For each table, the serial number of the sound calibrator under test, and information on the adaptor and the microphone used for the tests shall be clearly stated.

C.4.3 Relevant pages of the report, as applicable, shall be completed for each specimen of sound calibrator tested.

C.3.4 The tables in part 2 give details of the results that shall be supplied. Depending on the sound calibrator under test it will be necessary to extend or replicate these tables as appropriate, for example to cover several frequencies and sound pressure levels for multi-frequency or multi-level sound calibrators, or both.

SOUND CALIBRATORS

PATTERN EVALUATION REPORT

Report number .....

Sound calibrator model designation .....

The specifications and test requirements for sound calibrators are given in IEC 60942:2003. This pattern evaluation report gives details of the examinations and tests performed for the pattern of sound calibrator to determine conformance to the specifications.

The report is divided into two parts. Part 1 gives a summary of the content of the report and statements on conformity, and verifies that all information required by this standard was provided.

Part 1 has been completed according to the following example:

+	–	
x		Approved
	x	Not approved
n/a	n/a	Not applicable

Part 2 gives detailed test results.

OFFICE OR LABORATORY RESPONSIBLE FOR PART 1 OF THIS REPORT AND FOR DETERMINING APPROVAL OF THE PATTERN:

Name .....

Address .....

Signature .....

LABORATORY RESPONSIBLE FOR PART 2 OF THIS REPORT:

Name .....

Address .....

Signature .....

Where all the tests in Part 2 have not been performed by one laboratory, the above information shall be repeated for each laboratory, and the tests that each laboratory performed shall be clearly indicated within the report.

DATE OF THE REPORT: .....

PART 1

GENERAL INFORMATION CONCERNING THE PATTERN

Application No: .....

Manufacturer: .....

Manufacturer's address: .....

Applicant: .....

Applicant's address: .....

Instrument model: .....

Class of sound calibrator according to IEC 60942:2003 as specified in the instruction manual: .....

Number of specimens supplied: .....(at least five)

The following table gives details of the frequency(ies), sound pressure level(s) and configuration or models of microphone for which the instruction manual states conformance to the requirements of IEC 60942:2003 for the stated class.

Nominal frequency Hz	Specified frequency Hz	Configuration or model of microphone	Nominal sound pressure level dB re 20 μPa	Specified sound pressure level dB re 20 μPa

SUMMARY

Test number	Clause of IEC 60942: 2003	Description	+	–	Page number of test report	Remarks*
–	5	General examination				
–	6.1	Marking of the sound calibrator				
–	6.2	Individual calibration chart for class LS sound calibrator				
–	6.3	Instruction manual				
1	A.4.3	Sound pressure level**				
2	A.4.4	Sound pressure level stability – short-term level fluctuation				
3	A.4.5	Frequency				
4	A.4.6	Total distortion				
5	A.5.2	Influence of static pressure				
6	A.5.4	Abbreviated test of influence of temperature and humidity combined				
7	A.5.5	Influence of air temperature				
8	A.5.6	Influence of relative humidity				
9	A.5.7	Influence of temperature and humidity combined				
10	A.6.2	Radiofrequency emissions				
11	A.6.3	Electrostatic discharges				
12	A.6.4	Immunity to power- and radiofrequency fields				

* The page number of the report where the relevant remark appears shall be entered.

** The abbreviation SPL is used to represent sound pressure level in this report.

General

Subclause of IEC 60942 containing requirement	Description	+	–	Remarks
5.1.3	Calibration chart supplied if class LS sound calibrator			
5.1.7	Design and materials			
5.2.1.3	Principal sound pressure level at least 90 dB re 20 μPa			
5.3.1.1	Principal frequency in the range 160 Hz to 1 250 Hz			
5.3.1.2	Principal sound pressure level available at principal frequency			

Marking of the sound calibrator

Subclause of IEC 60942 containing requirement	Inscription or mark	+	–	Remarks
6.1 a)	Manufacturer's or supplier's name or trade mark			
6.1 b)	Model designation and serial number			
6.1 c)	Reference to IEC 60942:2003			
6.1 d)	Class of instrument, including the letter 'C' designation where applicable, and the quantity(ies) for which corrections need to be applied			
6.1 e)	A clear indication of all available combinations of sound pressure level and frequency that conform to the requirements of the class			
6.1 f)	The nominal sound pressure level or sound pressure levels			
6.1 g)	The nominal frequency or frequencies			
6.1 h)	Where possible, and applicable, an indication of the required orientation			
6.1 i)	If the sound calibrator is battery operated, the preferred battery type			
6.1 j)	Adaptors marked with model designations, where provided			

Instruction manual

Subclause of IEC 60942 containing requirement	Information	+	–	Remarks
6.3 a)	Identification of microphone models and configurations, adaptors and instructions to ensure sound calibrator operates as intended			
6.3 b)	For class LS – the nominal sound pressure level(s) and frequency(ies) For class 1 and class 2 – the specified sound pressure level(s) and frequency(ies) quoted with at least 0,1 dB resolution			
6.3 c)	Specific orientation of sound calibrator, if required			
6.3 d)	Elapsed time before specified sound pressure level and frequency stabilize Elapsed time necessary to stabilize micro-phone/sound calibrator combination after coupling			
6.3 e)	The principal sound pressure level			
6.3 f)	The principal frequency			
6.3 g)	The range of environmental conditions over which the sound calibrator is specified to operate, and the correction data, if applicable, together with the expanded uncertainties of measurement for the correction data. For class 2/C sound calibrators not supplied with a barometer, information on how to calculate the correction for the influence of static pressure when operating at different heights above sea level			
6.3 h)	Identification of the combinations of sound pressure level and frequency available which conform to the requirements of IEC 60942 for the stated class			
6.3 i)	Recommended procedure to ensure that the ambient sound level is sufficiently low such the sound calibrator operates as intended at each level setting			
6.3 j)	For class LS and class LS/C sound calibrators, the typical change in sound pressure level produced by the sound calibrator with changes in the effective load volume of the inserted microphone			
6.3 k)	If applicable, types of battery and typical lifetime, details of any battery status indicator and its operation. The nominal, maximum and minimum supply voltages. Where applicable, method of connection to external power supply			

~~6.3 l)~~	~~For sound calibrators with letter 'C' designation, a statement giving the maximum expanded uncertainty of the measurement of environmental conditions such that the ability of a sound calibrator to conform to the requirements of the relevant class is not affected; where a barometer is supplied, details of the expanded uncertainty of measurement of static pressure using the barometer~~			
~~6.3 m)~~	~~For class LS sound calibrators where a barometer is required but not supplied, details of a suitable device for measuring static pressure~~			
~~6.3 n)~~	~~The configuration for the normal mode of operation~~			
~~6.3 o)~~	~~Details of any cables and accessories with which the sound calibrator conforms to the electromagnetic compatibility requirements~~			
~~6.3 p)~~	~~The reference orientation for testing effects of radio-frequency fields~~			
~~6.3 q)~~	~~If applicable, the unmodulated root-mean-square electromagnetic field strength greater than 10 V/m for which the sound calibrator conforms to IEC 60942:2003~~			
~~6.3 r)~~	~~The configuration, sound pressure level and frequency settings for greatest radiofrequency emissions~~			
~~6.3 s)~~	~~The configuration and connecting devices, if any, which produce minimum immunity to power- and radiofrequency fields~~			
~~6.3 t)~~	~~Details of the combinations of sound pressure level and frequency that do not conform to the requirements for the class, together with a description of their acoustical characteristics, and a statement of the nominal tolerance limits maintained about the design goals.~~			

PART 2
INFORMATION FOR TESTING

General information concerning the pattern is given in part 1 of this report.

More specific information used during testing is given below:

Specimens of sound calibrator submitted for test:

Specimen of sound calibrator	Sound calibrator serial number	Barometer model / serial number (if applicable)	Specimen selected for full tests*	Specimen selected for limited tests*
1				
2				
3				
4				
5				
* Indicate specimens selected by marking x in appropriate column and row of table				

Adaptors submitted:

Specimen of sound calibrator	Adaptor 1		Adaptor 2		Adaptor 3	
	IEC microphone classification or microphone model	Model of adaptor	IEC microphone classification or microphone model	Model of adaptor	IEC microphone classification or microphone model	Model of adaptor
1						
2						
3						
4						
5						

IEC microphone classification is according to the IEC 61094 series.

Accessories submitted:

Type of accessory	Manufacturer	Model	Serial number (if applicable)

Principal sound pressure level ..... dB re 20 μPa

Principal frequency ..... Hz

Static pressure range over which sound calibrator is specified to operate: ..... to ..... (kPa)

If letter 'C' designation sound calibrator –
details of static pressure correction data supplied: .....

Temperature range over which sound calibrator is specified to operate: ..... to ..... (°C)

If letter 'C' designation sound calibrator (class 2 only for temperature) –
details of temperature correction data supplied: .....

Relative humidity range over which sound calibrator is specified to operate: ..... to ..... (%)

If letter 'C' designation sound calibrator (class 2 only for relative humidity) –
details of relative humidity correction data supplied: .....

Orientation: ..... Stabilizing times: .....

Battery: type .....; nominal voltage ..... V; number required .....

For each of the 12 tests described in this part 2 of the pattern evaluation report, the tolerance limits shown in the accompanying tables shall be those specified in Clause 5 of IEC 60942:2003. The maximum permitted expanded uncertainties of measurement shall be those specified in Annex A of IEC 60942:2003.

Microphones used during testing

Indicate the microphone used for each test by marking x in the appropriate column and row of table.

	Microphone number					
	1	2	3	4	5	6
Manufacturer						
Model						
Serial no.						
IEC classification from IEC 61094 series						
Method of calibration						
Pressure coefficient (if required) (dB/kPa)						
Temperature coefficient (if required) (dB/°C)						
Relative humidity coefficient (if required) (dB/ %)						
Test 1 Sound pressure level						
Test 2 Sound pressure level stability – short-term level fluctuation						
Test 3 Frequency						
Test 4 Total distortion						
Test 5 Influence of static pressure						
Test 6 Abbreviated test of temperature and humidity combined						
Test 7 Influence of air temperature						
Test 8 Influence of relative humidity						

Test 9 Influence of temperature and humidity combined						
Test 10 Radiofrequency emissions						
Test 11 Electrostatic discharges						
Test 12 Immunity to power- and radiofrequency fields						

Microphone number 1 and microphone number 2 shall be of the same model.

Test 1 Sound pressure level at and around reference environmental conditions *(5.2.2 and A.4.3.1 to A.4.3.4 of IEC 60942:2003)*

Principal sound pressure level

Microphone number 1

Frequency setting Hz	**Specified SPL** dB re 20 µPa	**Mean measured SPL** dB re 20 µPa*	**Actual expanded uncertainty of measurement** dB	**Absolute value of difference between measured SPL and specified SPL extended by actual expanded uncertainty of measurement** dB	**Tolerance limits** dB	**Maximum permitted expanded uncertainty of measurement** dB

* Corrected where necessary to reference environmental conditions, if sound calibrator has letter 'C' designation

Microphone number 2

Frequency setting Hz	**Specified SPL** dB re 20 µPa	**Mean measured SPL** dB re 20 µPa*	**Actual expanded uncertainty of measurement** dB	**Absolute value of difference between measured SPL and specified SPL extended by actual expanded uncertainty of measurement** dB	**Tolerance limits** dB	**Maximum permitted expanded uncertainty of measurement** dB

* Corrected where necessary to reference environmental conditions, if sound calibrator has letter 'C' designation

Other sound pressure levels (5.2.2 and A.4.3.5 of IEC 60942:2003)

Table to be replicated for each additional sound pressure level

Microphone number 1

Frequency setting Hz	**Specified SPL** dB re 20 µPa	**Mean measured SPL** dB re 20 µPa*	**Actual expanded uncertainty of measurement** dB	**Absolute value of difference between measured SPL and specified SPL extended by actual expanded uncertainty of measurement** dB	**Tolerance limits** dB	**Maximum permitted expanded uncertainty of measurement** dB

* Corrected where necessary to reference environmental conditions, if sound calibrator has letter 'C' designation

Static pressure range during measurements ____ kPa to ____ kPa

Temperature range during measurements ____ °C to ____ °C

Relative humidity range during measurements ____ % to ____ %

Remarks:

Effect of reduced operating voltage on sound pressure level
(5.2.4 and A.4.3.7 of IEC 60942:2003)

Reduced operating voltage (within 5 % of minimum operating voltage) V

Microphone number 1

Settings – SPL and frequency	Measured output voltage from microphone at nominal sound calibrator operating voltage V	Measured output voltage from microphone at reduced sound calibrator operating voltage V	Actual expanded uncertainty of measure-ment dB	Absolute value of difference between SPL measured at reduced operating voltage and SPL generated at nominal operating voltage extended by actual expanded uncertainty of measurement * dB	Tolerance limits dB	Maximum permitted expanded uncertainty of measurement dB
Principal SPL + principal frequency						
Maximum SPL + minimum frequency at that SPL setting						
Maximum SPL + maximum frequency at that SPL setting						
Minimum SPL + minimum frequency at that SPL setting						
Minimum SPL + maximum frequency at that SPL setting						
Minimum frequency + minimum SPL at that frequency						
Minimum frequency + maximum SPL at that frequency						
Maximum frequency + minimum SPL at that frequency						
Maximum frequency + maximum SPL at that frequency						

* Corrected where necessary to reference environmental conditions if sound calibrator has letter 'C' designation

NOTE In most cases it will not be necessary to complete all the rows of the table, as all the combinations specified will only apply in the case of multi-level and multi-frequency sound calibrators that generate several sound pressure levels and frequencies.

These results are also used to verify that the sound calibrator conforms to the tolerance limits of Table 1 at the reduced sound calibrator operating voltage.

Effect of operation with an external power supply on sound pressure level *(5.2.4 and A.4.3.9 of IEC 60942:2003)*

Microphone number 1

Settings – SPL and frequency	Measured output voltage from microphone at nominal sound calibrator operating voltage V	Measured output voltage from microphone at maximum permitted sound calibrator supply voltage V	Actual expanded uncertainty of measurement dB	Absolute value of difference between SPL measured when sound calibrator powered by external supply voltage and SPL generated at nominal operating voltage extended by actual expanded uncertainty of measurement* dB	Tolerance limits dB	Maximum permitted expanded uncertainty of measurement dB
Principal SPL + principal frequency						
* Corrected where necessary to reference environmental conditions if sound calibrator has letter 'C' designation						

These results are also used to verify that the sound calibrator conforms to the tolerance limits of Table 1 at the maximum permitted sound calibrator operating voltage.

Static pressure range during measurements _____ kPa to _____ kPa

Temperature range during measurements _____ °C to _____ °C

Relative humidity range during measurements _____ % to _____ %

Remarks:

Other microphone models *(5.2.2, 5.2.4 and A.4.3.10 of IEC 60942:2003)*

Unless the testing laboratory has reliable, justifiable evidence of the equivalence of other models of microphone, or of corrections to be applied, and presents details here to allow independent assessment, ALL OF TEST 1 SHALL BE REPEATED for all other microphone models. In this event, it will be necessary to replicate the above tables.

Test 2 Sound pressure level stability – short-term level fluctuation at and around reference environmental conditions
(5.2.3, A.4.4.1 and A.4.4.3 of IEC 60942:2003)

Principal sound pressure level and principal frequency

Ten measurements over period of 20 s

Microphone number 1

Maximum measured output voltage from microphone V	Minimum measured output voltage from microphone V	Actual expanded uncertainty of measurement dB	One-half corresponding variation in SPL extended by actual expanded uncertainty of measurement dB	Tolerance limits dB	Maximum permitted expanded uncertainty of measurement dB

These results are also used to verify that the sound calibrator conforms to the tolerance limits of Table 1 for sound pressure level for all measured output sound pressure levels during the 20 s period.

Minimum sound pressure level and principal frequency

Ten measurements over period of 20 s

Microphone number 1

Maximum measured output voltage from microphone V	Minimum measured output voltage from microphone V	Actual expanded uncertainty of measurement dB	One-half corresponding variation in SPL extended by actual expanded uncertainty of measurement dB	Tolerance limits dB	Maximum permitted expanded uncertainty of measurement dB

These results are also used to verify that the sound calibrator conforms to the tolerance limits of Table 1 for sound pressure level for all measured output sound pressure levels during the 20 s period.

Static pressure range during measurements _____ kPa to _____ kPa

Temperature range during measurements _____ °C to _____ °C

Relative humidity range during measurements _____ % to _____ %

Remarks:

Test 3 Frequency *(5.3.2 and A.4.5.1 of IEC 60942:2003)*

Principal sound pressure level

Microphone number 1

Specified frequency Hz	Measured frequency Hz	Actual expanded uncertainty of measurement %	Absolute value of percentage difference between measured frequency and specified frequency extended by actual expanded uncertainty of measurement %	Tolerance limits %	Maximum permitted expanded uncertainty of measurement %

Effect of reduced operating voltage on frequency *(5.3.2 and A.4.5.2 of IEC 60942:2003)*

Reduced operating voltage (within 5 % of minimum operating voltage) V

Microphone number 1

Settings – SPL and frequency	Specified frequency Hz	Measured frequency at reduced sound calibrator operating voltage Hz	Actual expanded uncertainty of measurement %	Absolute value of percentage difference between measured frequency at reduced operating voltage and specified frequency extended by actual expanded uncertainty of measurement %	Tolerance limits %	Maximum permitted expanded uncertainty of measurement %
Principal SPL + principal frequency						
Maximum SPL + minimum frequency at that SPL setting						
Maximum SPL + maximum frequency at that SPL setting						
Minimum SPL + minimum frequency at that SPL setting						
Minimum SPL + maximum frequency at that SPL setting						
Minimum frequency + minimum SPL at that frequency						
Minimum frequency + maximum SPL at that frequency						
Maximum frequency + minimum SPL at that frequency						
Maximum frequency + maximum SPL at that frequency						

NOTE In most cases it will not be necessary to complete all the rows of the table, as all the combinations specified will only apply in the case of multi-level and multi-frequency sound calibrators that generate several sound pressure levels and frequencies.

Effect of operation with an external power supply on frequency
(5.3.2 and A.4.5.4 of IEC 60942:2003)

Settings – SPL and frequency	Specified frequency Hz	Measured frequency at maximum permitted sound calibrator operating voltage Hz	Actual expanded uncertainty of measurement %	Absolute value of percentage difference between measured frequency at maximum permitted operating voltage and specified frequency extended by actual expanded uncertainty of measurement %	Tolerance limits %	Maximum permitted expanded uncertainty of measurement %
Principal SPL + principal frequency						

Static pressure range during measurements _____ kPa to _____ kPa

Temperature range during measurements _____ °C to _____ °C

Relative humidity range during measurements _____ % to _____ %

Remarks:

Test 4 – Total distortion *(5.5 and A.4.6.1 of IEC 60942:2003)*

Maximum sound pressure level

Microphone number 1

Frequency setting Hz	Measured distortion %	Actual expanded uncertainty of measurement %	Measured distortion extended by actual expanded uncertainty of measurement %	Maximum total distortion permitted %	Maximum permitted expanded uncertainty of measurement %

Minimum sound pressure level

Microphone number 1

Frequency setting Hz	Measured distortion %	Actual expanded uncertainty of measurement %	Measured distortion extended by actual expanded uncertainty of measurement %	Maximum total distortion permitted %	Maximum permitted expanded uncertainty of measurement %

Effect of reduced operating voltage on total distortion
(5.5 and A.4.6.2 of IEC 60942:2003)

Reduced operating voltage (within 5 % of minimum operating voltage) V

Microphone number 1

Settings SPL and frequency	Measured distortion %	Actual expanded uncertainty of measurement %	Measured distortion extended by actual expanded uncertainty of measurement %	Maximum total distortion permitted %	Maximum permitted expanded uncertainty of measurement %
Maximum SPL + minimum frequency at that SPL setting					
Maximum SPL + maximum frequency at that SPL setting					
Minimum SPL + minimum frequency at that SPL setting					
Minimum SPL + maximum frequency at that SPL setting					
Minimum frequency + minimum SPL at that frequency					
Minimum frequency + maximum SPL at that frequency					
Maximum frequency + minimum SPL at that frequency					
Maximum frequency + maximum SPL at that frequency					

NOTE In most cases it will not be necessary to complete all the rows of the table, as all the combinations specified will only apply in the case of multi-level and multi-frequency sound calibrators that generate several sound pressure levels and frequencies.

Static pressure range during measurements ____ kPa to ____ kPa

Temperature range during measurements ____ °C to ____ °C

Relative humidity range during measurements ____ % to ____ %

Remarks:

Test 5 Influence of static pressure *(5.4 and A.5.2 of IEC 60942:2003)*

Principal sound pressure level and principal frequency

Sound pressure level

Target static pressure kPa	**Measured static pressure** kPa	**Measured output voltage from microphone** V	**Actual expanded uncertainty of measurement** dB	**Absolute value of difference between corresponding SPL corrected to reference environmental conditions and SPL measured at reference environmental conditions, extended by actual expanded uncertainty of measurement *** dB	**Tolerance limits**** dB	**Maximum permitted expanded uncertainty of measurement** dB
65,0						
101,3						
108,0						

* The correction applied shall take account of any variation in microphone sensitivity level with changing static pressure, temperature and relative humidity. For class LS or class 1 sound calibrators with a letter 'C' designation a further correction shall also be applied, where appropriate, to take account of the effect of static pressure on the output of the sound calibrator.

For class 2 sound calibrators with a letter 'C' designation further corrections shall be applied, where appropriate, to take account of the effect of static pressure, temperature or relative humidity on the output of the sound calibrator.

** The tolerance limit shall be those specified in Table 1 or Table 4 as appropriate.

The above table is to be replicated for each frequency setting greater than the principal frequency.

Distortion

Maximum sound pressure level and principal frequency

Target static pressure kPa	Measured static pressure kPa	Measured distortion %	Actual expanded uncertainty of measurement %	Measured distortion extended by actual expanded uncertainty of measurement %	Maximum total distortion permitted %	Maximum permitted expanded uncertainty of measurement %
65,0						

Static pressure was measured using .....
(state manufacturer, model and serial no. of device used)

Expanded uncertainty of measurement _____ kPa

Air temperature was measured using
.....
(state manufacturer, model and serial no. of device used)

Air temperature range during measurements _____ °C to _____ °C

Expanded uncertainty of measurement _____ °C

Relative humidity was measured using
.....
(state manufacturer, model and serial no. of device used)

Relative humidity range during measurements for the air at ambient pressure _____ % to _____ %

Expanded uncertainty of measurement _____ %

Remarks:

Test 6 Abbreviated test of temperature and humidity combined
(5.4, A.5.3 and A.5.4 of IEC 60942:2003)

Principal sound pressure level and principal frequency

Sound pressure level

Target temperature and relative humidity °C and %	**Measured temper-ature** °C	**Measured relative humidity** %	**Measured output voltage from micro-phone** V	**Actual expanded uncertainty of measurement** dB	**Absolute value of difference between corresponding SPL corrected to reference environmental conditions and first measure-ment of SPL at reference environmental conditions, extended by actual expanded uncertainty of measurement*** dB	**Tolerance limits** dB	**Maximum permitted expanded uncertainty of measure-ment** dB
23 °C + 50 %							
23 °C + 50 %							

* The correction applied shall take account of any variation in microphone sensitivity level with changing temperature, relative humidity and static pressure. For class LS or class 1 sound calibrators with a letter 'C' designation, a further correction shall also be applied, where appropriate, to take account of the effect of static pressure on the output of the sound calibrator.

For class 2 sound calibrators with a letter 'C' designation, further corrections shall be applied, where appropriate, to take account of the effect of static pressure, temperature or relative humidity on the output of the sound calibrator.

Frequency

Target temperature and relative humidity °C and %	Measured temperature °C	Measured relative humidity %	Measured frequency Hz	Actual expanded uncertainty of measurement %	Absolute value of percentage difference between measured frequency and first measurement of frequency at reference environmental conditions, extended by actual expanded uncertainty of measurement %	Tolerance limits %	Maximum permitted expanded uncertainty of measurement %
23 °C + 50 %							
23 °C + 50 %							

Static pressure was measured using .....
(state manufacturer, model and serial no. of device used)

Static pressure range during measurements _____ kPa to _____ kPa

Expanded uncertainty of measurement ___ kPa

Air temperature was measured using .....
(state manufacturer, model and serial no. of device used)

Expanded uncertainty of measurement _____ °C

Relative humidity was measured using .....
(state manufacturer, model and serial no. of device used)

Expanded uncertainty of measurement _____ %

Remarks:

Additional measurements for multi-level and multi-frequency sound calibrators
(5.4, A.5.3 and A.5.4 of IEC 60942:2003)

Reference environmental conditions

Sound pressure level

Settings SPL and frequency	**Measured temperature** °C	**Measured relative humidity** %	**Measured output voltage from microphone** V
Maximum SPL + minimum frequency at that SPL setting			
Maximum SPL + maximum frequency at that SPL setting			
Minimum SPL + minimum frequency at that SPL setting			
Minimum SPL + maximum frequency at that SPL setting			
Minimum frequency + minimum SPL at that frequency			
Minimum frequency + maximum SPL at that frequency			
Maximum frequency + minimum SPL at that frequency			
Maximum frequency + maximum SPL at that frequency			
NOTE In most cases it will not be necessary to complete all the rows of the table, as all the combinations specified will only apply in the case of multi-level and multi-frequency sound calibrators that generate several sound pressure levels and frequencies.			

Maximum temperature and maximum relative humidity
Minimum temperature and minimum relative humidity

For multi-level and multi-frequency sound calibrators it will be necessary to replicate the table below for each of the above sets of conditions.

Sound pressure level

Settings SPL and frequency	Measured temperature °C	Measured relative humidity %	Measured output voltage from microphone V	Actual expanded uncertainty of measurement dB	Absolute value of difference between corresponding SPL corrected to reference environmental conditions and SPL measured at reference environmental conditions, extended by actual expanded uncertainty of measurement* dB	Tolerance limits dB	Maximum permitted expanded uncertainty of measurement dB
Principal SPL + principal frequency							
Maximum SPL + minimum frequency at that SPL setting							
Maximum SPL + maximum frequency at that SPL setting							
Minimum SPL + minimum frequency at that SPL setting							
Minimum SPL + maximum frequency at that SPL setting							
Minimum frequency + minimum SPL at that frequency							
Minimum frequency + maximum SPL at that frequency							

Maximum frequency + minimum SPL at that frequency								
Maximum frequency + maximum SPL at that frequency								

* The correction applied shall take account of any variation in microphone sensitivity level with changing temperature, relative humidity and static pressure. For class LS or class 1 sound calibrators with a letter 'C' designation, a further correction shall also be applied, where appropriate, to take account of the effect of static pressure on the output of the sound calibrator.

For class 2 sound calibrators with a letter 'C' designation, further corrections shall be applied, where appropriate, to take account of the effect of static pressure, temperature or relative humidity on the output of the sound calibrator.

NOTE In most cases it will not be necessary to complete all the rows of the table, as all the combinations specified will only apply in the case of multi-level and multi-frequency sound calibrators that generate several sound pressure levels and frequencies.

Reference environmental conditions

Frequency

Settings SPL and frequency	**Measured temperature** °C	**Measured relative humidity** %	**Measured frequency** Hz
Maximum SPL + minimum frequency at that SPL setting			
Maximum SPL + maximum frequency at that SPL setting			
Minimum SPL + minimum frequency at that SPL setting			
Minimum SPL + maximum frequency at that SPL setting			
Minimum frequency + minimum SPL at that frequency			
Minimum frequency + maximum SPL at that frequency			
Maximum frequency + minimum SPL at that frequency			
Maximum frequency + maximum SPL at that frequency			

NOTE In most cases it will not be necessary to complete all the rows of the table, as all the combinations specified will only apply in the case of multi-level and multi-frequency sound calibrators that generate several sound pressure levels and frequencies.

Maximum temperature and maximum relative humidity
Minimum temperature and minimum relative humidity

For multi-level and multi-frequency sound calibrators it will be necessary to replicate the table below for each of the above sets of conditions.

Settings SPL and frequency	Measured temper-ature °C	Measured relative humidity %	Measured frequency Hz	Actual expanded uncertainty of measurement %	Absolute value of percentage difference between measured frequency and frequency measured at reference environmental conditions, extended by actual expanded uncertainty of measurement %	Tolerance limits %	Maximum permitted expanded uncertainty of measurement %
Principal SPL + principal frequency							
Maximum SPL + minimum frequency at that SPL setting							
Maximum SPL + maximum frequency at that SPL setting							
Minimum SPL + minimum frequency at that SPL setting							
Minimum SPL + maximum frequency at that SPL setting							
Minimum frequency + minimum SPL at that frequency							
Minimum frequency + maximum SPL at that frequency							

Maximum frequency + minimum SPL at that frequency							
Maximum frequency + maximum SPL at that frequency							
NOTE In most cases it will not be necessary to complete all the rows of the table, as all the combinations specified will only apply in the case of multi-level and multi-frequency sound calibrators that generate several sound pressure levels and frequencies.							

Static pressure was measured using .....
(state manufacturer, model and serial no. of device used)

Static pressure range during measurements _____ kPa to _____ kPa

Expanded uncertainty of measurement ___ kPa

Air temperature was measured using .....
(state manufacturer, model and serial no. of device used)

Expanded uncertainty of measurement _____ °C

Relative humidity was measured using .....
(state manufacturer, model and serial no. of device used)

Expanded uncertainty of measurement _____ %

Remarks:

Test 7 Influence of air temperature (only to be performed if required by the results of test 6) *(5.4, A.5.3 and A.5.5 of IEC 60942:2003)*

Principal sound pressure level and principal frequency

Maximum sound pressure level and minimum frequency available at that sound pressure level

Maximum sound pressure level and principal frequency

Maximum sound pressure level and maximum frequency available at that sound pressure level

Minimum sound pressure level and minimum frequency available at that sound pressure level

Minimum sound pressure level and principal frequency

Minimum sound pressure level and maximum frequency available at that sound pressure level

Minimum frequency and minimum sound pressure level available at that frequency

Minimum frequency and principal sound pressure level

Minimum frequency and maximum sound pressure level available at that frequency

Maximum frequency and minimum sound pressure level available at that frequency

Maximum frequency and principal sound pressure level

Maximum frequency and maximum sound pressure level available at that frequency

For multi-level and multi-frequency sound calibrators it will be necessary to replicate the tables below, as required, for each of the above sets of settings.

NOTE In most cases it will not be necessary to replicate the tables for all of the above settings, as all the combinations will only apply in the case of multi-level and multi-frequency sound calibrators that generate several sound pressure levels and frequencies.

Target temperature °C	**Measured temperature** °C	**Measured output voltage from microphone** V	**Actual expanded uncertainty of measurement** dB	**Absolute value of difference between corresponding SPL corrected to reference environmental conditions and SPL measured at reference environmental conditions, extended by actual expanded uncertainty of measurement** * dB	**Tolerance limits** dB	**Maximum permitted expanded uncertainty of measurement** dB
Minimum temperature						
23,0						
Maximum temperature						

* The correction applied shall take account of any variation in microphone sensitivity level with changing temperature, static pressure and relative humidity. For class LS or class 1 sound calibrators with a letter 'C' designation, a further correction shall also be applied, where appropriate, to take account of the effect of static pressure on the output of the sound calibrator.

For class 2 sound calibrators with a letter 'C' designation, further corrections shall be applied, where appropriate, to take account of the effect of static pressure, temperature or relative humidity on the output of the sound calibrator.

Frequency

Target temper-ature °C	Measured temper-ature °C	Measured frequency Hz	Actual expanded uncertainty of measurement %	Absolute value of percentage difference between measured frequency and frequency measured at reference environmental conditions, extended by actual expanded uncertainty of measurement %	Tolerance limits %	Maximum permitted expanded uncertainty of measurement %
Minimum temperature						
23,0						
Maximum temperature						

Static pressure was measured using ……
(state manufacturer, model and serial no. of device used)

Static pressure range during measurements: _____ kPa to _____ kPa

Expanded uncertainty of measurement ___ kPa

Air temperature was measured using ……
(state manufacturer, model and serial no. of device used)

Expanded uncertainty of measurement _____ °C

Relative humidity was measured using ……
(state manufacturer, model and serial no. of device used)

Relative humidity range during measurements _____ % to _____ %

Expanded uncertainty of measurement _____ %

Remarks:

Test 8 Influence of relative humidity (only to be performed if required by the results of test 6) *(5.4, A.5.3 and A.5.6 of IEC 60942:2003)*

Principal sound pressure level and principal frequency

Maximum sound pressure level and minimum frequency available at that sound pressure level

Maximum sound pressure level and principal frequency

Maximum sound pressure level and maximum frequency available at that sound pressure level

Minimum frequency and maximum sound pressure level available at that frequency

Maximum frequency and maximum sound pressure level available at that frequency

For multi-level and multi-frequency sound calibrators it will be necessary to replicate the tables below, as required, for each of the above sets of settings.

NOTE In most cases it will not be necessary to replicate the tables for all of the above settings, as all the combinations specified will only apply in the case of multi-level and multi-frequency sound calibrators that generate several sound pressure levels and frequencies.

Sound pressure level

Target relative humidity %	**Measured relative humidity** %	**Measured output voltage from microphone** V	**Actual expanded uncertainty of measure-ment** dB	**Absolute value of difference between corresponding SPL corrected to reference environmental conditions and SPL measured at reference environmental conditions, extended by actual expanded uncertainty of measurement *** dB	**Tolerance limits** dB	**Maximum permitted expanded uncertainty of measurement** dB
Minimum RH						
50						
Maximum RH						

The correction applied shall take account of any variation in microphone sensitivity level with changing relative humidity, static pressure and temperature. For class LS or class 1 sound calibrators with a letter 'C' designation, a further correction shall also be applied, where appropriate, to take account of the effect of static pressure on the output of the sound calibrator.

For class 2 sound calibrators with a letter 'C' designation, further corrections shall be applied, where appropriate, to take account of the effect of static pressure, temperature or relative humidity on the output of the sound calibrator.

Frequency

Target relative humidity %	Measured relative humidity %	Measured frequency Hz	Actual expanded uncertainty of measurement %	Absolute value of percentage difference between measured frequency and frequency measured at reference environmental conditions, extended by actual expanded uncertainty of measurement %	Tolerance limits %	Maximum permitted expanded uncertainty of measurement %
Minimum RH						
50						
Maximum RH						

Static pressure was measured using .....
(state manufacturer, model and serial no. of device used)

Static pressure range during measurements _____ kPa to _____ kPa

Expanded uncertainty of measurement _____ kPa

Air temperature was measured using .....
(state manufacturer, model and serial no. of device used)

Air temperature range during measurements _____ °C to _____ °C

Expanded uncertainty of measurement _____ °C

Relative humidity was measured using .....
(state manufacturer, model and serial no. of device used)

Expanded uncertainty of measurement _____ %

Remarks:

Test 9 Influence of temperature and relative humidity combined (only to be performed if required by the results of test 6) *(5.4, A.5.3 and A.5.7 of IEC 60942:2003)*

Principal sound pressure level and principal frequency

Sound pressure level

Target temperature and relative humidity °C and %	**Measured temper-ature** °C	**Measured relative humidity** %	**Measured output voltage from micro-phone** V	**Actual expanded uncertainty of measurement** dB	**Absolute value of difference between corresponding SPL corrected to reference environmental conditions and SPL measured at reference environmental conditions, extended by actual expanded uncertainty of measurement*** dB	**Tolerance limits** dB	**Maximum permitted expanded uncertainty of measure-ment** dB
23 °C + 50 %							

* The correction applied shall take account of any variation in microphone sensitivity level with changing temperature, relative humidity and static pressure. For class LS or class 1 sound calibrators with a letter 'C' designation, a further correction shall also be applied, where appropriate, to take account of the effect of static pressure on the output of the sound calibrator.

For class 2 sound calibrators with a letter 'C' designation, further corrections shall be applied, where appropriate, to take account of the effect of static pressure, temperature or relative humidity on the output of the sound calibrator.

Frequency

Target temperature and relative humidity °C and %	Measured temper-ature °C	Measured relative humidity %	Measured frequency Hz	Actual expanded uncertainty of measurement %	Absolute value of percentage difference between measured frequency and measured frequency at reference environmental conditions, extended by actual expanded uncertainty of measurement %	Tolerance limits %	Maximum permitted expanded uncertainty of measurement %
23 °C + 50 %							

Static pressure was measured using .....
(state manufacturer, model and serial no. of device used)

Static pressure range during measurements ____ kPa to ____ kPa

Expanded uncertainty of measurement ___ kPa

Air temperature was measured using .....
(state manufacturer, model and serial no. of device used)

Expanded uncertainty of measurement _____ °C

Relative humidity was measured using .....
(state manufacturer, model and serial no. of device used)

Expanded uncertainty of measurement _____ %

Remarks:

Test 10 Radiofrequency emissions *(5.8.2, A.6.1 and A.6.2 of IEC 60942:2003)*

Sound calibrator configuration: .....

Sound calibrator settings: SPL ..... dB Frequency ..... Hz

Cables/connection devices fitted: .....

Measurement distance: ..... m

Reference orientation

Frequency range MHz	Maximum measured electromagnetic field strength of radio-frequency emissions dB re 1 µV/m quasi peak at distance given above	Maximum electromagnetic field strength of radio-frequency emissions dB re 1 µV/m quasi peak at 10 m *	Maximum permitted electromagnetic field strength of radio-frequency emissions dB re 1 µV/m quasi peak at 10 m
30 to 230			30
>230 to 1 000			37
* This column may be left blank if the measurement distance is 10 m			

Additional plane approximately orthogonal to plane of reference orientation

Description of plane used .....

Frequency range MHz	Maximum measured electromagnetic field strength of radio-frequency emissions dB re 1 µV/m quasi peak at distance given above	Maximum electromagnetic field strength of radio-frequency emissions dB re 1 µV/m quasi peak at 10 m *	Maximum permitted electromagnetic field strength of radio-frequency emissions dB re 1 µV/m quasi peak at 10 m
30 to 230			30
>230 to 1 000			37
* This column may be left blank if the measurement distance is 10 m			

Static pressure range during measurements _____ kPa to _____ kPa

Temperature range during measurements _____ °C to _____ °C

Relative humidity range during measurements _____ % to _____ %

Remarks:

Test 11 Electrostatic discharges *(5.8.3, A.6.1 and A.6.3 of IEC 60942:2003)*

Principal sound pressure level and principal frequency

Cables and connection devices fitted: .....

Type of discharge	**Level of discharge** kV	**After discharge – sound calibrator fully operational/in configuration identical to that set before start of tests?** **Yes/No**
Contact discharge	+4	
	–4	
Air discharge	+8	
	–8	

Static pressure range during measurements _____ kPa to _____ kPa

Temperature range during measurements _____ °C to _____ °C

Relative humidity range during measurements _____ % to _____ %

Remarks:

Test 12 Immunity to power- and radiofrequency fields
(5.8.1, A.6.1 and A.6.4 of IEC 60942:2003)

Principal sound pressure level and principal frequency

For multi-level, single frequency sound calibrators: all SPLs

For multi-frequency, single level sound calibrators: all frequencies

For multi-level and multi-frequency sound calibrators: all frequencies at minimum sound pressure level, and all sound pressure levels at principal frequency

For multi-level and/or multi-frequency sound calibrators it will be necessary to replicate the information and tables below for each of the required combinations of SPL and frequency.

Mode of operation: .....

Cables and connection devices fitted: .....

Sound pressure level or output voltage measured from microphone in absence of the radio

Frequency field ..... dB or V

Reference orientation –
root-mean-square field strength up to 10 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 900 Hz

Frequency range MHz	**SPL or measured output voltage from microphone** dB or V	**Actual expanded uncertainty of measurement** dB	**Absolute value of difference between corresponding SPL and SPL in absence of radio frequency field extended by actual expanded uncertainty of measurement** dB	**Tolerance limits** dB	**Maximum permitted expanded uncertainty of measurement** dB
26 to <500					
500 to 1 000					

Additional plane approximately orthogonal to plane of reference orientation – root-mean-square field strength up to 10 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 900 Hz

Description of plane used .....

Frequency range MHz	SPL or measured output voltage from microphone dB or V	Actual expanded uncertainty of measurement dB	Absolute value of difference between corresponding SPL and SPL in absence of radio frequency field extended by actual expanded uncertainty of measurement dB	Tolerance limits dB	Maximum permitted expanded uncertainty of measurement dB
26 to <500					
500 to 1 000					

Sound pressure level or output voltage measured from microphone in absence of the power frequency field ..... dB or V

Reference orientation – uniform root-mean-square alternating magnetic field strength of 80 A/m

Frequency Hz	SPL or measured output voltage from microphone dB or V	Actual expanded uncertainty of measurement dB	Absolute value of difference between corresponding SPL and SPL in absence of power frequency field extended by actual expanded uncertainty of measurement dB	Tolerance limits dB	Maximum permitted expanded uncertainty of measurement dB
50					
60					

Additional plane approximately orthogonal to plane of reference orientation – uniform root-mean-square alternating magnetic field strength of 80 A/m

Description of plane used .....

Frequency Hz	SPL or measured output voltage from microphone dB or V	Actual expanded uncertainty of measurement dB	Absolute value of difference between corresponding SPL and SPL in absence of power frequency field extended by actual expanded uncertainty of measurement dB	Tolerance limits dB	Maximum permitted expanded uncertainty of measurement dB
50					
60					

Static pressure range during measurements _____ kPa to _____ kPa

Temperature range during measurements _____ °C to _____ °C

Relative humidity range during measurements _____ % to _____ %

Remarks:

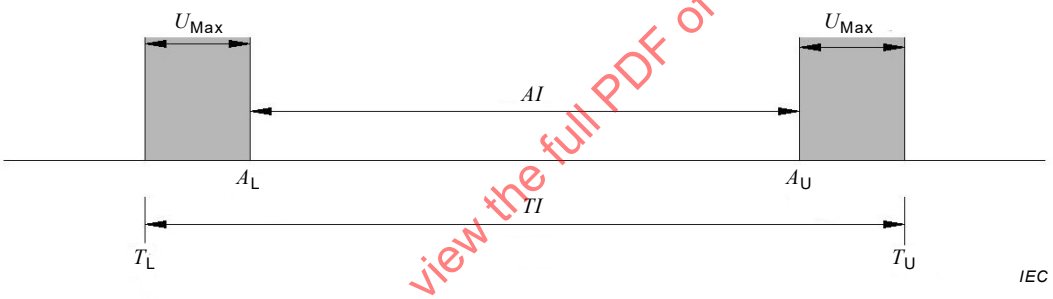
Annex D
(informative)

Relationship between tolerance interval, corresponding acceptance interval and the maximum-permitted uncertainty of measurement

This document, in common with others written by IEC/TC 29, uses adaptations of the guidelines from ISO/IEC Guide 98-4, *Uncertainty of measurement — Part 4: Role of measurement uncertainty in conformity assessment* (equivalent to guidance document JCGM 106 from the Joint Committee for Guides in Metrology), as the basis for demonstration of conformance of an instrument to the specifications given in this document.

ISO/IEC Guide 98-4 describes guarded acceptance in terms of tolerance intervals, acceptance intervals and uncertainties of measurement.

To promote clarity for users and testing laboratories, IEC/TC 29 has adopted a policy whereby tolerance limits around design goals are not explicitly stated, but can be determined if required from the specified acceptance limits for allowed deviations from a design goal and the corresponding specified maximum-permitted uncertainty of measurement, by using the illustration in Figure D.1.



Key

AI	acceptance interval
TI	tolerance interval
U_{max}	guard band for the maximum-permitted uncertainty of measurement for a 95 % coverage interval
A_L	lower acceptance limit
A_U	upper acceptance limit
T_L	lower tolerance limit
T_U	upper tolerance limit

Figure D.1 – Relationship between tolerance interval, corresponding acceptance interval and the maximum-permitted uncertainty of measurement

The limits of an acceptance interval are associated with the acceptance interval and not with the guard band for the maximum-permitted uncertainty of measurement. Hence a measured deviation equal to a limit of an acceptance interval demonstrates conformance to a specification, providing also that the uncertainty of the measurement from the laboratory performing a test does not exceed the specified maximum-permitted uncertainty.

Annex E
(informative)

Example assessments of conformance to specifications of this document

E.1 General

E.1.1 The purpose of Annex E is to clarify the use of measurement results and uncertainties of measurement in assessments of conformance to the specifications of this document in either pattern-evaluation tests or periodic tests of sound calibrators.

E.1.2 Annex E demonstrates assessment of conformance using some general illustrative examples.

E.2 Conformance criteria

E.2.1 According to the requirements in this document, conformance to a specification is established when measured deviations from design goals do not exceed the corresponding acceptance limits AND the uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement for a coverage probability of 95%.

E.2.2 With these two criteria, there are four possible outcomes:

(1) Measured deviations do not exceed acceptance limits AND actual uncertainty does not exceed maximum-permitted uncertainty

CONFORMANCE TO THE SPECIFICATION

(2) Measured deviations do not exceed acceptance limits AND actual uncertainty exceeds maximum-permitted uncertainty

NON-CONFORMANCE BECAUSE THE ACTUAL UNCERTAINTY EXCEEDS THE MAXIMUM-PERMITTED UNCERTAINTY

(3) Measured deviations exceed acceptance limits AND actual uncertainty does not exceed maximum-permitted uncertainty

NON-CONFORMANCE BECAUSE MEASURED DEVIATIONS EXCEED THE ACCEPTANCE LIMITS

(4) Measured deviations exceed acceptance limits AND actual uncertainty exceeds maximum-permitted uncertainty

NON-CONFORMANCE BECAUSE NEITHER CRITERION IS SATISFIED

NOTE In practice, a laboratory can sometimes pre-determine the uncertainty of a measurement. If the pre-determined uncertainty exceeds the maximum-permitted uncertainty, the laboratory will not attempt to perform the test.

E.3 Example test results

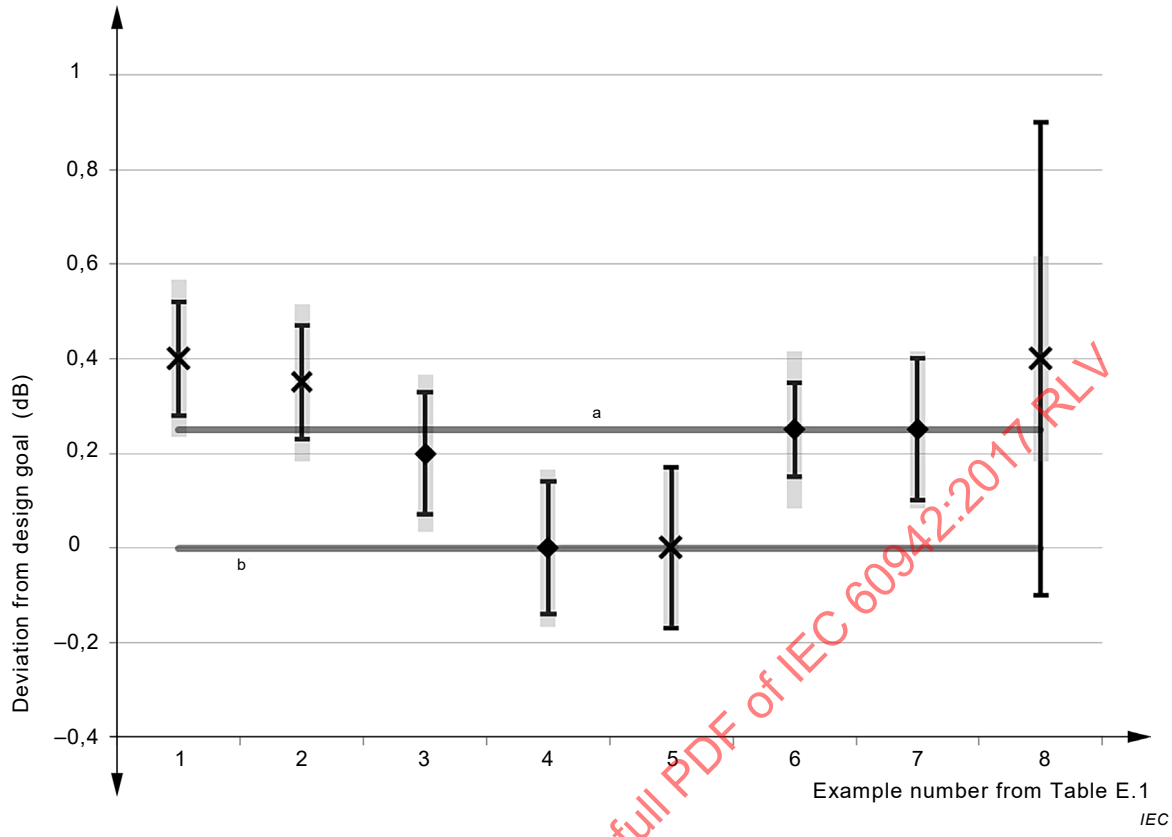
E.3.1 Table E.1 gives examples of test results to explain the method of determining conformance or non-conformance to the specifications of this document. This method applies for any tests in this document where acceptance limits and maximum-permitted uncertainties are specified.

Table E.1 – Examples of assessment of conformance

Example number	Absolute measured deviation from design goal dB	Acceptance limit dB	Actual uncertainty ± dB	Maximum-permitted uncertainty ± dB	Conforms to specifications Yes or No	Reasons for conformance or non-conformance
1	0,40	0,25	0,12	0,15	No	Deviation exceeds acceptance limits
2	0,35	0,25	0,12	0,15	No	Deviation exceeds acceptance limits
3	0,20	0,25	0,13	0,15	Yes	Deviation within acceptance limits AND uncertainty within maximum-permitted
4	0,00	0,25	0,14	0,15	Yes	Deviation within acceptance limits AND uncertainty within maximum-permitted
5	0,00	0,25	0,17	0,15	No	Deviation within acceptance limits BUT uncertainty exceeds maximum-permitted
6	0,25	0,25	0,10	0,15	Yes	Deviation within acceptance limits AND uncertainty within maximum-permitted
7	0,25	0,25	0,15	0,15	Yes	Deviation within acceptance limits AND uncertainty within maximum-permitted
8	0,40	0,25	0,50	0,20	No	Deviation exceeds acceptance limits AND uncertainty exceeds maximum-permitted

E.3.2 Figure E.1 shows the eight example assessments of conformance from Table E.1 in graphical form.

E.3.3 The practice illustrated in Table E.1 and Figure E.1 for assessing conformance applies equally for pattern-evaluation testing as well as periodic testing.



Key

a Upper acceptance limit

b Lower acceptance limit

The lower and upper acceptance limits are indicated by the heavy horizontal lines. The measured deviations from the design goal are shown by the solid markers. A diamond-shaped marker indicates conformance to the specification and a cross-shaped marker indicates non-conformance.

The actual uncertainty of measurement is indicated by the vertical error bars and the maximum-permitted uncertainty is indicated by the vertical shaded area.

Figure E.1 – Examples of assessment of conformance

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IEC 60942:2003, *Electroacoustics – Sound calibrators*

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IEC 60942

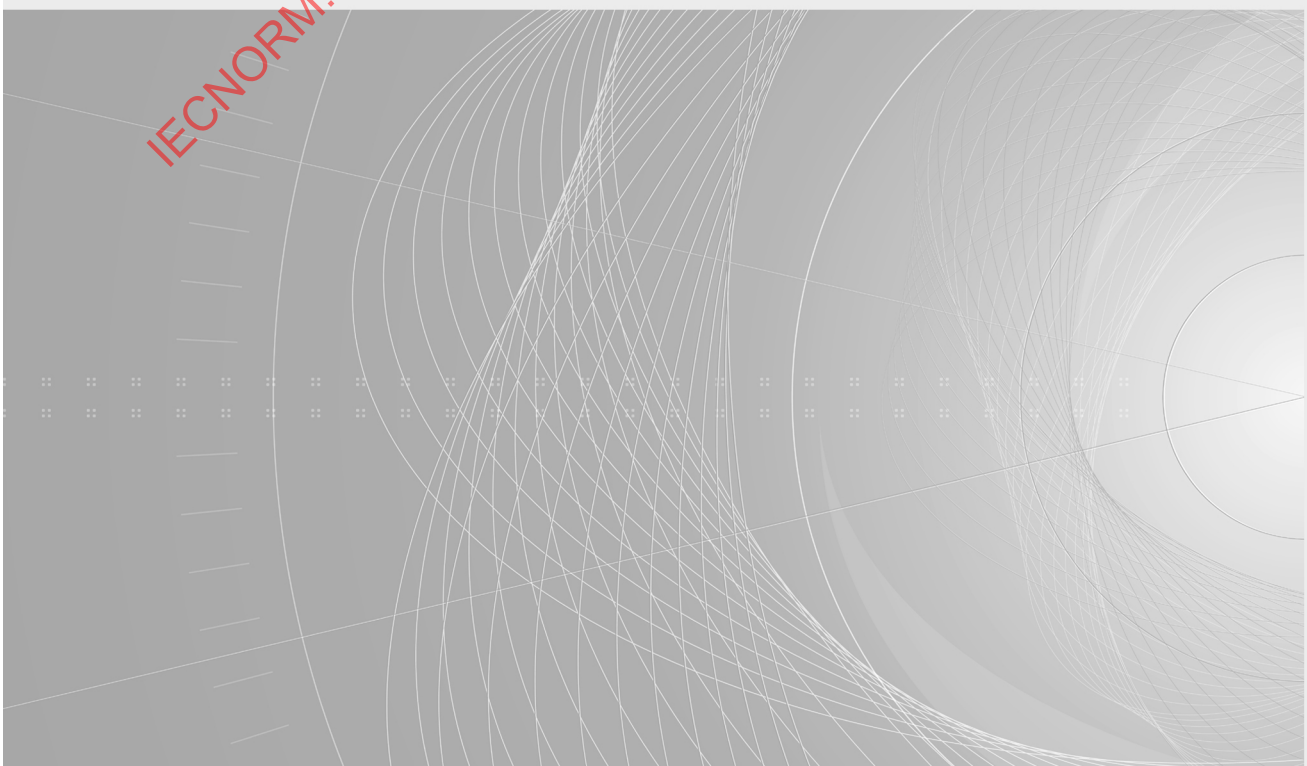
Edition 4.0 2017-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electroacoustics – Sound calibrators

Électroacoustique – Calibreurs acoustiques



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ELECTROACOUSTICS – SOUND CALIBRATORS

FOREWORD

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International Standard IEC 60942 has been prepared by IEC technical committee 29: Electroacoustics, in cooperation with the International Organization of Legal Metrology (OIML).

This fourth edition cancels and replaces the third edition published in 2003, of which it constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) deletion of the class designations, class LS/C, class 1/C and class 2/C;
b) addition of two further class designations, class LS/M and class 1/M, specifically for pistonphones;
c) addition of an amended criterion for assessing conformance to a specification: conformance is now demonstrated when (a) measured deviations from design goals do not exceed the applicable acceptance limits and (b) the uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty;

d) modification to the short-term level fluctuation test of the sound pressure level stability;

e) change to some environmental test conditions to avoid icing;

f) addition of an alternative test for immunity to radio-frequency fields using transverse electromagnetic (TEM) waveguides.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
29/962/FDIS	29/969/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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

INTRODUCTION

Sound calibrators are designed to produce one or more known sound pressure levels at one or more specified frequencies when coupled to specified models of microphone in specified configurations, for example, with or without protective grid. The sound pressure level generated by some sound calibrators depends on the static pressure.

Sound calibrators have two principal applications:

a) the determination of the electroacoustical pressure sensitivity of specified models of microphone in specified configurations;

b) checking or adjusting the overall sensitivity of acoustical measuring devices or systems.

ELECTROACOUSTICS – SOUND CALIBRATORS

1 Scope

This document specifies the performance requirements for three classes of sound calibrator: class LS (Laboratory Standard), class 1 and class 2. Acceptance limits are smallest for class LS and greatest for class 2 instruments. Class LS sound calibrators are normally used only in the laboratory; class 1 and class 2 are considered as sound calibrators for field use. A class 1 sound calibrator is primarily intended for use with a class 1 sound level meter and a class 2 sound calibrator primarily with a class 2 sound level meter, as specified in IEC 61672-1.

The acceptance limits for class LS sound calibrators are based on the use of a laboratory standard microphone, as specified in IEC 61094-1, for demonstrations of conformance to the requirements of this document. The acceptance limits for class 1 and class 2 sound calibrators are based on the use of a working standard microphone, as specified in IEC 61094-4, for demonstrations of conformance to the requirements of this document.

To promote consistency of testing of sound calibrators and ease of use, this document contains three normative annexes – Annex A "Pattern evaluation tests", Annex B "Periodic tests", Annex C "Pattern evaluation report", and two informative Annexes – Annex D "Relationship between tolerance interval, corresponding acceptance interval and the maximum-permitted uncertainty of measurement" and Annex E "Example assessments of conformance to specifications of this document".

This document does not include requirements for equivalent free-field or random-incidence sound pressure levels, such as can be used in the overall sensitivity adjustment of a sound level meter.

A sound calibrator can provide other functions, for example, tonebursts. Requirements for these other functions are not included in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-801:1994, *International Electrotechnical Vocabulary – Chapter 801: Acoustics and electroacoustics*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-20:2010, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61000-6-1:2005, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*[1]

IEC 61000-6-2:2005, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*[2]

IEC 61000-6-3:2006, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environment*
IEC 61000-6-3:2006/AMD1:2010

IEC 61094-1:2000, *Measurement microphones – Part 1: Specifications for laboratory standard microphones*

IEC 61094-4:1995, *Measurement microphones – Part 4: Specifications for working standard microphones*

IEC 61094-5, *Electroacoustics – Measurement microphones – Part 5: Methods for pressure calibration of working standard microphones by comparison*

IEC 61672-1, *Electroacoustics – Sound level meters – Part 1: Specifications*

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

CISPR 16-2-3:2016, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*

CISPR 22:2008, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*[3]

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO 266:1997, *Acoustics – Preferred frequencies*

ISO/IEC Guide 99, *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*

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1 2nd edition (2005). This 2nd edition has been replaced in 2016 by a 3rd edition IEC 61000-6-1:2016, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*, but to ensure consistency with other TC 29 standards this 3rd edition has not been used or referenced in this document, but will be considered prior to the next revision of this document.

2 2nd edition (2005). This 2nd edition has been replaced in 2016 by a 3rd edition IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*, but to ensure consistency with other TC 29 standards this 3rd edition has not been used or referenced in this document, but will be considered prior to the next revision of this document.

3 6th edition (2008). This 6th edition has been replaced in 2015 by CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements,* but to ensure consistency with other TC 29 standards CISPR 32:2015 has not been used or referenced in this document, but will be considered prior to the next revision of this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-801 and the ISO/IEC Guide 99, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

NOTE Definitions for other relevant quantities are given in the documents referenced in Clause 2.

3.1
sound calibrator
device that generates a sinusoidal sound pressure of specified sound pressure level and frequency when coupled to specified models of microphone in specified configurations

3.2
pistonphone
sound calibrator in which the sound pressure is generated in a fixed air volume by the motion of one or more pistons, creating a well-defined volume velocity

3.3
specified sound pressure level
sound pressure level(s) generated under reference environmental conditions for use with a particular microphone model and configuration, valid for either an individual sound calibrator (in the case of a class LS calibrator) or all sound calibrators of the same model (in the case of a class 1 or class 2 calibrator)

Note 1 to entry: Specified sound pressure level is expressed in decibels (dB).

Note 2 to entry: The reference value is 20 μPa.

3.4
nominal sound pressure level
close approximation to the specified sound pressure level(s), valid for all sound calibrators of the same model, rounded to the nearest decibel (intended for marking)

Note 1 to entry: Nominal sound pressure level is expressed in decibels (dB).

Note 2 to entry: The reference value is 20 μPa.

3.5
specified frequency
frequency(ies) of the sound generated by the sound calibrator under reference environmental conditions, valid for either an individual sound calibrator (in the case of a class LS calibrator) or all sound calibrators of the same model (in the case of a class 1 or class 2 calibrator)

Note 1 to entry: Specified frequency is expressed in hertz (Hz).

3.6
nominal frequency
close approximation to the specified frequency, often rounded according to ISO 266 (intended for marking)

Note 1 to entry: Nominal frequency is expressed in hertz (Hz).

3.7
principal sound pressure level
nominal sound pressure level specified in the instruction manual as principal

Note 1 to entry: Where the sound calibrator produces more than one sound pressure level, the manufacturer identifies one nominal sound pressure level as principal.

Note 2 to entry: Principal sound pressure level is used during demonstration of conformance of the sound calibrator to the requirements of this document.

Note 3 to entry: Principal sound pressure level is expressed in decibels (dB).

Note 4 to entry: The reference value is 20 μPa.

3.8
principal frequency
nominal frequency specified in the instruction manual as principal

Note 1 to entry: Where the sound calibrator produces more than one frequency, the manufacturer identifies one nominal frequency as principal.

Note 2 to entry: Principal frequency is used during demonstration of conformance of the sound calibrator to the requirements of this document.

Note 3 to entry: Principal frequency is expressed in hertz (Hz).

3.9
replication
repeat of a measurement involving coupling the microphone to the sound calibrator and then completely removing the microphone from the sound calibrator

3.10
total distortion + noise
ratio of the root-mean-square of the total distortion and noise components, including any harmonics and sub-harmonics, to the root-mean-square of the entire signal

Note 1 to entry: Distortion is the correlated component of the signal due to non-linearity, and noise is the uncorrelated component.

Note 2 to entry: Total distortion + noise is expressed in per cent (%).

3.11
reference orientation
orientation of a sound calibrator such that the principal axis of the opening of the cavity (the axis along which the microphone is inserted into the cavity) coincides with the principal direction of an emitter or receiver of radio-frequency fields, the opening of the cavity facing away from the emitter or receiver

3.12
reference plane
plane of contact between the microphone and the sound calibrator

3.13
effective load volume of a microphone
volume of air at reference environmental conditions that has the same acoustic compliance as the cavity bounded by the reference plane, the microphone diaphragm and the outer cylindrical surface of the microphone at the reference plane, including the equivalent volume of the microphone (described in IEC 61094-1)

Note 1 to entry: Effective load volume is generally expressed in cubic millimetres (mm^3) and may change with frequency.

3.14
coverage probability
probability that the set of true quantity values of a measurand is contained within a specified coverage interval

[SOURCE: ISO/IEC Guide 98-4:2012, 3.2.8]

3.15
acceptance limit
specified upper or lower bound of permissible measured quantity values

Note 1 to entry: Acceptance limits in this document are analogous to the allowances for design and manufacturing in IEC 60942:2003.

[SOURCE: ISO/IEC Guide 98-4:2012, 3.3.8, modified – Note 1 to entry has been added.]

4 Reference environmental conditions

Reference environmental conditions for specifying the performance of a sound calibrator are:

– air temperature: 23 °C;
– static pressure: 101,325 kPa;
– relative humidity: 50 %.

5 Requirements

5.1 General

5.1.1 A sound calibrator conforming to the requirements of this document shall have the characteristics described in Clause 5. Adaptors may be provided to accommodate more than one model of microphone. For the purpose of this document, any such adaptor is an integral part of the sound calibrator.

5.1.2 The sound calibrator shall conform to the requirements of this document for one or more of the sound pressure level and frequency combinations available. A multi-level and multi-frequency sound calibrator shall conform to the requirements for the same class designation for all sound pressure level and frequency combinations for which the instruction manual states that the instrument conforms to the requirements of this document. Conformance to the requirements of this document shall not be stated for sound pressure level and frequency settings for which this document provides no acceptance limits.

5.1.3 Throughout this document, where reference is made to a specific class of sound calibrator, this includes all the designations under that class, unless otherwise stated.

5.1.4 Class LS sound calibrators shall be supplied with an individual calibration chart containing the information required by 6.2. For class 1 and class 2 sound calibrators, the specified sound pressure level(s) and specified frequency(ies) shall be given in the instruction manual. Each specified level shall be defined in terms of an absolute level.

5.1.5 Class LS and class 1 pistonphones that require corrections for the influence of static pressure to conform to the specifications for the appropriate class shall have the letter "M" added to their class designation. The permissible classes and designations are described in Table 1. Sound calibrators designated class LS/M and class 1/M shall not require corrections for any of the other environmental conditions to achieve the requirements specified for the appropriate class. For class LS/M and class 1/M sound calibrators, the corrections for static pressure, necessary for the sound calibrator to conform to the requirements of this document,

shall be stated in the instruction manual, together with the uncertainties of measurement corresponding to a coverage probability of 95 %.

5.1.6 Sound calibrators designated class LS/M may also claim conformance to the requirements for a sound calibrator designated class 1/M if they meet the full specifications described in this document for both classes of sound calibrator.

5.1.7 Sound calibrators, other than those designated class LS/M or class 1/M, shall not require corrections for any of the environmental conditions to conform to the requirements for the relevant class.

5.1.8 Sound calibrators designated class LS/M and class1/M shall either be supplied with a barometer, or the manufacturer shall state the specifications in the instruction manual for any barometer to be used. A statement shall be included in the instruction manual giving the uncertainty of the measurement of static pressure required, for a coverage probability of 95%, so that the ability of a class LS/M or class 1/M sound calibrator to conform to the requirements for the relevant class is not affected.

NOTE 1 A class LS/M sound calibrator is normally used only in the laboratory where a suitable device is likely to be available for measuring static pressure.

NOTE 2 Some barometers provide the data directly in the form to be used to correct measured sound pressure levels to the reference static pressure.

Table 1 – Sound calibrator classes and designations

Class	Designation	Description
LS	LS	Sound calibrator designed to meet the specifications of this document for a class LS device with no corrections for the influence of environmental conditions
	LS/M	Pistonphone designed to meet the specifications of this document for a class LS device with the application of corrections for the influence of static pressure only
1	1	Sound calibrator designed to meet the specifications of this document for a class 1 device with no corrections for the influence of environmental conditions
	1/M	Pistonphone designed to meet the specifications of this document for a class 1 device with the application of corrections for the influence of static pressure only
2	2	Sound calibrator designed to meet the specifications of this document for a class 2 device with no corrections for the influence of environmental conditions

5.1.9 If a specific orientation of the sound calibrator is to be used to conform to the requirements of this document, this orientation shall either be indicated on the sound calibrator, or the indication on the sound calibrator shall refer to the instruction manual, which shall state the required orientation.

5.1.10 All performance requirements relate to the operation of the sound calibrator following stabilizing of the coupling of the microphone and sound calibrator, and after the sound pressure level and frequency have stabilized. The elapsed time necessary for stabilization of the sound pressure level and frequency, which begins once the sound calibrator is switched on with the microphone coupled to it, shall be stated in the instruction manual, and shall not exceed 30 s for any applicable combination of environmental conditions specified in 5.5. Where this stabilization time exceeds 10 s, an indicator shall be provided to demonstrate

when the output from the sound calibrator has stabilised. Information on the operation of this indicator shall be given in the instruction manual. Following the stabilization time, the sound pressure level and frequency shall remain stable within the acceptance limits of Table 2 and Table 4, or Table 5 and Table 6, as applicable, whilst switched on, which shall be for a period of at least 70 s. The sound calibrator and microphone shall be allowed to reach equilibrium with the prevailing environmental conditions before coupling.

NOTE 1 A period of at least 70 s is chosen as the measurement of short-term level fluctuation described in 5.3.3 requires measurement over a period of 60 s of operation of the sound calibrator.

NOTE 2 The stabilization time required following the coupling of the microphone to the sound calibrator can vary considerably depending on the model of microphone and sound calibrator in use.

NOTE 3 It is important that the sound calibrator is designed such that the static pressure inside the sound calibrator is equal to the static pressure outside the sound calibrator.

5.1.11 If the tests described in Annex A require the sound calibrator to operate for longer than the normal operating time, the manufacturer shall provide information in the instruction manual to describe how this can be achieved.

5.1.12 Those components of a sound calibrator that are not intended to be accessible to the user shall be protected by markings or a mechanism that makes those components inaccessible.

5.1.13 In 5.3 to 5.9, acceptance limits are provided for allowable values of measured deviations from design goals. For testing laboratories, the maximum-permitted uncertainties of measurement for a coverage probability of 95 % are stated in Annex A. Annex D describes the relationship between tolerance interval, corresponding acceptance interval and the maximum-permitted uncertainty of measurement.

5.1.14 The acceptance limits given for class LS sound calibrators also apply to those sound calibrators designated as class LS/M. The acceptance limits given for class 1 sound calibrators also apply to those sound calibrators designated as class 1/M.

5.1.15 Conformance to a performance specification is demonstrated when the following criteria are both satisfied: (a) measured deviations from design goals do not exceed the applicable acceptance limit AND (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in Annex A for a coverage probability of 95 %.

5.1.16 If the actual uncertainty of a measurement performed by the test laboratory, calculated for a coverage probability of 95 %, exceeds the maximum-permitted value given in Annex A, the measurement shall not be used to demonstrate conformance to the requirements of this document.

5.1.17 Annex E gives examples of evaluation of conformance to specifications of this document.

5.1.18 Full conformance to this document is only demonstrated when the model of sound calibrator has been shown to conform to the requirements of this document for pattern evaluation when tested according to Annex A, and the individual specimen of sound calibrator has been shown to conform to the requirements of this document for periodic testing when tested according to Annex B.

5.2 Adaptors

The instruction manual for the sound calibrator may provide information to allow design of adaptors to be used with the sound calibrator. This design data shall include all the information necessary to create an adaptor that can be used with the specified sound calibrator in a manner that maintains the specified performance class. Where this design data

is supplied, the instruction manual shall specify the insertion distance and minimum diameter of the microphone at which sealing will occur.

5.3 Sound pressure level

5.3.1 General

5.3.1.1 All specified sound pressure level(s) generated shall be stated in the instruction manual with a resolution better than, or equal to, 0,1 dB.

5.3.1.2 All the requirements and acceptance limits specified in this document relate to the level of the sound pressure produced at the diaphragm of the inserted microphone.

5.3.1.3 The principal sound pressure level of the sound calibrator shall be at least 90 dB re 20 μPa when the sound calibrator is applied to the models of microphone in the configurations specified in the instruction manual.

5.3.2 Generated sound pressure level

The absolute value of the difference between a measured sound pressure level and the corresponding specified sound pressure level shall not exceed the acceptance limits given in Table 2 for the class of sound calibrator. For sound calibrators with class designation LS/M or 1/M, the measured level shall be corrected for static pressure, if necessary, to the reference static pressure given in Clause 4. These acceptance limits apply to measurements made at and around reference environmental conditions within the following ranges: 97 kPa to 105 kPa, 20 °C to 26 °C and 40 % to 65 % relative humidity.

5.3.3 Short-term level fluctuation

The fluctuation in the sound pressure level shall be measured using time-weighting F (nominal time constant of 125 ms as specified in IEC 61672-1), by determining the mean and the maximum and minimum levels generated over a period of 60 s of operation of the sound calibrator, by sampling at least 30 times. The absolute value of the difference between each of the maximum and minimum levels measured, and the mean value shall each not exceed the short-term level fluctuation acceptance limits given in Table 2 for the class of sound calibrator. These short-term level fluctuation acceptance limits apply to measurements made at and around reference environmental conditions within the ranges specified in 5.3.2.

Where a sound calibrator is operated over a period of greater than 60 s, for example in measuring the performance of other instruments such as sound level meters, it is necessary to establish the level fluctuation over the longer time period.

NOTE 1 No specifications are provided in this document for a greater time period of operation.

NOTE 2 At lower frequencies, even for a stable signal, a short-term level fluctuation greater than zero will be indicated by the specified method of measurement. This is caused by the variation in the instantaneous sound pressure and the limited time averaging by the specified F time-weighting. The acceptance limits for short-term level fluctuation are increased at lower frequencies to allow for this phenomenon.

Table 2 – Acceptance limits for sound pressure level and short-term level fluctuation, at and around reference environmental conditions

Range of nominal frequencies Hz	Sound pressure level acceptance limits dB			Short-term level fluctuation limits dB		
	Class LS	Class 1	Class 2	Class LS	Class 1	Class 2
31,5 to 63	–	0,30	–	–	0,20	–
> 63 to < 160	–	0,30	–	–	0,10	–
160 to 1 250	0,10	0,25	0,40	0,03	0,07	0,15
> 1 250 to 4 000	–	0,35	–	–	0,07	–
> 4 000 to 8 000	–	0,45	–	–	0,07	–
> 8 000 to 16 000	–	0,50	–	–	0,07	–
Sound pressure level acceptance limits are for the absolute value of the difference between the sound pressure level generated by the sound calibrator and the specified sound pressure level. For a class LS, or class 2 sound calibrator, the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no acceptance limits.						

5.3.4 Sound pressure level over range of supply voltage

The absolute value of the difference between the sound pressure level generated by the sound calibrator, determined according to 5.3.2 over the range of supply voltages specified in the instruction manual, and the sound pressure level measured at the nominal supply voltage under reference environmental conditions shall not exceed the acceptance limits given in Table 3 for the class of sound calibrator. Also, the acceptance limits given in Table 2 for the absolute value of the difference between the measured sound pressure level and the specified sound pressure level shall not be exceeded for any supply voltage within the range.

Table 3 – Acceptance limits for the effect of supply voltage on sound pressure level, under reference environmental conditions

Acceptance limits dB		
Class LS	Class 1	Class 2
0,02	0,06	0,16
Acceptance limits are for the absolute value of the difference between the sound pressure level generated by the sound calibrator over the range of operating voltage, and the sound pressure level measured at the nominal supply voltage.		

5.4 Frequency

5.4.1 General

5.4.1.1 The principal frequency of the sound generated by the sound calibrator shall be in the range from 160 Hz to 1 250 Hz. Specified frequencies shall be calculated from the equation for exact frequency given in 3.1 of ISO 266:1997, or taken from Table 1 of ISO 266:1997 which gives the calculated frequency.

5.4.1.2 The principal sound pressure level shall be available at the principal frequency.

5.4.2 Frequency of sound generated by the sound calibrator

The absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator and the corresponding specified frequency shall not exceed the acceptance limits given in Table 4 for the class of sound calibrator. These acceptance

limits apply to measurements made at and around reference environmental conditions within the ranges specified in 5.3.2.

Table 4 – Acceptance limits for frequency, at and around reference environmental conditions

Acceptance limits %		
Class LS	**Class 1**	**Class 2**
0,7	0,7	1,7
Acceptance limits are for the absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator and the specified frequency. Acceptance limits are expressed as a percentage of the specified frequency.		

5.5 Influence of static pressure, air temperature and humidity

For environmental conditions outside the ranges specified in 5.3.2, sound calibrators shall operate within the acceptance limits given in Tables 5 and 6 relative to the values measured under reference environmental conditions, and shall not exceed the acceptance limits for Table 7, for the class of sound calibrator, over any combination of the range of environmental conditions given below.

Class LS	Static pressure:	65 kPa to 108 kPa
	Air temperature:	+16 °C to +30 °C
	Relative humidity:	25 % to 90 %

Class 1	Static pressure:	65 kPa to 108 kPa
	Air temperature:	–10 °C to +50 °C
	Relative humidity:	25 % to 90 %

Combinations of air temperature and relative humidity that would yield a dewpoint greater than +39 °C are excluded from the tests of conformance with these specifications.

Class 2	Static pressure:	65 kPa to 108 kPa
	Air temperature:	0 °C to +40 °C
	Relative humidity:	25 % to 90 %

NOTE The range of environmental conditions for class 1 and class 2 sound calibrators is the same as specified in IEC 61672-1 for class 1 and class 2 sound level meters.

Table 5 – Acceptance limits for sound pressure level, over the specified range of environmental conditions

Range of nominal frequencies	Acceptance limits dB		
Hz	Class LS	Class 1	Class 2
31,5 to < 160	–	0,25	–
160 to 1 250	0,10	0,25	0,40
> 1 250 to 4 000	–	0,30	–
> 4 000 to 8 000	–	0,45	–
> 8 000 to 16 000	–	0,60	–
Acceptance limits are for the absolute value of the difference between the sound pressure level generated by the sound calibrator over the specified range of environmental conditions (excluding the conditions covered by Table 2) and the sound pressure level measured under reference environmental conditions. For a class LS or class 2 sound calibrator, the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no acceptance limits.			

Table 6 – Acceptance limits for frequency, over the specified range of environmental conditions

Acceptance limits %		
Class LS	Class 1	Class 2
0,7	0,7	1,7
Acceptance limits are for the absolute value of the difference in per cent between the frequency of the sound generated by the sound calibrator over the specified range of environmental conditions (excluding the conditions covered by Table 4) and the frequency measured under reference environmental conditions. Acceptance limits are expressed as a percentage of the specified frequency.		

5.6 Total distortion + noise

The total distortion + noise, measured over the frequency range from 22,4 Hz (nominal frequency) to 22,4 kHz (nominal frequency), shall not exceed the maximum values given in Table 7, for the applicable range of environmental conditions specified in 5.5.

NOTE 1 Some distortion meters indicate the ratio of the magnitude of the unwanted components, including any harmonics and subharmonics, to the magnitude of the fundamental component of the signal. For the maximum total distortion + noise limits specified in this document, the difference between distortion measured as a ratio of the root-mean-square of the total distortion component + noise to the root-mean-square of the entire signal, or to the root-mean-square of the fundamental, is insignificant compared with the uncertainty of measurement. An instrument that measures total harmonic distortion only is not suitable.

NOTE 2 The aim is to ensure all noise contributions are included across the specified frequency range.

Table 7 – Maximum total distortion + noise

Range of nominal frequencies	Total distortion + noise %		
Hz	Class LS	Class 1	Class 2
31,5 to < 160	–	3,0	–
160 to 1 250	2,0	2,5	3,0
> 1 250 to 16 000	–	3,0	–
Acceptance limits are for the maximum total distortion + noise generated by the sound calibrator. For a class LS or class 2 sound calibrator, the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no acceptance limits.			

5.7 Power supply requirements

The sound calibrator shall include as an integral part some means of indicating that the supply voltage is sufficient to operate the sound calibrator in accordance with the requirements of this document, or shall ensure that the sound calibrator ceases to produce any sound output when the supply voltage falls below that required to operate the sound calibrator in accordance with the requirements of this document.

5.8 Specification and calibration of microphones

5.8.1 Microphone models and adaptors

5.8.1.1 The instruction manual for the sound calibrator shall either state the microphone configurations as designated in IEC 61094-1 or IEC 61094-4 with which the sound calibrator is specified to operate in conformity with the requirements of this document or alternatively, and in addition if desired, state the name of the manufacturer or supplier, model designation and configurations (for example, with or without protective grid) of those microphones with which the sound calibrator is specified to operate in conformity with the requirements of this document. In each case, the instruction manual shall state the required adaptor configuration (if any). This information may also be given on the manufacturer's webpage.

5.8.1.2 For class LS sound calibrators, at least one of the microphone configurations or models specified shall be a laboratory standard microphone as specified in IEC 61094-1.

5.8.1.3 For class 1 and class 2 sound calibrators, at least one of the microphone models specified shall be a working standard microphone as specified in IEC 61094-4.

NOTE A measurement microphone that conforms to the requirements of IEC 61094-1 for laboratory standard microphones also conforms to the requirements of IEC 61094-4 for working standard microphones.

5.8.1.4 A microphone model shall be used for which the electroacoustical characteristic is designated by the letter P in IEC 61094-1 or IEC 61094-4.

5.8.2 Microphone sensitivity level

For the microphone models specified, it shall be possible to determine the pressure sensitivity level of the microphone by at least one of the following:

a) a method specified in IEC 61094-2; or

b) a method specified in IEC 61094-5, or by an alternative comparison method.

5.9 Electromagnetic compatibility

5.9.1 General

Sound calibrators shall conform to the requirements of this document for radio-frequency emissions, and immunity to electrostatic discharges and power- and radio-frequency fields.

5.9.2 Radio-frequency emissions

5.9.2.1 The upper limits for the electromagnetic field strength of radio-frequency emissions from the sound calibrator are 30 dB (re 1 µV/m) quasi-peak, measured at 10 m, for frequencies in the range from 30 MHz to 230 MHz, and 37 dB (re 1 µV/m) quasi-peak, measured at 10 m, for frequencies in the range from 230 MHz to 1 GHz.

NOTE 1 The upper limits are defined for compatibility with many different standards. The limits given in Table 1 of IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010 form the basic requirements for sound calibrators.

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

5.9.2.2 The instruction manual shall state the mode of operation of the sound calibrator that produces the greatest radio-frequency emissions.

5.9.3 Electrostatic discharges

5.9.3.1 Sound calibrators shall withstand contact discharges up to 4 kV and air discharges up to 8 kV, for both positive and negative voltages relative to earth ground as specified in IEC 61000-6-1:2005, Table 1, requirement 1.5.

5.9.3.2 Performance criterion B as specified in IEC 61000-6-1 applies during and after these electrostatic discharge tests.

5.9.3.3 Following the completion of the electrostatic discharge tests, the sound calibrator shall be fully operational and in a configuration identical to that set before the start of the tests.

5.9.4 Immunity to power- and radio-frequency fields

5.9.4.1 Sound calibrators shall exhibit, as a minimum, immunity over the following ranges of power- and radio-frequencies and field strengths:

– frequency range from 26 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 900 Hz;

– frequency range from 1 400 MHz to 2 000 MHz; root-mean-square electric field strength up to and including 3 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 900 Hz;

– frequency range from 2 000 MHz to 2 700 MHz; root-mean-square electric field strength up to and including 1 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 900 Hz;

– uniform root-mean-square alternating magnetic field strength of 80 A/m; frequency 50 Hz and 60 Hz.

The requirements are those specified in 1.1 of Table 1 of IEC 61000-6-1:2005, and 1.2, 1.3 and 1.4 of Table 1 in IEC 61000-6-2:2005 with minor amendments. These amendments extend the range of radio-frequency fields to cover from 26 MHz to 1 GHz, change the modulation frequency from 1 kHz to 900 Hz, increase the field strength for the power-frequency field to 80 A/m, and exclude the reduced field strength requirements listed in Table 1, Note c, of IEC 61000-6-2:2005.

Some sound calibrators conform to the specifications of this document at an unmodulated root-mean-square electromagnetic field strength greater than those specified above. If this is the case, the applicable field strength should be stated in the instruction manual for each range of frequencies.

NOTE The latest editions of IEC 61000-6-1 and IEC 61000-6-2, published 2016, will be considered prior to the next revision of this document.

5.9.4.2 With the sound calibrator in the reference orientation and with the opening of the cavity where the microphone is inserted facing away from the emitter of the power or radio-frequency field, when the field is applied no change in operating state shall occur. The absolute value of the difference between the measured sound pressure level generated by the sound calibrator in the presence of the field, and in the absence of the field, shall not exceed 0,10 dB for a class LS sound calibrator, 0,25 dB for a class 1 sound calibrator, and 0,45 dB for a class 2 sound calibrator. For multi-level or multi-frequency sound calibrators, or both, the requirements apply for each combination of frequency and sound pressure level for which the instruction manual states that the sound calibrator conforms to the requirements of this document.

5.9.4.3 Tests for immunity to radio-frequency fields may be performed at discrete frequencies in accordance with Clause 8 of IEC 61000-4-3:2006, 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. Dwell time at each frequency shall be appropriate. Testing at a limited number of discrete frequencies does not eliminate the need to conform to the requirements of 5.9.4.1 and 5.9.4.2 at all frequencies within the specified ranges.

5.9.4.4 Tests of immunity to radio-frequency fields shall either be performed as described in Clause 8 of IEC 61000-4-3:2006 or shall use an alternative test method using transverse electromagnetic (TEM) waveguides. The requirements that shall be applied for the TEM waveguide are specified in IEC 61000-4-20, and Annex B of IEC 61000-4-20:2010 defines methods of implementing the testing. The performance requirements for the instrument under test are unchanged including the range of frequencies to be tested and the step size.

5.9.4.5 The instruction manual for the sound calibrator shall state the configuration and the connecting devices (if any) that produce the minimum immunity (maximum susceptibility) to power- and radio-frequency fields.

6 Instrument marking and documentation

6.1 Marking of the sound calibrator

A space shall be allowed for marking on the sound calibrator, and sound calibrators conforming to the requirements of this document shall be supplied with the following minimum information. Items a), b), c) and d) shall be marked on the sound calibrator. The remaining items shall be marked on, or displayed during operation of, the sound calibrator:

a) manufacturer’s or supplier’s name or trade mark;

b) model designation and serial number;

c) reference to this document by number and year of publication;

d) the class of instrument, including the letter "M" designation, where applicable and that this corresponds to a need for corrections for static pressure;

e) a clear indication of all available combinations of sound pressure level and frequency that conform to the requirements of the class;

f) the nominal sound pressure level or sound pressure levels;

g) the nominal frequency or frequencies;

h) where possible, and if required for the sound calibrator, an indication of the orientation required for installation on a microphone;

i) if the sound calibrator is battery operated, the preferred battery type;

j) model number of adaptors shall be marked on the adaptors, where provided

k) where appropriate, firmware and software version numbers.

6.2 Individual calibration chart for a class LS sound calibrator

A class LS sound calibrator shall be supplied with an individual calibration chart from the manufacturer or supplier. The chart shall state the specified sound pressure level(s) and frequency(ies) for the models and configuration of microphone for which the sound calibrator conforms to the requirements of this document.

6.3 Instruction manual

The sound calibrator shall be supplied with an instruction manual which shall contain the information required by Clause 5 and by 6.1. It shall also contain the following information:

a) either identification of the microphone configuration(s) as designated in IEC 61094-1 or IEC 61094-4, or alternatively (and in addition if desired), the name of the manufacturer or supplier, model designation and configurations (for example, with or without protective grid) and of the relevant adaptors required, together with detailed instructions which need to be followed to ensure that the sound calibrator functions as intended when used as described in the instruction manual;

b) for class LS sound calibrators, at least the nominal sound pressure level(s) and frequency(ies), and for class 1 and class 2 sound calibrators the specified sound pressure level(s) and frequency(ies) of the output signal when the sound calibrator is coupled to the specified microphone models and configurations;

c) where appropriate, details of relevant firmware and software, including, where applicable, version numbers;

d) if a specific orientation of the sound calibrator is to be used to conform to the requirements of this document, this orientation shall be stated;

e) the elapsed time, and details of operation of any indicator if required, before the specified sound pressure level and frequency stabilize, for any available combination of sound pressure level and frequency, once the sound calibrator is switched on with the microphone coupled to it. In addition, the instruction manual shall give information on the elapsed time necessary to stabilize the microphone and sound calibrator combination, after they are coupled together;

f) If the environmental tests, described in Annex A, require the sound calibrator to operate for longer than the normal operating time, information describing how this can be achieved;

g) the principal sound pressure level. For a sound calibrator with only one available sound pressure level, this is the principal sound pressure level;

h) the principal frequency. For a sound calibrator with only one available frequency, this is the principal frequency;

i) the range of static pressure over which the sound calibrator is specified to operate, and the correction data, if applicable, specified in 5.5, together with the uncertainties of measurement for a coverage probability of 95 % associated with the correction data;

j) identification of the available combinations of sound pressure level and frequency that conform to the requirements of this document for the class;

k) the typical change in sound pressure level produced by the sound calibrator with changes in the effective load volume of the inserted microphone, as applicable;

l) types of battery which can be used, if applicable, together with the typical operation lifetime, details of any battery status indicator and its operation, and the nominal,

maximum and minimum supply voltages; method of connection to an external power supply, where applicable;

m) for sound calibrators with letter "M" designation, a statement giving the uncertainty of the measurement, for a coverage probability of 95 %, of the static pressure so that the ability of a sound calibrator to conform to the requirements of the relevant class is not affected; where a barometer is supplied with the sound calibrator, the uncertainty of measurement, for a coverage probability of 95 %, of the static pressure when using the barometer;

n) for sound calibrators with letter "M" designation where a barometer is required but not supplied, details of a suitable device to measure static pressure;

o) a statement of the configuration for the normal mode of operation;

p) the cables and accessories, if any, for use with the sound calibrator with which the calibrator conforms to the electromagnetic compatibility requirements of 5.9;

q) a description of the reference orientation for testing the effects of exposure to radio-frequency fields;

r) if applicable, the unmodulated root-mean-square electric field strength greater than the specified requirements for which the sound calibrator conforms to the specifications of this document;

s) the configuration, sound pressure level and frequency settings for greatest radio-frequency emissions;

t) the configuration and connecting devices, if any, that produce minimum immunity (maximum susceptibility) to power- and radio-frequency fields;

u) if design data for adaptors is included, this data shall include the insertion distance and minimum diameter of the microphone at which sealing will occur;

v) details of the combinations of sound pressure level and frequency that do not conform to the requirements for the class, together with a description of their acoustical characteristics, and a statement of the nominal acceptance limits maintained about the design goals.

Where a sound calibrator has additional features not specified in this document, the instruction manual should include a statement to this effect together with a description of the manufacturer's design goals for the additional features and a statement of the corresponding nominal acceptance limits, together with the maximum-permitted uncertainty of measurement for a coverage probability of 95 %.

Annex A
(normative)

Pattern evaluation tests

A.1 General

A.1.1 Annex A gives details of the tests necessary to demonstrate conformance to all the requirements specified in this document for a model of sound calibrator. The tests are applicable to class LS, class 1 and class 2 sound calibrators, and aim to ensure that pattern evaluation tests are performed in a consistent manner at all testing laboratories. All applicable tests described in Annex A shall be performed.

A.1.2 Conformance to a performance specification is demonstrated when the following criteria are both satisfied: (a) a measured deviation from a design goal does not exceed the applicable acceptance limit and (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in this document for the same coverage probability of 95 %.

A.1.3 Laboratories performing pattern evaluation tests shall calculate all uncertainties of measurement in accordance with the guidelines given in the ISO/IEC Guide 98-3. Actual measurement uncertainties shall be calculated for a coverage probability of 95 %. Where a testing laboratory is only required to make a single measurement, it is necessary for the laboratory to make an estimate of the random contribution to the total uncertainty, using an earlier evaluation based on several measurements for a similar sound calibrator.

A.1.4 The uncertainties of measurement for a coverage probability of 95 % given in Annex A are the maximum permitted for demonstration of conformance, under Annex A, to the requirements of this document. If the actual uncertainty of a measurement performed by the test laboratory, calculated for a coverage probability of 95 %, exceeds the maximum-permitted value, the measurement shall not be used to demonstrate conformance to the requirements of this document.

A.1.5 In Annex A, tables are given for the maximum-permitted uncertainties of measurement for a coverage probability of 95 %. For sound calibrators at and around reference environmental conditions, Table A.1 gives the maximum-permitted uncertainty for the generated sound pressure level and short-term level fluctuation, and Table A.2 gives the maximum-permitted uncertainty for the frequency of the sound generated. Table A.3 gives the maximum-permitted uncertainty for the total distortion + noise in the output signal over the specified range of environmental conditions. For sound calibrators over the specified range of environmental conditions, Table A.4 gives the maximum-permitted uncertainty for the generated sound pressure level, and Table A.5 gives the maximum-permitted uncertainty for the frequency of the sound generated.

A.1.6 The test laboratory shall use instruments with current calibrations for the appropriate quantities. The calibrations shall be traceable to national standards, as required.

A.2 Submission for test

A.2.1 Five specimens of the same pattern of sound calibrator shall be submitted for pattern evaluation testing. As a minimum, the testing laboratory shall select two of the five specimens for testing. At least one of these two specimens shall then be tested fully according to the procedures given in Annex A. The testing laboratory shall decide whether the full tests shall also be performed on the second specimen, or whether limited testing is adequate to provide approval of the pattern.

A.2.2 Each sound calibrator, together with all relevant accessories (such as adaptors or barometer), shall be submitted for test together with a copy of the instruction manual. Each class LS sound calibrator shall also be supplied with an individual calibration chart.

A.3 Principal values

A.3.1 It shall be confirmed that the principal sound pressure level of the sound calibrator conforms to the requirement of 5.3.1.3.

A.3.2 It shall be confirmed that the principal frequency of the sound calibrator conforms to the requirement of 5.4.1.1.

A.4 Marking of the sound calibrator and supplied documentation

It shall be verified that the markings on the sound calibrator and the information in the instruction manual supplied conform to the requirements and contain all the information specified in 6.1 and 6.3. For class LS sound calibrators, it shall be verified that the individual calibration chart contains all the information required by 6.2.

A.5 Performance tests at and around reference environmental conditions

A.5.1 General

A.5.1.1 All tests in Clause A.5 shall be performed within the ranges of environmental conditions specified in 5.3.2.

A.5.1.2 For sound calibrators designated class LS/M or class 1/M, where appropriate, data supplied in the instruction manual shall be applied for the influence of static pressure, to correct measured sound pressure levels to the reference static pressure. If a barometer is supplied with the sound calibrator, it shall be used to measure the static pressure, and then the data supplied in the instruction manual shall be applied, where appropriate, to correct measured sound pressure levels to the reference environmental conditions.

A.5.1.3 Except for the tests described in A.5.5.6, A.5.5.7, A.5.5.8, A.5.7.2, A.5.7.4 and A.5.8.2, all measurements shall be performed at an operating voltage within 20 % of the nominal operating voltage and without exceeding the specified maximum or minimum operating voltage.

A.5.1.4 Where the manufacturer claims that a pistonphone conforms to the specifications for both class LS/M and class 1/M, the measurements performed shall cover all tests required for each class designation.

A.5.2 Orientation

If a specific orientation for application of the sound calibrator is stated in the instruction manual, this orientation shall be used for testing. If no specific orientation is prescribed, at least 3 different orientations shall be used for the measurements of sound pressure level described in A.5.5.3.

A.5.3 Ambient noise

To avoid ambient noise affecting any measurements, tests shall only be performed where the sound pressure level measured by the microphone after coupling to the sound calibrator, but before switching on, is at least 40 dB below the specified level being measured.

A.5.4 Microphone specification

For class LS, class 1 and class 2 sound calibrators, the microphone used for testing shall be one of the microphones specified for the relevant class in 5.8.1.

A.5.5 Sound pressure level

A.5.5.1 The sound pressure level generated by the sound calibrator shall be measured, as an average over a period between 20 s and 25 s of operation, at the principal sound pressure level specified in the instruction manual at each of the frequency settings for which the instruction manual states that the instrument conforms to the requirements of this document.

A.5.5.2 It is recommended that the sound pressure levels be measured using the insert voltage technique (described in 5.3 of IEC 61094-2:2009) or by an equivalent method to measure the open-circuit voltage from the microphone.

A.5.5.3 The sound pressure level shall be measured at least three times. The microphone shall be coupled to the sound calibrator before each measurement and uncoupled after each measurement. The microphone shall be rotated around its axis at each coupling so that the rotational orientation of the microphone is evenly distributed over the measurements. The absolute value of the difference between the mean measured sound pressure level and the corresponding specified sound pressure level shall not exceed the acceptance limits given in Table 2 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.1 for the class of sound calibrator.

A.5.5.4 Measurements of sound pressure level as described in A.5.5.3 shall be repeated for at least one other specimen of the same model of laboratory standard or working standard microphone as applicable, for each frequency setting of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this document.

A.5.5.5 For multi-level sound calibrators, the sound pressure level generated by the sound calibrator shall also be measured as described in A.5.5.3, at each level setting at each of the frequency settings for which the instruction manual states that the instrument conforms to the requirements of this document, using one specimen of the model of microphone.

A.5.5.6 The measurement(s) of the sound pressure level shall be repeated (excluding replications) within 5 % of the minimum operating voltage of the power supply, internal or external, consistent with operation of any battery condition indicator or acoustic signal cut-off facility supplied as an integral part of the sound calibrator, using one specimen of microphone. Measurements shall be made for the following combinations of sound pressure level and frequency, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the principal sound pressure level and principal frequency;
– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;
– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.5.5.7 The measurements shall be performed in terms of the variation of the level of the output voltage from the microphone at the reduced operating voltage for the sound calibrator, relative to the level of the output voltage from the microphone at the nominal supply voltage for the sound calibrator under reference environmental conditions. For each combination, the

absolute value of the difference between the sound pressure level generated at the reduced operating voltage and the sound pressure level generated by the sound calibrator at the nominal supply voltage at reference environmental conditions shall not exceed the acceptance limits given in Table 3. The actual uncertainty of measurement of the difference, calculated for a coverage probability of 95 %, shall not exceed 0,02 dB for class LS sound calibrators, and shall not exceed 0,04 dB for class 1 and class 2 sound calibrators. Also, the absolute value of the difference between the measured sound pressure level and the specified level shall not exceed the acceptance limits given in Table 2.

NOTE The uncertainty specified in A.5.5.7 is included in the maximum-permitted uncertainty given in Table A.1.

A.5.5.8 Where the sound calibrator is designed to be connected to an external power supply, the measurement(s) of sound pressure level shall be repeated (excluding replications) at the principal sound pressure level and principal frequency at the maximum-permitted supply voltage. The measurements shall be performed in terms of the variation of the level of the output voltage from the microphone at the maximum-permitted supply voltage for the sound calibrator, relative to the level of the output voltage from the microphone at the nominal supply voltage for the sound calibrator under reference environmental conditions. The absolute value of the difference between the sound pressure level generated at the maximum-permitted supply voltage and the sound pressure level generated by the sound calibrator at the nominal supply voltage at reference environmental conditions shall not exceed the acceptance limits given in Table 3. The actual uncertainty of measurement of the difference, calculated for a coverage probability of 95 %, shall not exceed 0,02 dB for class LS sound calibrators, and shall not exceed 0,04 dB for class 1 and class 2 sound calibrators. Also, the absolute value of the difference between the measured sound pressure level and the specified level shall not exceed the acceptance limits given in Table 2.

NOTE The uncertainty specified in A.5.5.8 is included in the maximum-permitted uncertainty given in Table A.1.

A.5.5.9 Where the instruction manual states that the sound calibrator conforms to the requirements of this document for the same class when used with microphone models or microphone configurations other than that used in A.5.4, the measurements described in A.5.5 shall be repeated for those microphone models or configurations, unless the testing laboratory is satisfied that it has reliable, justifiable evidence of the equivalence of various models of microphone, or of corrections to be applied. In these cases, the laboratory will decide whether it is necessary to perform measurements using all models and configurations of microphones, or whether to use a representative sample of these equivalent models.

A.5.6 Sound pressure level stability – Short-term level fluctuation

A.5.6.1 Short-term fluctuation of the sound pressure level in the cavity of the sound calibrator shall be determined at the principal sound pressure level and principal frequency, with the microphone used in A.5.4. The mean level, and the maximum and minimum levels, measured using time-weighting F (nominal time constant of 125 ms as specified in IEC 61672-1), shall be determined over a period of 60 s of operation of the sound calibrator, by sampling at least 30 times at random time intervals. The absolute value of the difference between each of the maximum and minimum levels measured, and the mean value shall each not exceed the applicable acceptance limits given in Table 2 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 % shall not exceed those given in Table A.1 for the class of sound calibrator.

NOTE A sound level meter with resolution of at least 0,01 dB would meet the requirements for these measurements.

A.5.6.2 Short-term level fluctuation shall be measured with one microphone only.

A.5.6.3 For multi-level sound calibrators, the measurement of short-term level fluctuation as described in A.5.6.1 and A.5.6.2 shall be repeated at the principal frequency and at the minimum sound pressure level setting, and at the minimum frequency and principal sound pressure level setting, for which the instruction manual states that the instrument conforms to the requirements of this document.

Table A.1 – Maximum-permitted uncertainty of measurement for a coverage probability of 95 %, for sound pressure level and short-term level fluctuation at and around reference environmental conditions

Range of nominal frequencies Hz	Uncertainty of measurement for generated sound pressure level dB			Uncertainty of measurement for short-term level fluctuation dB		
	Class LS	Class 1	Class 2	Class LS	Class 1	Class 2
31,5 to 63	–	0,20	–	–	0,15	–
> 63 to < 160	–	0,20	–	–	0,10	–
160 to 1 250	0,10	0,15	0,35	0,02	0,03	0,05
> 1 250 to 4 000	–	0,25	–	–	0,03	–
> 4 000 to 8 000	–	0,35	–	–	0,03	–
>8 000 to 16 000	–	0,50	–	–	0,03	–
For a class LS or class 2 sound calibrator, the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no acceptance limits.						

A.5.7 Frequency

A.5.7.1 The frequency of the sound generated by the sound calibrator shall be measured, as an average over a period of between 20 s and 25 s of operation, with the microphone specified in A.5.4, at the principal sound pressure level, for each frequency setting of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this document. The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency shall not exceed the acceptance limits given in Table 4 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.2 for the class of sound calibrator.

A.5.7.2 Measurements of frequency shall be repeated within 5 % of the minimum operating voltage of the power supply, internal or external, consistent with operation of any battery condition indicator or acoustic signal cut-off facility supplied as an integral part of the sound calibrator. The measurements shall be for the following combinations of sound pressure level and frequency, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the principal sound pressure level and principal frequency;
– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;
– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.5.7.3 The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency shall not exceed the acceptance limits given in Table 4 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.2 for the class of sound calibrator.

A.5.7.4 Where the sound calibrator is designed to be connected to an external power supply, the measurement of frequency shall be repeated at the principal sound pressure level and principal frequency at the maximum-permitted supply voltage. The absolute value of the

difference in per cent between each measured frequency and the corresponding specified frequency shall not exceed the acceptance limits given in Table 4 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.2 for the class of sound calibrator.

Table A.2 – Maximum-permitted uncertainty of measurement for a coverage probability of 95 % for frequency, at and around reference environmental conditions

Uncertainty of measurement for frequency %		
Class LS	**Class 1**	**Class 2**
0,2	0,2	0,2
Uncertainties of measurement are expressed as a percentage of the specified frequency.		

A.5.8 Total distortion + noise

A.5.8.1 The total distortion + noise of the sound pressure signal generated by the sound calibrator shall be measured over a bandwidth of 22,4 Hz (nominal frequency) to 22,4 kHz (nominal frequency), as an average over a period of between 20 s and 25 s of operation, with the microphone specified in A.5.4 at each frequency setting, at the maximum and minimum sound pressure level setting for which the instruction manual states that the instrument conforms to the requirements of this document. The total distortion + noise can be measured using a rejection filter device (distortion factor meter) or an appropriate FFT analyser, and the method of measurement shall be reported. The measured total distortion + noise shall not exceed the acceptance limit given in Table 7 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.3 for the class of sound calibrator. An instrument that measures total harmonic distortion only is not suitable.

NOTE For one-octave and one-third-octave filters that are base 10, 22,4 Hz is the lower band edge of the 31,5 Hz one-octave filter and the lower band edge of the 25 Hz one-third-octave filter. The frequency 22,4 kHz is the upper band edge of the 16 kHz one-octave filter and the upper band edge of the 20 kHz one-third-octave filter.

A.5.8.2 Total distortion + noise measurements shall be repeated within 5 % of the minimum operating voltage of the power supply, internal or external, consistent with operation of any battery condition indicator or acoustic signal cut-off facility supplied as an integral part of the sound calibrator. The measurements shall be for the following combinations of sound pressure level and frequency, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;
– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;
– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.5.8.3 The measured total distortion + noise shall not exceed the limit given in Table 7 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.3 for the class of sound calibrator.

Table A.3 – Maximum-permitted uncertainty of measurement for a coverage probability of 95 % for total distortion + noise, over the appropriate range of environmental conditions

Range of nominal frequencies Hz	Uncertainty of measurement for total distortion + noise %		
	Class LS	Class 1	Class 2
31,5 to < 160	–	1,0	–
160 to 1 250	0,5	0,5	1,0
> 1 250 to 16 000	–	1,0	–
The above uncertainties are expressed in percentage distortion. For a class LS or class 2 sound calibrator, the "–" symbols in the table indicate nominal frequency ranges for which this document provides no acceptance limits.			

A.6 Environmental tests

A.6.1 General

A.6.1.1 If the instruction manual specifies a battery of particular model and type, such a battery shall be fitted to the sound calibrator for the tests of the influence of variation in environmental conditions.

A.6.1.2 In order to reduce the time for testing the influence of air temperature and humidity on the sound pressure level output of the sound calibrator, A.6.4 describes a set of abbreviated tests shorter than the full tests given in A.6.5, A.6.6 and A.6.7. These abbreviated tests measure the influence on the output of the sound calibrator of air temperature and humidity combined. For the abbreviated tests, conformance to the requirements of this document shall be demonstrated within acceptance limits smaller than those given in Tables 5 and 6. If a sound calibrator conforms to these reduced acceptance limits (described in A.6.4.7) at all the test conditions then it shall be deemed to conform to the requirements of this document, and the tests described in A.6.5, A.6.6 and A.6.7 shall not be performed. If the sound calibrator fails to conform within the reduced acceptance limits for any of the tests described in A.6.4, then the full tests of A.6.5, A.6.6 and A.6.7 shall be performed to determine whether the sound calibrator conforms to the requirements of this document within the acceptance limits given in Tables 5 and 6.

A.6.1.3 For class LS/M and class 1/M sound calibrators, where appropriate, data supplied in the instruction manual shall be applied for the influence of static pressure, to correct measured sound pressure levels to reference environmental conditions. If a barometer is supplied with the sound calibrator, it shall be used to measure the static pressure.

NOTE Some barometers provide the data directly in the form to be used to correct measured sound pressure levels to the reference static pressure.

A.6.2 Influence of static pressure

A.6.2.1 The sound pressure level generated by the sound calibrator shall be measured over the applicable range of static pressure at the principal sound pressure level and at the principal frequency and all higher frequencies for which the instruction manual states that the instrument conforms to the requirements of this document. Sound pressure levels shall be measured using one specified model and configuration of microphone for which the pressure and air temperature coefficients over the required range are known. During the measurements, the air temperature shall be kept constant as far as possible, preferably within ±2 °C of the reference air temperature. The relative humidity at the reference static pressure shall be within ±20 % relative humidity of the reference relative humidity.

NOTE In a given volume of humid air, when the static pressure of the air in the volume is reduced by removing, or increased by adding, a quantity of humid air, the amount of water vapour in the volume will be reduced or increased in proportion. The relative humidity will therefore decrease or increase from the initial relative humidity. For practical reasons, this test for the influence of static pressure does not compensate for variations in relative humidity caused by removal, or addition, of quantities of air from the initial volume.

A.6.2.2 Sound pressure levels shall be measured at a minimum of 5 static pressures, in terms of the variation of the level of the output voltage from the microphone as the static pressure is changed, relative to the level of the output voltage from the microphone under reference environmental conditions. These static pressures shall include the reference static pressure and the minimum and maximum static pressure applicable for the class of sound calibrator. The sound calibrator shall be left to acclimatize for at least 10 min at each static pressure prior to performing a measurement. The static pressure shall be measured using a device for which the calibration is traceable to national standards, which shall enable the static pressure to be measured with an actual uncertainty not exceeding 0,2 kPa for a coverage probability of 95 %.

A.6.2.3 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference static pressure, using the method described in A.6.1.3 where appropriate, for the class of sound calibrator. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in microphone sensitivity level with changing pressure, air temperature and relative humidity.

A.6.2.4 The range of static pressure over which the absolute value of the difference between the measured sound pressure level (corrected where applicable for static pressure for sound calibrators designated class LS/M or class 1/M) and the sound pressure level determined under reference environmental conditions does not exceed the acceptance limits given in Table 2 or Table 5, as appropriate for the static pressure and for the class of sound calibrator, shall be at least as wide as that stated in the instruction manual. This range of static pressure shall include that specified in 5.5 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.4 for the class of sound calibrator.

A.6.2.5 The total distortion + noise of the sound pressure signal generated by the sound calibrator shall be measured, according to A.5.8.1, at the lowest static pressure, for the principal frequency and the maximum sound pressure level setting for which the instruction manual states that the instrument conforms to the requirements of this document.

Table A.4 – Maximum-permitted uncertainty of measurement for a coverage probability of 95 %, for sound pressure level, over the specified range of environmental conditions

Range of nominal frequencies Hz	Uncertainty of measurement for sound pressure level dB		
	Class LS	Class 1	Class 2
31,5 to < 160	–	0,25	–
160 to 1 250	0,10	0,15	0,20
> 1 250 to 4 000	–	0,30	–
> 4 000 to 8 000	–	0,35	–
> 8 000 to 16 000	–	0,40	–

These uncertainties of measurement are for the difference between the measured sound pressure level over the specified range of environmental conditions and the measured sound pressure level under reference environmental conditions.

These uncertainties include the uncertainty in manufacturer-supplied corrections, where applicable.

These uncertainties do not include the uncertainty of measurement at reference environmental conditions, given in Table A.1.

For a class LS or class 2 sound calibrator, the "–" symbols in the table indicate ranges of nominal frequency for which this document provides no acceptance limits.

A.6.3 Acclimatization requirements for tests of the influence of variations in air temperature and relative humidity

A.6.3.1 The sound calibrator and measurement microphone shall be placed in an environmental chamber to test the influence of variations in air temperature and relative humidity on the sound pressure level, frequency and total distortion + noise generated by the sound calibrator.

A.6.3.2 For tests of the influence of variations in air temperature and relative humidity, the measurement microphone shall not be coupled to the sound calibrator, and the power to the sound calibrator shall be switched off during all acclimatization periods.

A.6.3.3 Prior to any measurements, the sound calibrator shall be left, switched off, to stabilize at approximately reference conditions for 12 h.

A.6.3.4 Following this stabilization, for tests of the effects of air temperature and humidity combined and for tests of the effect of relative humidity alone, at each measurement condition the sound calibrator and microphone shall be left to acclimatize for at least an additional 7 h prior to measurements. For tests of the effect of air temperature alone, this additional acclimatization period shall be at least 3 h.

A.6.3.5 Where the testing laboratory has the facility to couple the microphone to the sound calibrator without affecting the relative humidity, measurements can be performed following the time required for pressure equalization due to coupling of the microphone and calibrator. If this capability is not available, a further acclimatization period of 3 h shall be allowed before commencing measurements.

A.6.4 Abbreviated test of influence of air temperature and humidity combined

A.6.4.1 The sound pressure level and frequency of sound generated by the sound calibrator at the principal sound pressure level and the principal frequency shall be measured for the following combinations of air temperature and relative humidity, applicable to the class of sound calibrator:

Class LS Reference air temperature and relative humidity:

– an air temperature of 16 °C and relative humidity of 25 %;

– an air temperature of 30 °C and a relative humidity of 90 %.

Class 1 Reference air temperature and relative humidity:

– an air temperature of −10 °C and in the absence of icing;

– an air temperature of 5 °C and in the absence of icing;

– an air temperature of 40 °C and relative humidity of 90 %;

– an air temperature of 50 °C and a relative humidity of 50 %.

Class 2 Reference air temperature and relative humidity:

– an air temperature of 0 °C and in the absence of icing;

– an air temperature of 40 °C and a relative humidity of 90 %.

During the measurements, the static pressure shall be kept constant as far as possible, preferably within +2,0 kPa to −4,0 kPa of the reference static pressure.

The acceptance limits on the specified test conditions are ±2,5 °C and ±10 % relative humidity.

Sound pressure levels and frequencies shall be measured using one specified model and configuration of microphone for which the pressure, air temperature and relative humidity coefficients over the required range are known. The air temperature and relative humidity shall be measured using devices for which the calibrations are traceable to national standards. These devices shall enable the relevant environmental condition to be measured in such a way that the ability of a sound calibrator to conform to the requirements for the relevant class is not affected. The actual uncertainties of measurement shall not exceed 0,5 °C and 5 % relative humidity respectively, for a coverage probability of 95 %.

Following an initial measurement of sound pressure level and frequency at the reference air temperature and relative humidity, measurements shall be performed in decreasing order of the specified air temperatures, starting with the highest specified air temperature. A final measurement shall then be made at the reference air temperature and relative humidity.

NOTE The indicated combinations of air temperature and relative humidity were chosen in consideration of the dewpoints that were obtainable within available environmental test facilities. The combinations also reflect the range of environmental conditions for general applications of class LS, class 1 and class 2 sound calibrators.

A.6.4.2 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the output voltage and frequency of the signal from the microphone as the air temperature and relative humidity are changed, relative to the output voltage and frequency of the signal from the microphone for the first measurement at the reference air temperature and relative humidity.

A.6.4.3 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference static pressure, using the method described in A.6.1.3 where appropriate, for the class of sound calibrator. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in microphone sensitivity level with changing air temperature, relative humidity and static pressure.

A.6.4.4 For multi-level or multi-frequency sound calibrators, or both, additional measurements of sound pressure level and frequency shall be performed at the reference air temperature and relative humidity for the following combinations of sound pressure level and frequency, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;

– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level:

– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;

– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.6.4.5 For multi-level or multi-frequency sound calibrators, or both, further measurements shall be performed at the maximum and minimum air temperature and associated relative humidity given in A.6.4.1 for the appropriate class. The following combinations of sound pressure level and frequency shall be used, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the principal sound pressure level and principal frequency;

– the maximum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;

– the minimum sound pressure level and the minimum and maximum frequencies available at that sound pressure level;

– the minimum frequency and the minimum and maximum sound pressure levels available at that frequency;

– the maximum frequency and the minimum and maximum sound pressure levels available at that frequency.

A.6.4.6 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the output voltage and frequency of the signal from the microphone as the air temperature and relative humidity are changed, relative to the output voltage and frequency of the signal from the microphone for the measurement at the reference air temperature and relative humidity.

A.6.4.7 The absolute value of the difference between the measured sound pressure levels (corrected where applicable for static pressure for sound calibrators designated class LS/M or class 1/M) and the first measurement of the corresponding sound pressure level at the appropriate sound pressure level and frequency at the reference air temperature and relative humidity shall not exceed the reduced acceptance limits derived from those given in Table 5 as follows: for class LS and class 1 sound calibrators, the applicable acceptance limits are those given in Table 5 reduced by 0,05 dB, and for class 2 sound calibrators the applicable acceptance limits are those given in Table 5 reduced by 0,10 dB. The absolute value of the difference in per cent between the measured frequencies and the first measurement of the corresponding frequency at the reference air temperature and relative humidity shall not exceed the reduced acceptance limits derived from those in Table 6 as follows: for class LS, class 1 and class 2 sound calibrators, the applicable acceptance limits are 0,5 %, 0,5 % and 1,3 % respectively. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.4 and Table A.5 for the class of sound calibrator.

Table A.5 – Maximum-permitted uncertainty of measurement for a coverage probability of 95 % for frequency, over the specified range of environmental conditions

Uncertainty of measurement for frequency %		
Class LS	**Class 1**	**Class 2**
0,2	0,2	0,2
Uncertainties of measurement are expressed as a percentage of the specified frequency.		

A.6.5 Influence of air temperature

A.6.5.1 If required by the results of the tests described in A.6.4, the sound pressure level and frequency of the sound generated by the sound calibrator shall be measured over the applicable range of air temperature at the principal sound pressure level and principal frequency. Where the sound calibrator is a multi-level or multi-frequency sound calibrator, or both, measurements shall be repeated for the following combinations of sound pressure levels and frequencies, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the maximum sound pressure level and the minimum, principal and maximum frequencies available at that sound pressure level;

– the minimum sound pressure level and the minimum, principal and maximum frequencies available at that sound pressure level;

– the minimum frequency and the minimum, principal and maximum sound pressure levels available at that frequency;

– the maximum frequency and the minimum, principal and maximum sound pressure levels available at that frequency.

Measurements of sound pressure level and frequency shall be performed using one specified model and configuration of microphone for which the air temperature, pressure and relative humidity coefficients over the required range are known. During the measurements, the static pressure shall be kept constant as far as possible, preferably within +2,0 kPa to −4,0 kPa of the reference static pressure, and the relative humidity shall be kept constant as far as possible at a stated humidity within ±20 % relative humidity of the reference relative humidity.

It is important to monitor the relative humidity each time the air temperature is changed to ensure that it remains within the acceptance limits specified in A.6.5.1. Rapid changes of air temperature in the chamber should be avoided and care should be taken to avoid condensation as the temperature of the air in the environmental chamber is changed.

If the testing laboratory considers that the 3 h acclimatization time is inadequate, this time may be increased.

A.6.5.2 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the output voltage and frequency of the signal from the microphone as the air temperature is changed, relative to the output voltage and frequency of the signal from the microphone under reference environmental conditions. Measurements shall be performed at a minimum of five air temperatures. These shall include the reference air temperature and the minimum and maximum air temperature applicable for the class of sound calibrator, and two other air temperatures outside the range from 20 °C to 26 °C. The air temperature shall be measured using a device for which the calibration is traceable to national standards. This device shall enable the air temperature to be measured such that the ability of a sound calibrator to conform to the requirements for the relevant class is not affected. Actual uncertainty of measurement, for a coverage probability of 95 %, for this device shall not exceed 0,5 °C.

A.6.5.3 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference static pressure, using the method described in A.6.1.3 where appropriate. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in the microphone sensitivity level with changing air temperature, pressure and relative humidity.

A.6.5.4 The range of air temperature over which

– the absolute value of the difference between the measured sound pressure level (corrected where applicable for static pressure for sound calibrators designated class LS/M or class 1/M) and the corresponding sound pressure level determined under reference environmental conditions does not exceed the acceptance limits given in Table 5, and

– the absolute value of the difference in per cent between the measured frequency and the frequency determined under reference environmental conditions does not exceed the acceptance limits given in Table 6

shall be at least as wide as that specified in the instruction manual, which shall include the range given in 5.5 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Tables A.4 and A.5 respectively for the class of sound calibrator.

A.6.6 Influence of relative humidity

A.6.6.1 If required by the results of the tests described in A.6.4, the sound pressure level generated by the sound calibrator at the principal sound pressure level and the principal frequency shall be measured over the applicable range of relative humidity. Where the sound calibrator is a multi-level or multi-frequency sound calibrator, or both, measurements shall be repeated at the following combinations of sound pressure levels and frequencies, for which the instruction manual states that the instrument conforms to the requirements of this document:

– the maximum sound pressure level and the minimum, principal and maximum frequencies available at that sound pressure level;

– the minimum frequency and the maximum sound pressure level available at that frequency;

– the maximum frequency and the maximum sound pressure level available at that frequency.

Measurements of sound pressure level and frequency shall be performed using one specified model and configuration of microphone for which the pressure, air temperature and humidity coefficients over the required range are known. During the measurements, the static pressure and air temperature shall be kept constant as far as possible, preferably within +2,0 kPa to −4,0 kPa of the reference static pressure, and within ±2 °C of the reference air temperature.

A.6.6.2 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the level of the output voltage and frequency of the signal from the microphone as the relative humidity is changed, relative to the level of the output voltage and frequency of the signal from the microphone under reference environmental conditions, at a minimum of five relative humidities. These shall include the reference relative humidity and the minimum and maximum relative humidity applicable for the class of sound calibrator as specified in 5.5, and two other relative humidities outside the range from 40 % to 65 %. The relative humidity shall be measured using a device for which the calibration is traceable to national standards. This device shall enable the relative humidity to be measured such that the ability of a sound calibrator to conform to the requirements for the relevant class is not affected. Actual uncertainty of measurement, for a coverage probability of 95 %, for this device shall not exceed 5 % relative humidity.

A.6.6.3 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference static pressure, using the method described in A.6.1.3 where appropriate. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in microphone sensitivity level with changing relative humidity, pressure and air temperature.

A.6.6.4 The range of relative humidity over which

– the absolute value of the difference between the measured sound pressure level (corrected where applicable for static pressure for sound calibrators designated class LS/M or class 1/M) and the corresponding sound pressure level determined under reference environmental conditions does not exceed the acceptance limits given in Table 5, and
– the absolute value of the difference in per cent between the measured frequency and the frequency determined under reference environmental conditions does not exceed the acceptance limits given in Table 6

shall be at least as wide as that specified in the instruction manual, which shall include the range given in 5.5 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Tables A.4 and A.5 respectively for the class of sound calibrator.

A.6.7 Influence of air temperature and humidity combined

A.6.7.1 If required by the results of the tests described in A.6.4, the sound pressure level and frequency of the sound generated by the sound calibrator at the principal sound pressure level and the principal frequency shall be measured at the following combinations of air temperature and relative humidity, applicable to the class of sound calibrator.

For class LS sound calibrators:

– the reference air temperature and relative humidity;
– an air temperature of 16 °C and relative humidity of 25 %;
– an air temperature of 30 °C and a relative humidity of 90 %.

For class 1 sound calibrators:

– the reference air temperature and relative humidity;
– an air temperature of −10 °C and in the absence of icing;
– an air temperature of 40 °C and a relative humidity of 90 %.

For class 2 sound calibrators:

– the reference air temperature and relative humidity;
– an air temperature of 0 °C and in the absence of icing;
– an air temperature of 40 °C and a relative humidity of 90 %.

The acceptance limits on the nominal air temperatures are ±2,5 °C and on nominal relative humidity are ±10 % relative humidity.

A.6.7.2 Measurements of sound pressure level and frequency shall be performed using one specified model and configuration of microphone for which the pressure, air temperature and humidity coefficients over the required range are known. During the measurements, the static pressure shall be kept constant as far as possible, preferably within +2,0 kPa to −4,0 kPa of the reference static pressure. The uncertainties of the devices used to measure air temperature and relative humidity shall not exceed 0,5 °C and 5 % relative humidity respectively for a coverage probability of 95 %.

A.6.7.3 Changes in sound pressure level and frequency of the sound generated by the sound calibrator shall be measured in terms of the variation of the output voltage and frequency of the signal from the microphone as the air temperature and relative humidity are changed, relative to the output voltage and frequency of the signal from the microphone under reference environmental conditions. The air temperature and relative humidity shall be measured using devices for which the calibrations are traceable to national standards. These devices shall enable the relevant environmental conditions to be measured adequately so that the ability of a sound calibrator to conform to the specifications for the relevant class is not affected.

A.6.7.4 For sound calibrators designated class LS/M or class 1/M, the measured sound pressure levels shall be corrected to the reference static pressure, using the method described in A.6.1.3 where appropriate. Where applicable, a correction shall be applied to the microphone sensitivity level to take account of the variation in microphone sensitivity level with changing air temperature, relative humidity and pressure.

A.6.7.5 The absolute value of the difference between each measured sound pressure level (corrected where applicable for static pressure for sound calibrators designated class LS/M or class 1/M) and the corresponding sound pressure level determined under reference environmental conditions shall not exceed the acceptance limits given in Table 5 for the class of sound calibrator. The absolute value of the difference in per cent between each measured frequency and the corresponding frequency determined under reference environmental conditions shall not exceed the acceptance limits given in Table 6 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.4 and Table A.5 for the class of sound calibrator.

A.7 Electromagnetic compatibility

A.7.1 General

A.7.1.1 The tests described in Clause A.7 shall be performed unless the particular configuration of the sound calibrator renders them inappropriate, in which case equivalent tests shall be substituted.

A.7.1.2 During testing, the sound calibrator shall be set to the mode of operation specified in the instruction manual as appropriate for the test being performed. It shall be operating and powered by the preferred power supply specified in the instruction manual.

A.7.1.3 Full details of the equipment necessary to perform the tests and the detailed test methods are mostly contained in other International Standards, with additional requirements given in Clause A.7. These other International Standards, listed in Clause 2, shall be referred to for all relevant tests.

A.7.1.4 Uncertainties of measurement of the electromagnetic and electrostatic characteristics shall be as specified in the appropriate International Standards. The actual uncertainties of measurement, calculated for a coverage probability of 95 %, of the testing laboratory for the sound calibrator shall not exceed those given in Clause A.7.

A.7.2 Radio-frequency emissions

A.7.2.1 The sound calibrator shall be configured and set as specified in the instruction manual to produce the greatest radio-frequency emissions in the frequency range being investigated.

A.7.2.2 Radio-frequency field-strength emission levels, in decibels relative to 1 μV/m, shall be measured by the method of CISPR 16-2-3:2016. The quasi-peak detector instrument shall be as specified in CISPR 16-1-1 for the frequency ranges specified in this document.

A.7.2.3 Measuring receivers, antennas and test procedures shall be as described in Clauses 6 and 10 of CISPR 22:2008. All measured emissions shall conform to the requirements for enclosure ports in Table 1 of IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010.

A.7.2.4 The sound calibrator shall initially be tested in the reference orientation stated in the instruction manual. A microphone of a model specified in the instruction manual for use with the sound calibrator shall be inserted into the cavity of the sound calibrator.

A.7.2.5 Maintaining the configuration of A.7.2.1 and A.7.2.4, the sound calibrator shall be tested for radio-frequency emissions in at least one other plane approximately orthogonal to the reference orientation, within the limits of suitable positioning for the radio-frequency measuring system employed.

A.7.2.6 Any fixtures and fittings used to maintain the position of the sound calibrator (including the microphone and cable, if appropriate) shall be such as to have no significant influence on the measurement of any radio-frequency emissions from the sound calibrator.

A.7.2.7 If the sound calibrator is fitted with any connection device that allows interface or interconnection cables to be attached to it, then all tests of radio-frequency emissions shall be performed with cables connected to all available connection devices. All cables shall be left unterminated and shall be arranged as described in 8.2 of CISPR 22:2008, unless the manufacturer of the sound calibrator also supplies the device connected to the sound calibrator by this cable, in which case all items shall be tested when connected together.

A.7.2.8 The radio-frequency test results shall comply with the requirements of 5.9.2.1.

A.7.3 Electrostatic discharges

A.7.3.1 The equipment required and methods of testing for electrostatic discharges shall be as described in IEC 61000-4-2.

A.7.3.2 If the sound calibrator 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 tests. Discharges shall not be made to pins on connectors that are recessed behind the exterior surface of either the connector or the sound calibrator.

A.7.3.3 Any supports or other items used to maintain the position of the sound calibrator during testing shall not obscure any part of the sound calibrator required for access for electrostatic discharge testing, nor shall they influence the testing of the sound calibrator. A microphone of a model specified for use with the sound calibrator shall be inserted into the cavity of the sound calibrator. The sound calibrator shall be set in accordance with the instruction manual for normal usage at the principal frequency and principal sound pressure level.

A.7.3.4 Contact and air discharges at the maximum voltage of both polarities shall each be applied 10 times to all appropriate parts of the sound calibrator. Care should be taken to ensure that the sound calibrator is fully discharged from any effects of each test before repeating the application of a discharge.

A.7.3.5 After a discharge, the sound calibrator shall return to the same operating state as before the discharge. During the test, unquantified changes in performance are permitted.

A.7.3.6 If the instruction manual specifies a performance degradation or loss of function after the discharge tests, this degradation or loss of function shall not result in any permanent reduced operation or change of configuration.

A.7.4 Immunity to power- and radio-frequency fields

A.7.4.1 The equipment required and methods of testing for radio-frequency fields shall either be as described in IEC 61000-4-3, or shall use an alternative test method using transverse electromagnetic (TEM) waveguides. The requirements for the TEM waveguide are specified in IEC 61000-4-20, and Annex B of IEC 61000-4-20:2010 defines methods of implementing the testing. The performance requirements for the instrument under test are unchanged including the range of frequencies to be tested and the step size.

A.7.4.2 Testing shall first be performed for the reference orientation stated in the instruction manual with a microphone or "remote-microphone" adaptor inserted into the cavity of the sound calibrator. The sound calibrator shall be set to operate at the principal sound pressure level and principal frequency. The sound pressure level generated in the absence of the electromagnetic field shall be recorded.

In order to avoid possible effects of electromagnetic fields on the microphone, a "remote-microphone" adaptor including a non-metallic tube can be used between the sound calibrator cavity and a microphone located in an area where the electric field strength is less than that to which the sound calibrator is subjected.

A.7.4.3 Tests for immunity to radio-frequency fields shall be performed either as a continuous frequency sweep or at discrete frequencies in accordance with IEC 61000-4-3:2006, Clause 8, except that increments of up to 4 % for frequencies less than 500 MHz and up to 2 % for all other frequencies can be substituted for the 1 % specified in IEC 61000-4-3:2006. Dwell time at each frequency shall be appropriate to the sound calibrator under test. Testing at a limited number of discrete frequencies does not remove the need for the sound calibrator to conform to the requirements of this document at all frequencies within the specified range.

NOTE Other standards and requirements require 1 % frequency increments as specified in IEC 61000-4-3.

A.7.4.4 If the sound calibrator is fitted with any 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 7.3 of IEC 61000-4-3:2006, unless the manufacturer of the sound calibrator also supplies the device connected to the sound calibrator by this cable, in which case all items shall be tested when connected together.

A.7.4.5 Power-frequency fields shall be as specified in 5.9.4.1. Tests of susceptibility to power-frequency fields shall be performed with the sound calibrator applied to a microphone in a manner that has no influence on the power-frequency field. The microphone shall be of a model stated in the instruction manual for use with the sound calibrator.

A.7.4.6 Maintaining the configuration of A.7.4.2 and A.7.4.4, the sound calibrator shall be tested in at least one other plane, approximately orthogonal to the plane containing the principal axis of the reference orientation, within the limits of suitable positioning for the radio-frequency transmitting system employed.

A.7.4.7 During testing, the sound calibrator shall remain fully operational and in the same configuration as it was before testing commenced.

A.7.4.8 The absolute value of the difference between the measured sound pressure level and the sound pressure level measured in the absence of the power-frequency or radio-frequency field shall not exceed the requirements of 5.9.4.2. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed 0,05 dB for all classes of sound calibrator. This uncertainty does not include any contribution from measurement of the electromagnetic field.

A.7.4.9 If the instruction manual states that the sound calibrator conforms to the requirements of this document for any other combinations of sound pressure level and frequency, in addition to the principal sound pressure level and principal frequency, the tests for immunity to power- and radio-frequency fields shall be repeated as follows:

– for multi-level single-frequency sound calibrators, all sound pressure levels for which the instruction manual states that the instrument conforms to the requirements of this document shall be tested;

– for multi-frequency single-level sound calibrators, all frequencies for which the instruction manual states that the instrument conforms to the requirements of this document shall be tested;

– for multi-level, multi-frequency sound calibrators, all frequencies for which the instruction manual states that the instrument conforms to the requirements of this document shall be tested at the minimum sound pressure level for which conformance with this document is stated;

– for multi-level, multi-frequency sound calibrators, all sound pressure levels for which the instruction manual states that the instrument conforms to the requirements of this document shall be tested at the principal frequency.

A.7.4.10 In each case, the absolute value of the difference between the measured sound pressure level and the sound pressure level measured in the absence of the power-frequency or radio-frequency field shall not exceed the requirements of 5.9.4.2. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed 0,05 dB for all classes of sound calibrator. This uncertainty does not include any contribution from measurement of the electromagnetic field.

Annex B
(normative)

Periodic tests

B.1 General

B.1.1 Annex B gives details of the periodic tests applicable to class LS, class 1 and class 2 sound calibrators. It aims at ensuring that testing is performed in a consistent manner at all testing laboratories. All applicable tests described in Annex B shall be performed.

B.1.2 For multi-level and multi-frequency calibrators, a limited number of sound pressure level and frequency settings may be tested if this is specified by, and agreed with, the customer, but these agreed combinations shall include the principal sound pressure level at the principal frequency. Where testing is limited in this way the sound calibrator shall be marked to show that only limited tests have been performed. Wording shall be added to the certificate to indicate that full testing according to this document has not been performed, so no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of this document.

B.1.3 Conformance to the requirements of Annex B is demonstrated when the following criteria are both satisfied: (a) a measured deviation from a design goal does not exceed the applicable acceptance limit and (b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in this document for the same coverage probability of 95 %.

Laboratories performing these tests shall calculate the uncertainties associated with all the measurements in accordance with the guidelines given in ISO/IEC Guide 98-3. Actual measurement uncertainties shall be calculated for a coverage probability of 95 %.

Where a testing laboratory is only required to make a single measurement, it is necessary for the laboratory to make an estimate of the random contribution to the total uncertainty, using an earlier evaluation based on several measurements for a similar sound calibrator.

B.1.4 The uncertainties of measurement for a coverage probability of 95 % given for the corresponding tests in Annex A are also the maximum-permitted for demonstration of conformance to the requirements of Annex B. If the actual uncertainty of a measurement performed by the test laboratory, calculated for a coverage probability of 95 %, exceeds the maximum-permitted value, the measurement shall not be used to demonstrate conformance to the requirements of Annex B.

B.1.5 For legal metrology purposes, the relevant periodic tests are those described in Annex B. These tests apply to both initial and subsequent verification. Following successful testing to Annex B, if desired, the sound calibrator may be marked with a verification mark in accordance with national regulations.

B.1.6 Where the manufacturer claims that a pistonphone conforms to the specifications for both class LS/M and class1/M, full tests for each class designation shall be performed, unless testing against the specifications of only class LS/M or only class 1/M has been specified by, and agreed with, the customer. In this case, the sound calibrator shall be marked to show that only limited tests have been performed. Wording shall be added to the certificate to indicate that full testing to both class LS/M and class 1/M according to this document has not been performed, so no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of this document for the class not tested.

B.1.7 The test laboratory shall use instruments with current calibrations for the appropriate quantities. The calibrations shall be traceable to national standards, as required.

B.2 Submission for test

The sound calibrator, together with all relevant accessories (such as adaptors or barometer), shall be submitted for test together with a copy of the instruction manual, if required by the testing laboratory. A class LS sound calibrator shall also be supplied with an individual calibration chart. Where a class LS sound calibrator requires repair, the first re-calibration following the repair gives the new specified level.

B.3 Preliminary inspection

Prior to any measurements, the sound calibrator and all accessories shall be visually inspected, and any controls operated to ensure that they are in working order. It shall be established that the power supply of the instrument is within the operating limits specified in the instruction manual, by using the method specified in the instruction manual.

B.4 Performance tests

B.4.1 Orientation

If a specific orientation for application of the sound calibrator is stated in the instruction manual, this orientation shall be used for testing.

B.4.2 Ambient noise

To avoid ambient noise affecting any measurements, tests shall only be performed where the sound pressure level measured by the microphone after coupling to the sound calibrator, but before switching on, is at least 30 dB below the specified level being measured.

B.4.3 Environmental conditions

B.4.3.1 All tests in Clause B.4 shall be carried out within the following ranges of environmental conditions:

– static pressure: 80 kPa to 105 kPa;
– air temperature: 20 °C to 26 °C;
– relative humidity: 25 % to 90 %;

unless the location of the laboratory is such that static pressure is not within the range specified. In this case, a pressure chamber shall be used enabling static pressure within the range specified to be achieved. The specifications in Table 2 apply for the measurement of sound pressure level.

B.4.3.2 For sound calibrators designated class LS/M or class 1/M, where appropriate, data supplied in the instruction manual shall be applied for the influence of static pressure, to correct measured sound pressure levels to the reference static pressure. If a barometer is supplied with the sound calibrator, it shall be used to measure the static pressure.

NOTE Some barometers provide the data directly in the form to be used to correct measured sound pressure levels to the reference static pressure.

B.4.4 Additional equipment

If a barometer is provided with the sound calibrator, prior to making any measurements of the sound pressure level generated by the sound calibrator, the indication of the barometer shall be checked by comparison with that of a calibrated precision barometer at the prevailing static pressure. The reading of the barometer under test shall be recorded, and if acceptance limits for the measurement of static pressure are provided in the instruction manual for the sound calibrator, the indicated static pressure shall be within the acceptance limits given in the

instruction manual. If the indicated static pressure is not within any acceptance limits given in the instruction manual, then the periodic testing of the sound calibrator shall not be performed. If acceptance limits are not provided, and the correction is used, this may cause the sound calibrator to fail the periodic testing if the correction is incorrect.

NOTE A single-point pressure check of a barometer gives no information about performance at other static pressures. It is therefore good practice to compare the indication of the supplied barometer with that of a calibrated precision barometer over the applicable pressure range. OIML International Recommendation R 97 gives information on suitable test procedures.

B.4.5 Microphone specification

For class LS, class 1 and class 2 sound calibrators, the microphone used for testing shall be one of the microphones specified for the relevant class in 5.8.1.

B.4.6 Sound pressure level

B.4.6.1 General

Following coupling of the microphone to the sound calibrator, the time specified in the instruction manual shall be allowed for the microphone and sound calibrator to stabilize. The sound pressure level generated by the sound calibrator shall then be measured, as an average over a period of between 20 s and 25 s of operation, at the principal sound pressure level and principal frequency.

B.4.6.2 Methods for measurement of sound pressure level

B.4.6.2.1 Microphone method

B.4.6.2.1.1 The sound pressure level generated by the sound calibrator under test shall be measured using a calibrated microphone or microphone system. The insert voltage technique (described in IEC 61094-2) or an equivalent method may be used.

B.4.6.2.1.2 It is recommended that the testing laboratory maintain two independent lines of traceability to national standards, by use of the microphone or microphone system and a calibrated device, such as a sound calibrator. The performance of the calibrated microphone or microphone system should be verified using the calibrated device before and after making any measurements of conformance according to Annex B. In selecting the calibrated device, consideration shall be given to the uncertainty requirements of this document.

B.4.6.2.2 Sound calibrator comparison method

B.4.6.2.2.1 The sound pressure level generated by the sound calibrator under test shall be measured by comparison with the sound pressure level generated by a calibrated sound calibrator.

B.4.6.2.2.2 When the calibrated sound calibrator does not operate at the same sound pressure level and frequency as the sound calibrator under test, it will be necessary for the testing laboratory to establish the level linearity and frequency response of the measurement system at all frequencies of interest.

B.4.6.2.2.3 It is recommended that the testing laboratory maintain two independent lines of traceability to national standards, by use of the calibrated sound calibrator and a calibrated device, such as another sound calibrator, or a microphone or microphone system. The performance of the calibrated sound calibrator should be verified using the calibrated device before and after making any measurements of conformance according to Annex B. In selecting the calibrated device, consideration shall be given to the uncertainty requirements of this document.

B.4.6.3 Measurements

B.4.6.3.1 Using the method described in B.4.6.2.1 or B.4.6.2.2, the principal sound pressure level at the principal frequency shall be measured at least three times. The microphone shall be coupled to the sound calibrator before each measurement and uncoupled after each measurement. The microphone shall be rotated around its axis at each coupling so that the rotational orientation of the microphone is evenly distributed over the measurements. The absolute value of the difference between the mean measured sound pressure level and the specified sound pressure level shall not exceed the acceptance limits given in Table 2 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.1 for the class of sound calibrator.

B.4.6.3.2 For multi-frequency sound calibrators, unless not required by the customer (under B.1.2) measurements of the principal sound pressure level, as described in B.4.6.3.1, shall be repeated for the maximum and minimum frequency settings of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this document.

B.4.6.3.3 The measurement of sound pressure level shall be repeated (excluding replications) for all other combinations of sound pressure level and frequency settings for which the instruction manual states that the instrument conforms to the requirements of this document, or for those combinations required by the customer (as described in B.1.2). The absolute value of the difference between each measured sound pressure level and the corresponding specified sound pressure level shall not exceed the acceptance limits given in Table 2 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.1 for the class of sound calibrator. It is recommended that testing is normally performed for one model of microphone only.

B.4.7 Frequency

The frequency of the sound generated by the sound calibrator coupled to the microphone used in B.4.6 shall be measured as an average over a period of between 20 s and 25 s of operation, at the principal sound pressure level, for each frequency setting of the sound calibrator for which the instruction manual states that the instrument conforms to the requirements of this document, or for the principal frequency and for any other combinations of sound pressure level setting and frequency setting specified by the customer. The absolute value of the difference in per cent between each measured frequency and the corresponding specified frequency shall not exceed the acceptance limits given in Table 4 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.2 for the class of sound calibrator.

B.4.8 Total distortion + noise

The total distortion + noise of the sound pressure signal generated by the sound calibrator shall be measured over a bandwidth of 22,4 Hz (nominal frequency) to 22,4 kHz (nominal frequency), as an average over a period of between 20 s and 25 s of operation with the microphone used in B.4.6, at the maximum and minimum sound pressure level settings available at each frequency for which the instruction manual states that the instrument conforms to the requirements of this document, or for the principal sound pressure level and principal frequency and for any other combinations of sound pressure level setting and frequency setting specified by the customer. The total distortion + noise can be measured using a rejection filter device (distortion factor meter) or an appropriate FFT analyser, and the method of measurement shall be reported. The measured total distortion + noise shall not exceed the acceptance limits given in Table 7 for the class of sound calibrator. Actual uncertainties of measurement, calculated for a coverage probability of 95 %, shall not exceed those given in Table A.3 for the class of sound calibrator. An instrument that measures total harmonic distortion only is not suitable.

B.5 Calibration of the sound calibrator with other models of microphone

Clause B.4 provides details of the full tests necessary to demonstrate conformance of a sound calibrator to the requirements given in Annex B for periodic testing, using a particular microphone model. In addition to these tests, it is possible that a calibration of the sound calibrator with other models of microphone is required by the customer. For these additional tests, the measured sound pressure level, frequency and total distortion + noise should be stated in the test documentation. In this case, the measurements should be performed using the required model(s) of microphone and the test methods described in Clause B.4. Any additional model(s) of microphone for which a calibration of the sound calibrator is required should be model(s) intended for use with the particular model of sound calibrator. The method of measurement used, the measured values obtained and the corresponding actual uncertainties of measurement, calculated for a coverage probability of 95 %, should be given in the test documentation.

B.6 Documentation

Clause B.6 is only a recommendation, with the exception of Clause B.6 a), b), c), f), i), j), k), l), p), and q), which shall be stated where applicable. The extent and content of the documentation provided by the test laboratory will vary depending on national regulations. However, following testing of a sound calibrator, the testing laboratory should issue a document containing, as a minimum, the following information:

a) the name and location of the laboratory performing the tests;

b) the name of the manufacturer or supplier and the model designation of the sound calibrator;

c) the serial number of the sound calibrator, together with details of any adaptors used;

d) the name of the manufacturer or supplier and the model and configuration of the microphone(s) used;

e) a statement as to the availability to the public of evidence, from a testing organization responsible for performing pattern evaluation tests, to demonstrate that the model of sound calibrator submitted for periodic testing had successfully completed the pattern evaluation tests of Annex A;

f) a statement that the sound calibrator has been tested as specified in Annex B;

g) where public evidence of conformance of the model of sound calibrator to the requirements of Annex A for pattern evaluation is available, and the results of the tests according to Annex B are satisfactory, a statement as follows: "As public evidence was available, from a testing organization responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, the sound calibrator tested is considered to conform to all the class X requirements of IEC 60942:2017." A reference should be given to the source of the publicly available evidence that allowed this conclusion to be stated;

h) where public evidence of conformance of the model of sound calibrator to the requirements of Annex A for pattern evaluation is not available and the results of the tests according to Annex B are satisfactory, a statement as follows: "The sound calibrator has been shown to conform to the class X requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed. However, as public evidence was not available, from a testing organization responsible for pattern approval, to demonstrate that the model of sound calibrator conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017.";

i) the date(s) on which the periodic verification tests were performed;

j) a description of the methods used for the measurements, including the method used to measure total distortion + noise;

k) the measured sound pressure level(s), corrected to reference static pressure if the sound calibrator has a letter "M" designation, together with associated uncertainty(ies) calculated for a coverage probability of 95 %, and the information on the source (instruction manual or instrument, for example, a barometer) of the static pressure correction data used, if any;

l) the measured frequency(ies) and total distortion(s) + noise, together with associated uncertainty(ies) of measurement, calculated for a coverage probability of 95 %, as appropriate;

m) the environmental conditions at the time the tests were performed;

n) if any adjustments were made to the sound calibrator or a supplied barometer, all indications observed, or sound pressure levels measured, prior to adjustment;

o) where the sound calibrator does not conform to the requirements of Annex B for the designated class for the conditions under which the tests were performed, a statement indicating which tests did not conform;

p) for multi-level and multi-frequency calibrators where testing of a limited number of sound pressure level and frequency settings has been specified by, and agreed with, the customer, the documentation shall include a statement as follows: "As the customer did not require full periodic testing as specified in Annex B of IEC 60942:2017 for the range of sound pressure level and frequency settings for which the instruction manual states that the instrument conforms to the requirements of IEC 60942:2017, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017". A full description of the sound pressure level and frequency settings tested shall be given;

q) where the manufacturer claims that a pistonphone conforms to the specifications for both class LS/M and class1/M, and testing against the specifications of only class LS/M or only class 1/M has been specified by, and agreed with, the customer, the documentation shall include a statement as follows: "As the customer only required testing of the sound calibrator, as specified in Annex B of IEC 60942:2017, against the specifications for class LS/M or class 1/M (delete as appropriate), and the manufacturer claims that the sound calibrator conforms to the specifications for both class LS/M and class1/M, no general statement or conclusion can be made about conformance of the sound calibrator to the requirements of IEC 60942:2017 for class LS/M or class 1/M (delete as appropriate) as this has not been tested.";

r) where applicable, additional values of sound pressure level, frequency and total distortion + noise, together with the uncertainties of measurement, calculated for a coverage probability of 95 %, measured using other model(s) of microphone according to Clause B.5.

Annex C
(normative)

Pattern evaluation report

C.1 General

C.1.1 Sound calibrators that are submitted to the control of legal metrology services shall conform to the requirements given in this document.

C.1.2 For legal metrology purposes, the acceptance limits stated in this document are considered as the maximum permissible errors for pattern evaluation.

C.1.3 A pattern evaluation report shall give full details of all the tests performed and the results of the various tests to which a pattern of a sound calibrator shall be submitted with a view to its approval. The tests are described in Annex A. All specified tests shall be performed, as applicable.

C.1.4 It is recommended that information on models of sound calibrator which have successfully undergone pattern evaluation be made publicly available by the testing laboratory.

C.2 Marking

Following successful testing to the requirements of Annex A, sound calibrators of the model tested can be marked with a pattern approval sign in accordance with national regulations, in addition to the markings required by 6.1.

C.3 Submission for test

C.3.1 The number of specimens of the same pattern of sound calibrator submitted for pattern evaluation testing shall conform to the requirement of A.2.1. As a minimum, the testing laboratory shall select two of the specimens of sound calibrator for pattern evaluation testing. At least one of these two specimens shall then be tested fully according to the procedures given in Annex A. The testing laboratory shall decide whether the full tests shall also be performed on the second specimen, or whether limited testing is adequate to provide approval of the pattern.

C.3.2 All accessories (for example, a barometer or connecting leads) described in the instruction manual shall be supplied with the sound calibrator.

C.3.3 An individual calibration chart containing all the information required by 6.2 shall be supplied with each class LS sound calibrator.

C.3.4 An instruction manual shall be supplied with the sound calibrator.

C.4 Pattern evaluation report content

C.4.1 A pattern evaluation report shall be generated for reporting the testing of a pattern of sound calibrator to the requirements of Annex A. This pattern evaluation report shall consist of two parts. Part 1 gives a summary of the content of the report and statements on conformity, and verifies that all information required by this document is available. Part 2 gives detailed test results. The two parts of the report may be completed by different organizations. Also, it is possible that all the tests in part 2 cannot be performed by one

laboratory, and that additional laboratories are involved in the testing. In either of these cases, each organization or laboratory shall be responsible for completing the relevant parts of the pattern evaluation report. The full name and address of each organization and laboratory involved shall be supplied. For part 2, the tests that each laboratory performed shall be clearly identified in the pattern evaluation report. The pattern evaluation report may be supplied in electronic form.

C.4.2 Each pattern evaluation report shall display a header on each page giving the following information: reference to IEC 60942:2017, Annex C, the page number of the report, identification of the observer or operator, the date when the test was performed and a unique report identification number. For each table, the serial number of the sound calibrator under test, and information on the adaptor and the microphone used for the tests shall be clearly stated.

C.4.3 Relevant pages of the report, as applicable, shall be completed for each specimen of sound calibrator tested.

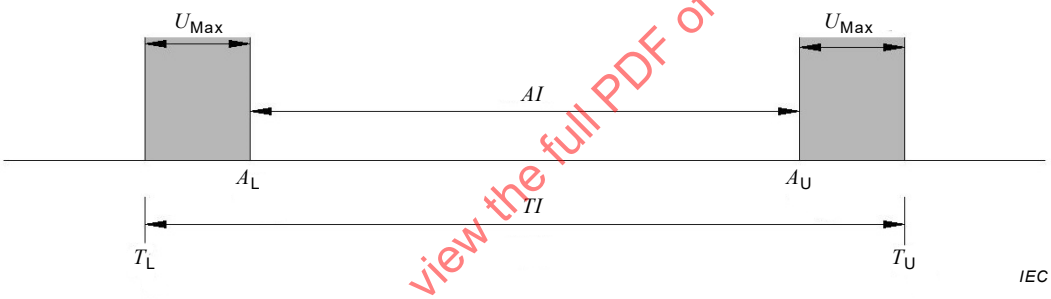
Annex D
(informative)

Relationship between tolerance interval, corresponding acceptance interval and the maximum-permitted uncertainty of measurement

This document, in common with others written by IEC/TC 29, uses adaptations of the guidelines from ISO/IEC Guide 98-4, *Uncertainty of measurement — Part 4: Role of measurement uncertainty in conformity assessment* (equivalent to guidance document JCGM 106 from the Joint Committee for Guides in Metrology), as the basis for demonstration of conformance of an instrument to the specifications given in this document.

ISO/IEC Guide 98-4 describes guarded acceptance in terms of tolerance intervals, acceptance intervals and uncertainties of measurement.

To promote clarity for users and testing laboratories, IEC/TC 29 has adopted a policy whereby tolerance limits around design goals are not explicitly stated, but can be determined if required from the specified acceptance limits for allowed deviations from a design goal and the corresponding specified maximum-permitted uncertainty of measurement, by using the illustration in Figure D.1.



Key

AI	acceptance interval
TI	tolerance interval
U_{max}	guard band for the maximum-permitted uncertainty of measurement for a 95 % coverage interval
A_L	lower acceptance limit
A_U	upper acceptance limit
T_L	lower tolerance limit
T_U	upper tolerance limit

Figure D.1 – Relationship between tolerance interval, corresponding acceptance interval and the maximum-permitted uncertainty of measurement

The limits of an acceptance interval are associated with the acceptance interval and not with the guard band for the maximum-permitted uncertainty of measurement. Hence a measured deviation equal to a limit of an acceptance interval demonstrates conformance to a specification, providing also that the uncertainty of the measurement from the laboratory performing a test does not exceed the specified maximum-permitted uncertainty.

Annex E
(informative)

Example assessments of conformance to specifications of this document

E.1 General

E.1.1 The purpose of Annex E is to clarify the use of measurement results and uncertainties of measurement in assessments of conformance to the specifications of this document in either pattern-evaluation tests or periodic tests of sound calibrators.

E.1.2 Annex E demonstrates assessment of conformance using some general illustrative examples.

E.2 Conformance criteria

E.2.1 According to the requirements in this document, conformance to a specification is established when measured deviations from design goals do not exceed the corresponding acceptance limits AND the uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement for a coverage probability of 95%.

E.2.2 With these two criteria, there are four possible outcomes:

(1) Measured deviations do not exceed acceptance limits AND actual uncertainty does not exceed maximum-permitted uncertainty

CONFORMANCE TO THE SPECIFICATION

(2) Measured deviations do not exceed acceptance limits AND actual uncertainty exceeds maximum-permitted uncertainty

NON-CONFORMANCE BECAUSE THE ACTUAL UNCERTAINTY EXCEEDS THE MAXIMUM-PERMITTED UNCERTAINTY

(3) Measured deviations exceed acceptance limits AND actual uncertainty does not exceed maximum-permitted uncertainty

NON-CONFORMANCE BECAUSE MEASURED DEVIATIONS EXCEED THE ACCEPTANCE LIMITS

(4) Measured deviations exceed acceptance limits AND actual uncertainty exceeds maximum-permitted uncertainty

NON-CONFORMANCE BECAUSE NEITHER CRITERION IS SATISFIED

NOTE In practice, a laboratory can sometimes pre-determine the uncertainty of a measurement. If the pre-determined uncertainty exceeds the maximum-permitted uncertainty, the laboratory will not attempt to perform the test.

E.3 Example test results

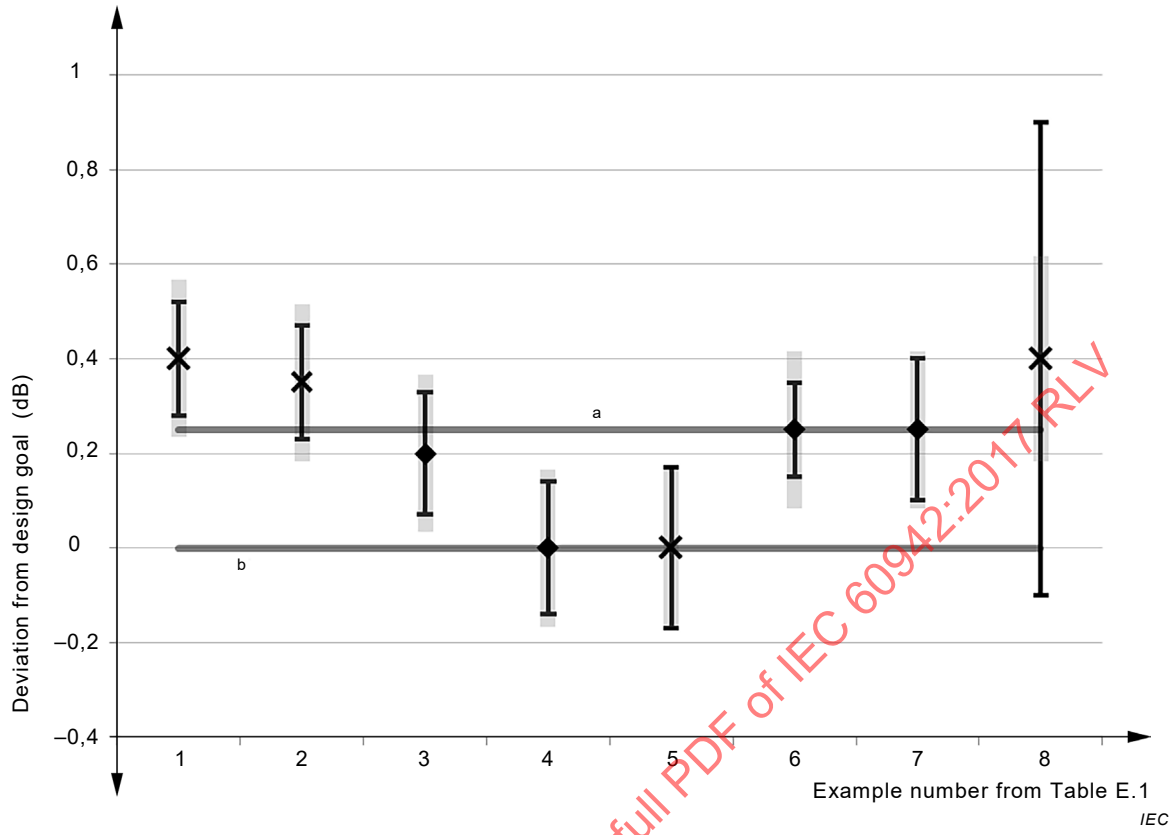
E.3.1 Table E.1 gives examples of test results to explain the method of determining conformance or non-conformance to the specifications of this document. This method applies for any tests in this document where acceptance limits and maximum-permitted uncertainties are specified.

Table E.1 – Examples of assessment of conformance

Example number	Absolute measured deviation from design goal dB	Acceptance limit dB	Actual uncertainty ± dB	Maximum-permitted uncertainty ± dB	Conforms to specifications Yes or No	Reasons for conformance or non-conformance
1	0,40	0,25	0,12	0,15	No	Deviation exceeds acceptance limits
2	0,35	0,25	0,12	0,15	No	Deviation exceeds acceptance limits
3	0,20	0,25	0,13	0,15	Yes	Deviation within acceptance limits AND uncertainty within maximum-permitted
4	0,00	0,25	0,14	0,15	Yes	Deviation within acceptance limits AND uncertainty within maximum-permitted
5	0,00	0,25	0,17	0,15	No	Deviation within acceptance limits BUT uncertainty exceeds maximum-permitted
6	0,25	0,25	0,10	0,15	Yes	Deviation within acceptance limits AND uncertainty within maximum-permitted
7	0,25	0,25	0,15	0,15	Yes	Deviation within acceptance limits AND uncertainty within maximum-permitted
8	0,40	0,25	0,50	0,20	No	Deviation exceeds acceptance limits AND uncertainty exceeds maximum-permitted

E.3.2 Figure E.1 shows the eight example assessments of conformance from Table E.1 in graphical form.

E.3.3 The practice illustrated in Table E.1 and Figure E.1 for assessing conformance applies equally for pattern-evaluation testing as well as periodic testing.



Key

a Upper acceptance limit

b Lower acceptance limit

The lower and upper acceptance limits are indicated by the heavy horizontal lines. The measured deviations from the design goal are shown by the solid markers. A diamond-shaped marker indicates conformance to the specification and a cross-shaped marker indicates non-conformance.

The actual uncertainty of measurement is indicated by the vertical error bars and the maximum-permitted uncertainty is indicated by the vertical shaded area.

Figure E.1 – Examples of assessment of conformance

Bibliography

IEC 60942:2003, *Electroacoustics – Sound calibrators*

IEC 61094-2:2009, *Electroacoustics – Measurement microphones – Part 2: Primary method for pressure calibration of laboratory standard microphones by the reciprocity technique*

ISO/IEC Guide 98-4:2012, *Uncertainty of measurement – Role of measurement uncertainty in conformity assessment*

OIML International Recommendation R 97:1990, *Barometers*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ÉLECTROACOUSTIQUE – CALIBREURS ACOUSTIQUES

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La Norme internationale IEC 60942 a été établie par le comité d'études 29 de l'IEC: Électroacoustique, en coopération avec l'Organisation internationale de métrologie légale (OIML).

Cette quatrième édition annule et remplace la troisième édition parue en 2003, dont elle constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) suppression des désignations de classe, classe LS/C, classe 1/C et classe 2/C;
b) ajout de deux autres désignations de classes, les classes LS/M et 1/M, spécifiquement destinées aux pistonphones;
c) ajout d'un critère modifié pour évaluer la conformité avec une spécification: désormais, la conformité est démontrée lorsque (a) les écarts mesurés par rapport aux valeurs

nominales ne dépassent pas les limites d'acceptation applicables et (b) l'incertitude de mesure ne dépasse pas l'incertitude de mesure maximale admise correspondante;

d) modification de l'essai de fluctuation du niveau à court terme de la stabilité du niveau de pression acoustique;

e) modification de certaines conditions applicables aux essais d'environnement pour éviter la formation de givre;

f) ajout d'une variante d'essai pour l'immunité aux champs aux fréquences radioélectriques, faisant appel aux guides d'ondes électromagnétiques transverses (TEM).

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
29/962/FDIS	29/969/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les directives ISO/IEC, Partie 2.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. A cette date, le document sera

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- amendé.

INTRODUCTION

Les calibreurs acoustiques sont conçus pour produire un ou plusieurs niveaux de pression acoustique connus à une ou plusieurs fréquences spécifiées lorsqu'ils sont couplés à des microphones de modèles spécifiés dans des configurations spécifiées, par exemple avec ou sans grille de protection. Le niveau de pression acoustique généré par certains calibreurs acoustiques dépend de la pression statique.

Les calibreurs acoustiques ont deux applications principales:

a) la détermination de l'efficacité électroacoustique en pression de modèles spécifiés de microphones dans des configurations spécifiées;

b) la vérification ou le réglage de la sensibilité globale d'appareils ou de systèmes de mesure acoustique.

ÉLECTROACOUSTIQUE – CALIBREURS ACOUSTIQUES

1 Domaine d'application

Le présent document spécifie les exigences de performance de trois classes de calibreurs acoustiques: la classe LS (Laboratory Standard, étalon de laboratoire), la classe 1 et la classe 2. Les limites d'acceptation les plus faibles concernent la classe LS et les plus élevées concernent les appareils de classe 2. Les calibreurs acoustiques de classe LS ne sont normalement utilisés qu'en laboratoire; les appareils de classe 1 et de classe 2 sont considérés comme des calibreurs acoustiques utilisés sur le terrain. Un calibreur de classe 1 est prévu pour être utilisé principalement avec un sonomètre de classe 1 et un calibreur de classe 2 est prévu pour être utilisé principalement avec un sonomètre de classe 2, tel qu'il est spécifié dans l'IEC 61672-1.

Les limites d'acceptation concernant les calibreurs de classe LS pour démontrer la conformité avec les exigences du présent document sont basées sur l'utilisation d'un microphone étalon de laboratoire spécifié dans l'IEC 61094-1. Les limites d'acceptation concernant les calibreurs acoustiques de classe 1 et 2 pour démontrer la conformité avec les exigences du présent document sont basées sur l'utilisation d'un microphone étalon de travail spécifié dans l'IEC 61094-4.

Par souci d'homogénéité des essais des calibreurs acoustiques et de facilité d'utilisation, le présent document contient trois annexes normatives: l'Annexe A "Essais d'évaluation de modèle", l'Annexe B "Essais périodiques" et l'Annexe C "Rapport d'évaluation de modèle", et deux annexes informatives: l'Annexe D "Relation entre l'intervalle de tolérance, l'intervalle d'acceptation correspondant et l'incertitude de mesure maximale admise" et l'Annexe E "Exemples d'évaluation de conformité avec les spécifications du présent document".

Le présent document n'inclut pas les exigences concernant les niveaux de pression acoustique équivalents en champ libre ou en incidence aléatoire, tels qu'ils peuvent être utilisés pour le réglage de la sensibilité globale d'un sonomètre.

Un calibreur acoustique peut comporter d'autres fonctions, comme la production de bruits impulsionnels. Le présent document ne comporte pas d'exigences pour ces autres fonctions.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-801:1994, *Vocabulaire Électrotechnique International – Partie 801: Acoustique et électroacoustique*

IEC 61000-4-2:2008, *Compatibilité électromagnétique (CEM) – Partie 4-2: Techniques d'essai et de mesure – Essai d'immunité aux décharges électrostatiques*

IEC 61000-4-3:2006, *Compatibilité électromagnétique (CEM) – Partie 4-3: Techniques d'essai et de mesure – Essai d'immunité aux champs électromagnétiques rayonnés aux fréquences radioélectriques*

IEC 61000-4-20:2010, *Compatibilité électromagnétique (CEM) – Partie 4-20: Techniques d'essai et de mesure – Essais d'émission et d'immunité dans les guides d'ondes TEM*

IEC 61000-6-1:2005, *Compatibilité électromagnétique (CEM) – Partie 6-1: Normes génériques – Immunité pour les environnements résidentiels, commerciaux et de l'industrie légère*[1]

IEC 61000-6-2:2005, *Compatibilité électromagnétique (CEM) – Partie 6-2: Normes génériques – Immunité pour les environnements industriels*[2]

IEC 61000-6-3:2006, *Compatibilité électromagnétique (CEM) – Partie 6-3: Normes génériques – Norme sur l'émission pour les environnements résidentiels, commerciaux et de l'industrie légère*
IEC 61000-6-3:2006/AMD1:2010

IEC 61094-1:2000, *Microphones de mesure – Partie 1: Spécification des microphones étalons de laboratoire*

IEC 61094-4:1995, *Microphones de mesure – Partie 4: Spécifications des microphones étalons de travail*

IEC 61094-5, *Électroacoustique – Microphones de mesure – Partie 5: Méthodes pour l'étalonnage en pression par comparaison des microphones étalons de travail*

IEC 61672-1, *Électroacoustique – Sonomètres – Partie 1: Spécifications*

CISPR 16-1-1, *Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-1: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Appareils de mesure*

CISPR 16-2-3:2016, *Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 2-3: Méthodes de mesure des perturbations et de l'immunité – Mesurages des perturbations rayonnées*

CISPR 22:2008, *Appareils de traitement de l'information – Caractéristiques des perturbations radioélectriques – Limites et méthodes de mesure*[3]

Guide ISO/IEC 98-3:2008, *Incertitude de mesure – Partie 3: Guide pour l'expression de l'incertitude de mesure (GUM:1995)*

ISO 266:1997, *Acoustique – Fréquences normales*

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1 2ème édition (2005). Cette 2ème édition a été remplacée en 2016 par une 3ème édition IEC 61000-6-1:2016, *Compatibilité électromagnétique (CEM) – Partie 6-1: Normes génériques – Norme d'immunité pour les environnements résidentiels, commerciaux et de l'industrie légère*, mais pour assurer la cohérence avec d'autres normes du TC 29, cette 3ème édition n'a pas été utilisée ni référencée dans le présent document. Elle sera prise en considération avant la prochaine édition du présent document.

2 2ème édition (2005). Cette 2ème édition a été remplacée en 2016 par une 3ème édition IEC 61000-6-2:2016, *Compatibilité électromagnétique (CEM) – Partie 6-2: Normes génériques – Norme d'immunité pour les environnements industriels*, mais pour assurer la cohérence avec d'autres normes du TC 29, cette 3ème édition n'a pas été utilisée ni référencée dans le présent document. Elle sera prise en considération avant la prochaine édition du présent document.

3 6ème édition (2008). Cette 6ème édition a été remplacée en 2015 par la CISPR 32:2015, *Compatibilité électromagnétique des équipements multimédia – Exigences d'émission*, mais pour assurer la cohérence avec d'autres normes du TC 29, la CISPR 32:2015 n'a pas été utilisée ni référencée dans le présent document. Elle sera prise en considération avant la prochaine édition du présent document.

Guide ISO/IEC 99, *Vocabulaire international de métrologie – Concepts fondamentaux et généraux et termes associés (VIM)*

3 Termes et définitions

Pour les besoins du présent document, les termes et les définitions de l'IEC 60050-801, le Guide ISO/IEC 99 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

NOTE Les définitions relatives aux autres grandeurs concernées sont données dans les documents référencés à l'Article 2.

3.1
calibreur acoustique
dispositif qui produit une pression acoustique sinusoïdale correspondant à un niveau de pression acoustique et à une fréquence spécifiés lorsqu'il est couplé à un microphone faisant partie de modèles spécifiés dans des configurations spécifiées

3.2
pistonphone
calibreur acoustique dans lequel la pression acoustique est générée dans un volume d'air fixé en mettant en marche un ou plusieurs pistons, créant un flux de vitesse acoustique bien défini

3.3
niveau de pression acoustique spécifié
niveau(x) de pression acoustique produit(s) dans des conditions d'environnement de référence lors d'une utilisation avec un microphone d'un modèle particulier et dans une configuration particulière, valable(s) pour un calibreur acoustique individuel (dans le cas d'un calibreur de classe LS) ou pour tous les calibreurs acoustiques de même modèle (dans le cas d'un calibreur de classe 1 ou de classe 2)

Note 1 à l'article: Le niveau de pression acoustique spécifié est exprimé en décibels (dB).

Note 2 à l'article: La valeur de référence est 20 μPa.

3.4
niveau nominal de pression acoustique
valeur approchée du ou des niveaux de pression acoustique spécifiés, valable pour tous les calibreurs acoustiques de même modèle, arrondie au décibel le plus proche (dans un but de marquage)

Note 1 à l'article: Le niveau de pression acoustique nominal est exprimé en décibels (dB).

Note 2 à l'article: La valeur de référence est 20 μPa.

3.5
fréquence spécifiée
fréquence(s) du son produit par le calibreur acoustique dans les conditions d'environnement de référence, valable(s) pour un calibreur acoustique particulier (dans le cas d'un calibreur de classe LS) ou pour tous les calibreurs acoustiques du même modèle (dans le cas d'un calibreur de classe 1 ou de classe 2)

Note 1 à l'article: La fréquence spécifiée est exprimée en hertz (Hz).

3.6
fréquence nominale
valeur approchée de la fréquence spécifiée souvent arrondie conformément à l'ISO 266 (dans un but de marquage)

Note 1 à l'article: La fréquence nominale est exprimée en hertz (Hz).

3.7
niveau de pression acoustique principal
niveau de pression acoustique nominal spécifié comme principal dans le manuel d'instruction

Note 1 à l'article: Lorsque le calibreur acoustique produit plus d'un niveau de pression acoustique, le fabricant identifie un niveau de pression acoustique nominal comme étant le niveau principal.

Note 2 à l'article: Le niveau de pression acoustique principal est utilisé lors de la vérification de la conformité du calibreur acoustique avec les exigences du présent document.

Note 3 à l'article: Le niveau de pression acoustique principal est exprimé en décibels (dB).

Note 4 à l'article: La valeur de référence est 20 μPa.

3.8
fréquence principale
fréquence nominale spécifiée comme principale dans le manuel d'instruction

Note 1 à l'article: Lorsque le calibreur acoustique produit plus d'une fréquence, le fabricant identifie une fréquence nominale comme étant principale.

Note 2 à l'article: La fréquence principale est utilisée lors de la vérification de la conformité du calibreur acoustique avec les exigences du présent document.

Note 3 à l'article: La fréquence principale est exprimée en hertz (Hz).

3.9
reproduction
répétition d'une mesure comprenant le couplage du microphone au coupleur acoustique suivie de la désolidarisation complète entre le microphone et le calibreur acoustique

3.10
distorsion totale + bruit
rapport de la valeur efficace de l'ensemble des composantes de la distorsion et du bruit, y compris toutes les harmoniques et sous-harmoniques, à la valeur efficace de l'ensemble du signal

Note 1 à l'article: La distorsion est la composante corrélée du signal due à la non-linéarité, et le bruit est la composante non corrélée.

Note 2 à l'article: La distorsion totale + bruit s'exprime en pourcentage (%).

3.11
orientation de référence
orientation d'un calibreur acoustique telle que l'axe principal de l'ouverture de la cavité (axe le long duquel le microphone est inséré dans la cavité) coïncide avec la direction principale d'un émetteur ou d'un récepteur de champ à fréquence radioélectrique, l'ouverture de la cavité étant à l'opposé de l'émetteur ou du récepteur

3.12
plan de référence
plan de contact entre le microphone et le calibreur acoustique

3.13
volume de charge effectif d'un microphone
volume d'air, dans les conditions d'environnement de référence, qui présente la même élasticité acoustique que la cavité limitée par le plan de référence, la membrane du microphone et la surface cylindrique externe du microphone dans le plan de référence, comprenant le volume équivalent du microphone (voir description dans l'IEC 61094-1)

Note 1 à l'article: Le volume de charge effectif est exprimé généralement en millimètre cube (mm^3) et peut varier en fonction de la fréquence.

3.14
probabilité de couverture
probabilité que l'ensemble des valeurs réelles d'une grandeur d'un mesurande se situe dans un intervalle de couverture spécifié

3.15
limite d'acceptation
limite supérieure ou inférieure spécifiée des valeurs d'une grandeur mesurée autorisées

Note 1 à l'article: Les limites d'acceptation dans le présent document sont analogues aux tolérances de conception et de fabrication de l'IEC 60942:2003.

4 Conditions d'environnement de référence

Les conditions d'environnement de référence pour spécifier les caractéristiques d'un calibreur acoustique sont les suivantes:

– température de l'air: 23 °C;
– pression statique: 101,325 kPa;
– humidité relative: 50 %.

5 Exigences

5.1 Généralités

5.1.1 Un calibreur acoustique satisfaisant aux exigences du présent document doit présenter les caractéristiques décrites à l'Article 5. On peut avoir recours à des adaptateurs de façon à permettre le couplage avec plusieurs modèles de microphone. Dans le cadre du présent document, un tel adaptateur fait partie intégrante du calibreur acoustique.

5.1.2 Le calibreur acoustique doit être conforme aux exigences du présent document pour une ou plusieurs des combinaisons de niveau de pression acoustique et de fréquence possibles. Un calibreur acoustique multifréquences et multiniveaux doit être conforme aux exigences relatives à la même classe pour toutes les combinaisons de fréquences et de niveau de pression acoustique pour lesquelles le manuel d'instruction spécifie que l'appareil est conforme aux exigences du présent document. La conformité avec les exigences du présent document ne doit pas être spécifiée pour des réglages du niveau de pression acoustique et de la fréquence pour lesquels le présent document ne fournit aucune limite d'acceptation.

5.1.3 Dans tout ce document, lorsqu'il est fait référence à une classe spécifique de calibreur acoustique, cela comprend toutes les désignations relevant de cette classe, sauf mention contraire.

5.1.4 Les calibreurs acoustiques de classe LS doivent être fournis avec une feuille d'étalonnage individuelle contenant les renseignements prescrits en 6.2. Pour les calibreurs acoustiques de classe 1 et de classe 2, le ou les niveaux de pression acoustique ainsi que la

ou les fréquences spécifiées doivent être donnés dans le manuel d'instruction. Chaque niveau spécifié doit être défini en termes de niveau absolu.

5.1.5 Les pistonphones de classe LS et de classe 1 qui nécessitent des corrections en fonction de la pression statique pour se conformer aux spécifications de la classe appropriée doivent comporter la lettre "M" ajoutée à la désignation de leur classe. Les classes et désignations admissibles sont indiquées dans le Tableau 1. Les calibreurs acoustiques désignés comme étant de classe LS/M ou 1/M ne doivent pas nécessiter de correction pour les autres conditions d'environnement afin de satisfaire aux exigences spécifiées pour la classe concernée. Pour les calibreurs acoustiques des classes LS/M et 1/M, les corrections de pression statique, nécessaires au calibreur acoustique pour être conforme aux exigences du présent document, doivent être mentionnées dans le manuel d'instruction, avec les incertitudes de mesure correspondant à une probabilité de couverture de 95 %.

5.1.6 Les calibreurs acoustiques de classe LS/M peuvent également revendiquer la conformité avec les exigences applicables à un calibreur acoustique désigné comme étant de classe 1/M s'ils satisfont à l'ensemble des exigences indiquées dans le présent document pour les deux classes de calibreur acoustique.

5.1.7 Les calibreurs acoustiques non désignés comme étant de classe LS/M ou 1/M ne doivent nécessiter de correction pour aucune des conditions d'environnement afin de satisfaire aux exigences applicables à la classe concernée.

5.1.8 Les calibreurs acoustiques désignés comme étant de classe LS/M ou 1/M doivent être fournis avec un baromètre, ou le fabricant doit préciser dans le manuel d'instruction les spécifications applicables au baromètre devant éventuellement être utilisé. Le manuel d'instruction doit comporter une spécification donnant l'incertitude de la mesure de la pression statique exigée, pour une probabilité de couverture de 95 %, de façon à ce que la possibilité pour un calibreur acoustique de classe LS/M ou 1/M de se conformer aux exigences de la classe concernée n'en soit pas affectée.

NOTE 1 Un calibreur acoustique de classe LS/M n'est utilisé normalement que dans un laboratoire où il est probable qu'un dispositif convenable soit disponible pour mesurer la pression statique.

NOTE 2 Certains baromètres fournissent des données sous une forme qui peut être directement utilisée pour corriger les niveaux de pression acoustique mesurés de façon à les ramener à la pression acoustique de référence.

Tableau 1 – Classes et désignations de calibreur acoustique

Classe	Désignation	Description
LS	LS	Calibreur acoustique conçu pour satisfaire aux spécifications du présent document pour un dispositif de classe LS sans correction due à l'influence des conditions d'environnement
	LS/M	Pistonphone conçu pour satisfaire aux exigences du présent document pour un dispositif de classe LS moyennant l'application de corrections dues à l'influence de la pression statique uniquement
1	1	Calibreur acoustique conçu pour satisfaire aux exigences du présent document pour un dispositif de classe 1 sans correction due à l'influence des conditions d'environnement
	1/M	Pistonphone conçu pour satisfaire aux exigences du présent document pour un dispositif de classe 1 moyennant l'application de corrections dues à l'influence de la pression statique uniquement
2	2	Calibreur acoustique conçu pour satisfaire aux exigences du présent document pour un dispositif de classe 2 sans correction due à l'influence des conditions d'environnement

5.1.9 Si le calibreur acoustique doit être utilisé dans une orientation particulière pour satisfaire aux exigences du présent document, cette orientation doit être indiquée sur le calibreur, ou l'indication marquée sur le calibreur acoustique doit faire référence au manuel d'instruction, qui doit indiquer l'orientation exigée.

5.1.10 Toutes les exigences de performance concernent le fonctionnement du calibreur acoustique après stabilisation du couplage entre le microphone et le calibreur acoustique et après stabilisation du niveau de pression acoustique et de la fréquence. La durée nécessaire à la stabilisation du niveau de pression acoustique et de la fréquence, qui commence lorsque le calibreur acoustique est mis en marche, le microphone étant couplé à lui, doit être spécifiée dans le manuel d'instruction et ne doit pas excéder 30 s pour n'importe quelle combinaison des conditions d'environnement spécifiées en 5.5. Si cette durée de stabilisation dépasse 10 s, un indicateur doit être prévu pour montrer quand le niveau de sortie du calibreur acoustique s'est stabilisé. Des informations sur le fonctionnement de cet indicateur doivent être données dans le manuel d'instruction. À la suite de la durée de stabilisation, le niveau de pression acoustique et la fréquence doivent rester stables dans les limites d'acceptation des Tableaux 2 et 4, ou des Tableaux 5 et 6 selon le cas, pendant une durée de fonctionnement d'au moins 70 s. Le calibreur acoustique et le microphone doivent pouvoir atteindre l'équilibre aux conditions d'environnement existantes avant le couplage.

NOTE 1 Une durée d'au moins 70 s est choisie car la mesure de la fluctuation du niveau à court terme définie en 5.3.3 nécessite une mesure sur une durée de 60 s de fonctionnement du calibreur acoustique.

NOTE 2 La durée de stabilisation nécessaire à la suite du couplage entre le microphone et le calibreur acoustique peut varier considérablement en fonction des modèles de microphone et de calibreur acoustique utilisés.

NOTE 3 Il est important que le calibreur acoustique soit conçu de manière à ce que la pression statique à l'intérieur du calibreur acoustique soit égale à la pression statique à l'extérieur du calibreur acoustique.

5.1.11 Si les essais décrits en Annexe A exigent que le calibreur acoustique fonctionne plus longtemps que la durée de fonctionnement normale, le fabricant doit donner des informations dans le manuel d'instruction pour décrire la manière d'y parvenir.

5.1.12 Les composants d'un calibreur acoustique qui ne sont pas destinés à être accessibles à l'utilisateur doivent être protégés par des marquages ou par un mécanisme rendant ces composants inaccessibles.

5.1.13 Les Paragraphes 5.3 à 5.9 donnent les limites d'acceptation pour les valeurs admissibles des écarts mesurés par rapport aux valeurs nominales. Pour les laboratoires d'essai, les incertitudes de mesure maximales admises pour une probabilité de couverture de 95 % sont indiquées à l'Annexe A. L'Annexe D décrit la relation entre l'intervalle de tolérance, l'intervalle d'acceptation correspondant et l'incertitude de mesure maximale admise.

5.1.14 Les limites d'acceptation concernant les calibreurs de classe LS s'appliquent également aux calibreurs acoustiques désignés comme étant de classe LS/M. Les limites d'acceptation concernant les calibreurs de classe 1 s'appliquent également aux calibreurs acoustiques désignés comme étant de classe 1/M.

5.1.15 La conformité à une spécification de performance est démontrée lorsque les critères suivants sont satisfaits: (a) les écarts mesurés par rapport aux valeurs nominales ne dépassent pas la limite d'acceptation applicable ET (b) l'incertitude de mesure ne dépasse pas l'incertitude de mesure maximale admise correspondante donnée dans l'Annexe A pour une probabilité de couverture de 95 %.

5.1.16 Si la valeur réelle de l'incertitude d'une mesure réalisée par le laboratoire d'essai, calculée pour une probabilité de couverture de 95 %, dépasse la valeur maximale admise donnée dans l'Annexe A, la mesure ne doit pas être utilisée pour démontrer la conformité avec les exigences du présent document.

5.1.17 L'Annexe E donne des exemples d'évaluation de la conformité avec les spécifications du présent document.

5.1.18 La parfaite conformité avec le présent document n'est démontrée que lorsqu'il a été montré que le modèle de calibreur acoustique était conforme aux exigences du présent document pour l'évaluation de modèle lorsque les essais sont effectués conformément à l'Annexe A, et que l'exemplaire individuel du calibreur acoustique a été montré conforme aux exigences du présent document pour les essais périodiques lorsque les essais sont effectués conformément à l'Annexe B.

5.2 Adaptateurs

Le manuel d'instruction pour le calibreur acoustique peut donner des informations pour permettre la conception des adaptateurs à utiliser avec le calibreur acoustique. Ces données de conception doivent comprendre toutes les informations nécessaires pour créer un adaptateur pouvant être utilisé avec le calibreur acoustique spécifié de manière à conserver la classe de performances spécifiée. Lorsque ces données de conception sont fournies, le manuel d'instruction doit spécifier la distance d'insertion et le diamètre minimal du microphone sur lequel le scellement va être effectué.

5.3 Niveau de pression acoustique

5.3.1 Généralités

5.3.1.1 Tous les niveaux de pression acoustique produits doivent être indiqués dans le manuel d'instruction avec une résolution égale à 0,1 dB ou meilleure.

5.3.1.2 Toutes les exigences et toutes les limites d'acceptation spécifiées dans le présent document concernent le niveau de pression acoustique produit au niveau de la membrane du microphone inséré.

5.3.1.3 Le niveau de pression acoustique principal du calibreur acoustique doit être au moins de 90 dB (par rapport à 20 µPa), lorsque le calibreur est couplé aux modèles de microphone dans les configurations spécifiées dans le manuel d'instruction.

5.3.2 Niveau de pression acoustique produit

La valeur absolue de la différence entre le niveau de pression acoustique mesuré et le niveau de pression acoustique spécifié correspondant ne doit pas excéder les limites d'acceptation données dans le Tableau 2 pour la classe correspondante du calibreur. Pour les calibreurs acoustiques ayant une désignation de classe LS/M ou 1/M, le niveau mesuré doit être corrigé pour la pression statique, si nécessaire, pour être ramené à la pression acoustique de référence donnée à l'Article 4. Ces limites d'acceptation s'appliquent aux mesures effectuées dans les conditions d'environnement de référence et dans des conditions approchant celles-ci, dans les plages suivantes: pression statique comprise entre 97 kPa et 105 kPa, température de l'air comprise entre 20 °C et 26 °C et un taux d'humidité relative compris entre 40 % et 65 %.

5.3.3 Fluctuation de niveau à court terme

La fluctuation du niveau de pression acoustique doit être mesurée en utilisant la pondération temporelle F (constante de temps nominale de 125 ms spécifiée dans l'IEC 61672-1), en déterminant la moyenne et les niveaux maximal et minimal produits sur une durée de 60 s de fonctionnement du calibreur acoustique, en échantillonnant au moins 30 fois. La valeur absolue de la différence entre chacun des niveaux maximaux et minimaux mesurés ainsi que la valeur moyenne ne doivent pas excéder les limites d'acceptation de la fluctuation du niveau à court terme données dans le Tableau 2 pour la classe de calibreur acoustique concernée. Ces limites d'acceptation de la fluctuation de niveau à court terme s'appliquent aux mesures effectuées dans les conditions d'environnement de référence et dans des conditions approchant celles-ci, dans les plages spécifiées en 5.3.2.