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NORME INTERNATIONALE

Electroacoustics – Sound calibrators

Électroacoustique – Calibreurs acoustiques

IEC 60942:2017-11(en-fr)

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CONTENTS

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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.

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