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Acoustics — Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels

Acoustique — Prescriptions relatives aux performances et à l'étalonnage des sources sonores de référence pour la détermination des niveaux de puissance acoustique

[Revision of second edition (ISO 6926:1999)]

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ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6926 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This third edition cancels and replaces the second edition (ISO 6926:1999), which has been technically revised.

Introduction

Reference sound sources are used extensively in "comparison methods" for determining the noise emissions of physically stationary sound sources. A reference sound source, of known sound power output, is used to establish the numerical relationship between the sound power level of a source, in a given location in a given acoustic environment and the space- and time-averaged sound pressure level at a set of microphone positions. Once that relationship is established, it is straightforward to measure the average sound pressure level produced by an "unknown source" and to determine the sound power level produced by that source.

This International Standard defines the important physical and performance characteristics of reference sound sources and specifies procedures for their calibration, primarily to determine the sound power level of other sound sources.

This International Standard supplements a series of International Standards, the ISO 3740 series, that describes various methods for determining the sound power levels of machines and equipment. This series specifies the acoustical requirements for measurements that are appropriate for different test environments.

Five International Standards in the ISO 3740 series include procedures in which a reference sound source is used: ISO 3741, ISO 3743, ISO 3744, ISO 3746 and ISO 3747. ISO 3740 gives guidelines for the use of all the International Standards in the series.

It should be noted that the sound power output of reference sound sources will vary, in particular at low frequencies, with the distance from the source to nearby reflecting planes. Sound power data of reference sound sources are thus valid only for the position used during the calibration.

In addition to being useful for determining sound power levels by the comparison method, reference sound sources may be used for qualification tests on an acoustic environment and to estimate the influence of an acoustic environment on the sound pressure levels produced by one or more sound sources located in that environment. Examples of International Standards referring to reference sound sources with these applications are ISO 11690-3 and ISO 14257. Requirements other than those of this International Standard may be applicable in these cases.

This third edition of ISO 6926 cancels and replaces the second edition (ISO 6926:1999), of which it constitutes a technical revision. The main changes are the following:

The clause on measurement uncertainty has been updated with stricter reference to ISO/IEC Guide 98-3 and moved backwards in the standard to be more in line with ISO 3745.

The corrections for meteorological conditions have been brought in line with ISO 3745:2012 and a new Annex A on the acoustic radiation impedance correction has been introduced.

An alternative method using sound intensity for low frequency calibration in hemi-anechoic rooms not fully qualified for low frequencies has been introduced in a new Annex B.

Acoustics — Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels

1 Scope

This International Standard specifies the acoustical performance requirements for reference sound sources:

— temporal steadiness (stability) of the sound power output,

— spectral characteristics,

— directivity.

Temporal steadiness is defined in terms of the standard deviation of repeatability (see 5.2). The performance requirements on directivity index can only be verified in a hemi-anechoic room (see 5.5.) The spectral characteristics can be verified in either a hemi-anechoic room or a reverberation test room from measurements of the frequency band sound power levels according to this International Standard (see 5.4).

This International Standard also specifies procedures for providing level calibration data and uncertainty on a sound source intended for use as a reference sound source in terms of its sound power level under reference meteorological conditions as defined in Clause 4 in octave and in one-third octave bands, and with frequency weighting A.

This International Standard is titled as a calibration standard even though the method is conducted in a test laboratory and the level calibration results are not directly traceable to national standards of measure in a strict metrological sense. Test laboratories performing this method, and users of the calibration data that results from this method, are not expected to meet all requirements normally associated with a calibration laboratory.

NOTE ISO/IEC 17025[15] specifies different requirements for the competence of testing and calibration laboratories respectively. Laboratories testing reference sound sources would typically comply with the requirements for testing laboratories but not necessarily with those for calibration laboratories.

This International Standard specifies methods to calibrate reference sound sources not only in a free field over a reflecting plane but also in reverberation test rooms at different distances from the boundary surfaces. For the position of the reference sound source on one reflecting plane, the two different test environments mentioned above are considered equivalent for frequency bands above or equal to 200 Hz. Below 200 Hz some systematic differences may occur (see 11.2). For frequencies below 100 Hz an alternative calibration method using sound intensity is given.

The sound source may either be placed directly on the floor or mounted on a stand to be used at a certain elevation above the floor. According to this International Standard stand-mounted sources have to be calibrated in reverberation test rooms. Floor-mounted sources can be calibrated both in hemi-anechoic and reverberation test rooms. For floor-mounted sources in hemi-anechoic rooms, this International Standard is valid only for sources whose maximum vertical dimension is less than 0,5 m and whose maximum horizontal dimension is less than 0,8 m. According to this International Standard only floor-mounted reference sound sources may be used when carrying out measurements on a measurement surface. For reference sound sources to be used or calibrated under reverberant conditions, no such restrictions on maximum dimensions apply.

2 Normative references

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

ISO 3741:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms*

ISO 3745:2012, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for anechoic test rooms and hemi-anechoic test rooms*

ISO 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

ISO 9613-1:1993, *Acoustics — Attenuation of sound during propagation outdoors — Part 1: Calculation of the absorption of sound by the atmosphere*

ISO 9614-3, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 3: Precision method for measurement by scanning*

IEC 61183, *Electroacoustics — Random-incidence and diffuse-field calibration of sound level meters*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1
reference sound source
RSS
portable, generally electroacoustical or aerodynamic sound source or other noise-generating device, and associated control circuitry giving a broad-band stable output complying with the requirements of this International Standard

3.2
free sound field over a reflecting plane
free sound field in a homogeneous, isotropic medium in the half-space above an infinite, reflecting plane in the absence of other reflecting obstacles

3.3
hemi-anechoic room
test room in which a free sound field over a reflecting plane is obtained

3.4
reverberation test room
test room meeting the requirements of ISO 3741

3.5
measurement surface
hypothetical surface of area S, on which the microphone positions are located at which the sound pressure levels are measured, enveloping the source under test and, in the case of a hemi-anechoic room, terminating on the reflecting plane on which the source is located

Note 1 to entry: The measurement surface area is expressed in metres squared.

3.6
surface sound pressure level
$\overline{L_p}$
the energy-average of the time-averaged sound pressure levels at all the microphone positions, or traverses, on the measurement surface, with the background noise corrections, K_1, applied at each microphone position or traverse.

Note 1 to entry: Surface sound pressure level is expressed in decibels.

Note 2 to entry: For definition and calculation of K_1, see ISO 3745.

3.7
sound power level
L_W
ten times the logarithm to the base 10 of the ratio of the sound power of a source, P, to a reference value, P_0, expressed in decibels

$$L_W = 10 \lg \frac{P}{P_0} \text{ dB}$$

where the reference value, P_0, is 1 pW

Note 1 to entry: If a specific frequency weighting as specified in IEC 61672-1 and/or specific frequency bands are applied, this should be indicated by appropriate subscripts: e.g. L_{WA} denotes the A-weighted sound power level.

Note 2 to entry: This definition is technically in accordance with ISO 80000-8:2007[17], 8-23.

[SOURCE: ISO/TR 25417:2007[16], 2.9]

3.8
measurement radius
r
radius of a hemi-spherical measurement surface

3.9
directivity index
D_{Ii}
measure of the extent to which a source radiates sound in a particular direction, relative to the mean sound radiation over the measurement surface, where for fixed microphones, the direction is from the source to the position of the microphone, and for traverses, the direction is from the source to the position along the microphone path at which the highest sound pressure level is recorded

Note 1 to entry: The directivity index of direction i is calculated from measurements in a hemi-anechoic room by the following equation:

$$D_{Ii} = L_{pi} - \overline{L_p}$$

where

L_{pi} <for fixed microphones> is the sound pressure level for each one-third octave band at the i-th microphone position on the measurement surface, in decibels;

L_{pi} <for microphone traverses> is the maximum sound pressure level for each one-third octave band that is recorded during the i-th microphone traverse (see 8.2) on the measurement surface, in decibels;

$\overline{L_p}$ is the surface sound pressure level averaged over the same measurement surface, in decibels.

Note 2 to entry: With the above "operational" definition, the directivity index is a measure of the uniformity of sound radiation from the source over the particular measurement surface being employed and as it is installed in the test

environment. Definitions for the “theoretical” directivity index appearing in textbooks and the literature usually represent the uniformity of sound radiation by comparing the source under test in its test environment to a point source of the same sound power radiating into a full sphere in a totally free field. When such definitions are applied to sources located in a free field above a reflecting plane, they include a constant “+ 3 dB” to account for the hemispherical radiation. Care should be taken when comparing or using different definitions of directivity index.

3.10
frequency range of interest
the frequency range of one-third-octave bands with nominal mid-band frequencies from 100 Hz to 10 000 Hz

Note 1 to entry: The frequency range may be extended up to as much as 20 000 Hz or down to as low as 50 Hz, provided that the requirements of this International Standard are still met.

3.11
comparison method
method in which the sound power level is calculated by comparing the measured sound pressure levels produced by the source under test in an environment with the sound pressure levels produced by a reference sound source of known sound power output in the same environment.

3.12
direct method
method in reverberation test rooms where the sound power level is calculated using the equivalent sound absorption area determined from measurements of the reverberation time.

3.13
reverberation time
T
time that is required for the sound pressure level to decrease by 60 dB after the sound source has stopped

Note 1 to entry: If the reverberation time is evaluated from the decay of the first 10 dB or 15 dB, it is denoted T_{10} or T_{15} respectively.

Note 2 to entry: It is expressed in seconds.

3.14
repeatability conditions
conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time

4 Reference meteorological conditions

Reference meteorological conditions for the purpose of calculating the sound power level, corresponding to a reference characteristic acoustic impedance of air ρc = 411,5 Nsm^{-3} (where ρ is the density of air and c is the speed of sound) are:

air temperature: 23,0 °C;
static pressure: 1,013 25 × 10^5 Pa;
relative humidity: 50 %.

5 Performance requirements

5.1 General

A manufacturer may only state that its RSS is in full compliance with this International Standard if all of the requirements laid out in this clause are met.