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

Acoustique — Exigences relatives aux performances et à l'étalonnage des sources sonores de référence utilisées dans la détermination des niveaux de puissance sonore

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Contents

Page

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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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

This second edition cancels and replaces the first edition (ISO 6926:1990), 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 acoustical 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.

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 and repeatability of the sound power output,

— spectral characteristics,

— directivity index.

The stability of the sound power output and the directivity index, for those sources where directivity is needed, are normally only determined in connection with pattern evaluation of the reference sound source. Because of the directivity measurements (for an exception see 5.5), pattern evaluations can only be performed in a hemi-anechoic environment. For regular verification measurements, only the frequency band sound power levels are normally determined. In this case measurements may be made in either hemi-anechoic or reverberant conditions.

This International Standard also specifies procedures for calibrating a sound source intended for use as a reference sound source in terms of its sound power level under the reference condition that the characteristic impedance of air (ρc) is equal to 400 Ns/m^3 in octave and in one-third-octave bands, and with frequency weighting A. Different procedures are specified for pattern evaluation and verification.

NOTE Reference sound sources may also be used for measurements in one-half-octave bands, e.g. for ISO 9295. However, under these circumstances the stability and reproducibility limits stated in this International Standard will not apply.

This International Standard specifies methods to calibrate reference sound sources not only in a free field over a reflecting plane but also in reverberation 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 100 Hz. Below 100 Hz the measurement uncertainties are significantly different (see Table 1).

This International Standard is applicable to a sound source which is intended for use as a reference sound source. 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. For floor-mounted sources, 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 normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For

undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3741:1999, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Precision methods for reverberation rooms*.

ISO 3744, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane*.

ISO 3745:1977, *Acoustics — Determination of sound power levels of noise sources — Precision methods for anechoic and semi-anechoic rooms*.

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

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

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

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
free field over a reflecting plane
sound field in a homogeneous, isotropic medium in the half-space above an infinite, rigid plane surface over which the source is located

3.2
hemi-anechoic room
test room with a reflecting plane (hard floor) meeting the requirements of ISO 3745

3.3
surface sound pressure level
$L_{p\mathrm{f}}$
energy-average (see ISO 3744) of the time-averaged sound pressure levels at all the microphone positions on the measurement surface

NOTE It is expressed in decibels.

3.4
sound power level
L_W
ten times the logarithm to the base 10 of the ratio of the sound power radiated by the sound source under test to the reference sound power (10^{-12} W)

NOTE It is expressed in decibels.

3.5
measurement surface
hypothetical surface enveloping the source on which the sound pressure levels are measured

NOTE For the purposes of this International Standard, the measurement surface is either a hemisphere terminating on the reflecting plane or a sphere.

3.6
far field
that portion of the radiation field of a sound source in which the sound pressure level decreases by 3 dB for each doubling of the area of the measurement surface

NOTE This attenuation rate is equivalent to a decrease of 6 dB for each doubling of the distance from a point source. In the far field the mean-square sound pressure is proportional to the total acoustic power radiated by the source.

3.7
near field
that portion of the radiation field of a sound source which lies between the source and the far field

3.8
directivity index
$D_{\mathrm{I}i}$
measure of the extent to which a source radiates sound predominantly in one direction

NOTE 1 The directivity index of direction i is calculated from measurements in a hemi-anechoic or anechoic room by the equation

$$D_{\mathrm{I}i} = L_{pi} - L_{p\mathrm{f}} \qquad (1)$$

where

L_{pi} is the sound pressure level, in decibels, as measured on the measurement surface of the source in the particular direction in which $D_{\mathrm{I}i}$ is desired;

$L_{p\mathrm{f}}$ is the surface sound pressure level, at the same distance averaged over the measurement surface.

The measurement surface is a hemisphere when the reference sound source is intended to be located directly on the floor and a sphere if it is intended to be used in positions elevated above the floor.

NOTE 2 This definition is different from that in ISO 3745 because the reference is a source in a free field above a reflecting plane instead of a source in a free field.

3.9
reverberation room
test room meeting the requirements of ISO 3741

3.10
frequency range of interest
this is normally the octave bands with midband frequencies from 125 Hz to 8 000 Hz or the one-third-octave bands with midband frequencies from 100 Hz to 10 000 Hz

NOTE 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
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 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 It is expressed in seconds.

