
**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*



This document is a preview generated by ERS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	2
3 Terms and definitions	2
4 Reference meteorological conditions	4
5 Performance requirements	5
5.1 General	5
5.2 Temporal steadiness (stability) of sound power output	5
5.3 Total broadband sound power level	5
5.4 Spectral characteristics	5
5.5 Directivity	6
5.6 Recalibration	6
6 Instrumentation	7
6.1 General	7
6.2 Microphone in a hemi-anechoic room	7
6.3 Microphone in a reverberation test room	7
6.4 Microphone frequency response correction	7
6.5 Verification	8
6.6 Microphone calibration check	8
7 Installation and operation of the reference sound source during calibration	8
7.1 General	8
7.2 Requirements in hemi-anechoic rooms	9
7.3 Requirements in reverberation rooms	9
8 Calibration procedure in hemi-anechoic rooms	9
8.1 Test environment	9
8.2 Microphone positions	9
8.2.1 General	9
8.2.2 Meridional paths	9
8.2.3 Spiral path	9
8.2.4 Fixed point array	9
8.2.5 Coaxial circular paths	9
8.3 Measurements	10
8.3.1 General	10
8.3.2 Directivity index	10
8.3.3 Temporal steadiness	10
8.4 Calculations	11
9 Calibration procedure in reverberation test rooms	12
9.1 Test environment	12
9.2 Microphone positions	12
9.3 Measurements	12
9.3.1 General	12
9.3.2 Temporal steadiness	13
9.4 Calculations	13
10 Alternative calibration procedure at low frequencies	13
11 Measurement uncertainty	13
11.1 General	13
11.2 Typical values of the reproducibility standard deviation	14
12 Information to be recorded	15

13	Information to be reported	15
Annex A (informative)	Guidance on the determination of C_2	16
Annex B (normative)	Alternative calibration procedure at low frequencies	18
Bibliography		19

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is 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 with the following changes:

- 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 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](#).

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 group or family of International Standards, the ISO 3740 group, which describes various methods for determining the sound power levels of machines and equipment. This group of International Standards specifies the acoustical requirements for measurements that are appropriate for different test environments.

Five International Standards in the ISO 3740 group include procedures in which a reference sound source is used: ISO 3741, ISO 3743-1, ISO 3744, ISO 3746 and ISO 3747. ISO 3740 gives guidelines for the use of all the International Standards in the group.

Note 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 can 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/TR 11690-3 and ISO 14257. Requirements other than those of this International Standard can 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 (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 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 in accordance with this International Standard (see 5.4). The performance requirements on directivity index can only be verified in a hemi-anechoic room (see 5.5.)

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 testing laboratory and the level calibration results are not directly traceable to national standards of measure in a strict metrological sense. Testing laboratories performing 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 laboratories and calibration laboratories respectively. Laboratories testing reference sound sources in accordance with this International Standard 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. At 160 Hz and below, some systematic differences can occur (see 11.2). For frequencies below 100 Hz, an alternative calibration method using sound intensity is given.

The sound source can 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 are calibrated in reverberation test rooms. Floor-mounted sources are either calibrated in hemi-anechoic or in 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 can 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 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

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

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 60942:2003, *Electroacoustics — Sound calibrators*

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

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

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

IEC 61260-1, *Electroacoustics — Octave-band and fractional-octave-band filters — Part 1: Specifications*

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

IEC 61672-3:2013, *Electroacoustics — Sound level meters — Part 3: Periodic tests*

IEC 62585, *Electroacoustics — Methods to determine corrections to obtain the free-field response of a sound level meter*

ISO/IEC Guide 98-3, *Uncertainty of 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 broadband stable output complying with the requirements of this International Standard

3.2 free sound field over a reflecting plane

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