

**ANSI S12.5-2006 /  
ISO 6926:1999**  
(Revision of ANSI S12.5-1990)

Reaffirmed by ANSI  
on December 2, 2011

---

---

---

## AMERICAN NATIONAL STANDARD

### **Acoustics — Requirements for the Performance and Calibration of Reference Sound Sources Used for the Determination of Sound Power Levels**

**(A Nationally Adopted International Standard)**

---

---

---

**NAIS STANDARD  
ANSI S12.5-2006 /  
ISO 6926:1999**

**Accredited Standards Committee S12, Noise**

---

Standards Secretariat  
Acoustical Society of America  
35 Pinelawn Road, Suite 114 E  
Melville, NY 11747-3177

The American National Standards Institute, Inc. (ANSI) is the national coordinator of voluntary standards development and the clearinghouse in the U.S.A. for information on national and international standards.

The Acoustical Society of America (ASA) is an organization of scientists and engineers formed in 1929 to increase and diffuse the knowledge of acoustics and to promote its practical applications.



**ANSI S12.5-2006 / ISO 6926:1999**  
(Revision of ANSI S12.5-1990)

AMERICAN NATIONAL STANDARD

**Acoustics — Requirements for the Performance and  
Calibration of Reference Sound Sources Used for  
the Determination of Sound Power Levels**

**Secretariat**

**Acoustical Society of America**

**Approved 18 December 2006**

**American National Standards Institute, Inc.**

**Abstract**

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 is an identical national adoption of ISO 6926:1999.

## AMERICAN NATIONAL STANDARDS ON ACOUSTICS

The Acoustical Society of America (ASA) provides the Secretariat for Accredited Standards Committees S1 on Acoustics, S2 on Mechanical Vibration and Shock, S3 on Bioacoustics, and S12 on Noise. These committees have wide representation from the technical community (manufacturers, consumers, trade associations, organizations with a general interest, and government representatives). The standards are published by the Acoustical Society of America as American National Standards after approval by their respective Standards Committees and the American National Standards Institute.

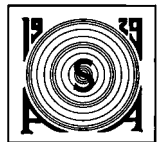
These standards are developed and published as a public service to provide standards useful to the public, industry, and consumers, and to Federal, State, and local governments.

Each of the accredited Standards Committees [operating in accordance with procedures approved by American National Standards Institute (ANSI)] is responsible for developing, voting upon, and maintaining or revising its own Standards. The ASA Standards Secretariat administers Committee organization and activity and provides liaison between the Accredited Standards Committees and ANSI. After the Standards have been produced and adopted by the Accredited Standards Committees, and approved as American National Standards by ANSI, the ASA Standards Secretariat arranges for their publication and distribution.

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered and that a concerted effort be made towards their resolution.

The use of an American National Standard is completely voluntary. Their existence does not in any respect preclude anyone, whether he or she has approved the Standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the Standards.

NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this Standard.



Acoustical Society of America  
ASA Secretariat  
35 Pinelawn Road, Suite 114E  
Melville, New York 11747-3177  
Telephone: 1 (631) 390-0215  
Fax: 1 (631) 390-0217  
E-mail: [asastds@aip.org](mailto:asastds@aip.org)

© 2006 by Acoustical Society of America. This standard may not be reproduced in whole or in part in any form for sale, promotion, or any commercial purpose, or any purpose not falling within the provisions of the U.S. Copyright Act of 1976, without prior written permission of the publisher. For permission, address a request to the Standards Secretariat of the Acoustical Society of America.

## Contents

|     |   |    |
|-----|---|----|
| 1   | Scope .....   | 1  |
| 2   | Normative references .....  | 2  |
| 3   | Terms and definitions .....   | 2  |
| 4   | Measurement uncertainty .....   | 4  |
| 5   | Performance requirements .....  | 5  |
| 5.1 | General .....   | 5  |
| 5.2 | Temporal steadiness and repeatability of sound power output .....                 | 5  |
| 5.3 | Total broad-band sound power level .....  | 6  |
| 5.4 | Spectral characteristics .....  | 6  |
| 5.5 | Directivity index .....   | 6  |
| 5.6 | Recalibration .....   | 7  |
| 6   | Installation and operation of the reference sound source during calibration ..... | 7  |
| 6.1 | General .....   | 7  |
| 6.2 | Position of the reference source .....  | 7  |
| 7   | Calibration procedure in hemi-anechoic rooms .....                                | 8  |
| 7.1 | Test environment .....  | 8  |
| 7.2 | Microphone .....  | 8  |
| 7.3 | Microphone positions .....  | 8  |
| 7.4 | Measurements .....  | 9  |
| 7.5 | Air absorption .....  | 9  |
| 7.6 | Calculations .....  | 10 |
| 8   | Calibration procedure in reverberation rooms .....                                | 10 |
| 8.1 | Test environment .....  | 10 |
| 8.2 | Microphone .....  | 11 |
| 8.3 | Microphone positions .....  | 11 |
| 8.4 | Measurements .....  | 11 |
| 8.5 | Calculations .....  | 11 |
| 9   | Information to be recorded .....  | 11 |
| 10  | Information to be reported .....  | 11 |

## Tables

Table 1 — Estimated upper values of the standard deviations of reproducibility of sound power levels of reference sound sources determined according to this American National Standard .....

Table 2 — Maximum value of the standard deviation of the sound power level under repeatability conditions for a reference sound source according to this American National Standard .....

## Foreword

*[This Foreword is for information only, and is not a part of the American National Standard ANSI S12.5-2006 / ISO 6926-1999 American National Standard Acoustics — Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels.]*

This standard comprises a part of a group of definitions, standards, and specifications for use in noise. It was developed and approved by Accredited Standards Committee S12 Noise, under its approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI). The Scope of Accredited Standards Committee S12 is as follows:

*Standards, specifications, and terminology in the field of acoustical noise pertaining to methods of measurement, evaluation, and control; including biological safety, tolerance, and comfort, and physical acoustics as related to environmental and occupational noise.*

This standard is an identical national adoption of ISO 6926:1999. One clarification is given here and is not normative:

There are certain applications for which users will require Reference Sound Source calibration in the 63-Hz octave band and/or up to the frequency of 20,000 Hz as mentioned in the note in 3.10. Users requiring RSS sound power calibration in the 63-Hz octave band should require that the sound power results down to the one-third octave frequency of 50 Hz be obtained according to Clause 3.10 and reported according to Clause 10. Users requiring RSS sound power calibration up to 20,000 Hz should similarly require appropriate measurements according to Clause 3.10 and reporting according to Clause 10.

In conformance with ANSI and ISO rules, editorial modifications were made including: the addition of footnotes to update references to outdated/revised ISO standards, substitution of the words "American National Standard" for "International Standard", use of American English spelling in place of British English spelling, and substituting decimal points for the commas used in ISO documents.

The ANSI equivalents for the ISO standards in the ISO 3740 series are given below:

- ANSI S12.50-2002/ISO 3740:2000 is an identical national adoption of ISO 3740:2000;
- ANSI S12.51-2002/ISO 3741:1999 is an identical national adoption of ISO 3741:1999;
- ANSI S12.53/Part 1-1999/ISO 3743-1:1994 is an identical national adoption of ISO 3743-1:1994;
- ANSI S12.53/Part 2-1999/ISO 3743-2:1994 is an identical national adoption of ISO 3743-2:1994;
- ANSI S12.54-1999/ISO 3744:1994 is an identical national adoption of ISO 3744:1994;
- ANSI S12.55-2006/ISO 3745:2003 is an identical national adoption of ISO 3745:2003;
- ANSI S12.56-1999/ISO 3746:1995 is an identical national adoption of ISO 3746:1995; and
- ANSI S12.57-2002/ISO 3747:2000 is an identical national adoption of ISO 3747:2000.

ANSI S12.50-2002/ISO 3740:2000 gives guidelines for the use of all the standards in the series.

At the time this Standard was submitted to Accredited Standards Committee S12, Noise for approval, the membership was as follows:

R.D. Hellweg, *Chair*

W.J. Murphy, *Vice-Chair*

S.B. Blaeser, *Secretary*

|  |                      |
|--|----------------------|
| <b>Acoustical Society of America</b> .....   | B.M. Brooks          |
| <b>Aearo Company</b> .....   | E.H. Berger          |
| <b>Air-Conditioning and Refrigeration Institute</b> .....                              | R. Seel              |
| .....  | D. Brown (Alt.)      |
| <b>Alcoa Inc.</b> .....  | W.D. Gallagher       |
| <b>American Industrial Hygiene Association</b> .....                                   | D. Driscoll          |
| .....  | S.N. Hacker (Alt.)   |
| <b>American Society of Heating, Refrigeration and Air-Conditioning Engineers</b> ..... | R.J. Peppin          |
| .....  | E. Rosenberg (Alt.)  |
| <b>American Speech-Language-Hearing Association</b> .....                              | L.A. Wilber          |
| .....  | V. Gladstone (Alt.)  |
| <b>Bruel &amp; Kjaer Instruments, Inc.</b> .....                                       | M. Alexander         |
| .....  | J. Chou (Alt.)       |
| <b>Caterpillar, Inc.</b> .....   | K.G. Meitl           |
| .....  | D.G. Roley (Alt.)    |
| <b>Compressed Air and Gas Institute</b> .....  | J.H. Addington       |
| .....  | D.R. Bookshar (Alt.) |
| <b>Council for Accreditation in Occupational Hearing Conservation</b> .....            | J. Banach            |
| .....  | E.H. Berger (Alt.)   |
| <b>Emerson Electric – Copeland Corporation</b> .....                                   | A.T. Herfat          |
| <b>General Motors</b> .....  | D. Moore             |
| <b>Howard Leight Industries</b> .....  | B. Witt              |
| .....  | V. Larson (Alt.)     |
| <b>Information Technology Industry Council</b> .....                                   | R.D. Hellweg         |
| .....  | J. Rosenberg         |
| <b>Institute of Noise Control Engineering</b> .....                                    | B. Tinianov          |
| .....  | M. Lucas (Alt.)      |
| <b>International Safety Equipment Association</b> .....                                | J. Birkner           |
| .....  | J.C. Bradley (Alt.)  |
| <b>James, Anderson &amp; Associates</b> .....  | R.R. Anderson        |
| .....  | R.R. James (Alt.)    |
| <b>John Deere</b> .....  | K. Cone              |

|  |  |
|--|--|
| <b>National Council of Acoustical Consultants</b> .....                    | J. Erdreich<br>.....G.E. Winzer (Alt.)   |
| <b>National Hearing Conservation Association</b> .....                     | K. Michael                               |
| <b>National Institute for Occupational Safety and Health</b> .....         | W.J. Murphy<br>.....M. Stephenson (Alt.) |
| <b>Noise Control Engineering, Inc.</b> .....                               | M. Bahtiarian<br>.....R. Fischer (Alt.)  |
| <b>Noise Pollution Clearinghouse</b> .....                                 | L. Blomberg                              |
| <b>North American Insulation Manufacturers Association</b> .....           | R.D. Godfrey                             |
| <b>PCB Group</b> .....   | K. Cox<br>.....L. Harbaugh (Alt.)        |
| <b>Plantronics, Inc.</b> .....   | A.K. Woo                                 |
| <b>Power Tool Institute, Inc.</b> .....                                    | W.D.Spencer<br>.....M. Hickok (Alt.)     |
| <b>Quest Technologies, Inc.</b> .....                                      | M. Wurm<br>.....P. Battenberg (Alt.)     |
| <b>Rubber Manufacturers Association</b> .....                              | S. Butcher<br>.....A. Hartke (Alt.)      |
| <b>SAE International</b> .....   | C. Michaels                              |
| <b>Schomer and Associates, Inc.</b> .....                                  | P.D. Schomer                             |
| <b>U.S. Air Force</b> .....  | R. McKinley                              |
| <b>U.S. Army Aeromedical Research Laboratories</b> .....                   | W. Ahroon<br>.....N. Alem (Alt.)         |
| <b>U.S. Army Center for Health Promotion and Preventive Medicine</b> ..... | W.A. Russell<br>.....W. Whiteford (Alt.) |
| <b>U.S. Army Construction Engineering Research Laboratories</b> .....      | M. White<br>.....L. Pater (Alt.)         |
| <b>U.S. Army Human Research and Engineering Directorate</b> .....          | J. Kalb<br>.....M.S. Binseel (Alt.)      |
| <b>U.S. Department of Transportation</b> .....                             | A. Konheim                               |
| <b>U.S. Naval Surface Warfare Center Carderock</b> .....                   | M. Craun<br>.....J. Niemiec (Alt.)       |



Individual Experts of Accredited Standards Committee S12, Noise, were:

|                 |                |                 |
|-----------------|----------------|-----------------|
| P.K. Baade      | L.S. Finegold  | P.D. Schomer    |
| L.L. Beranek    | W.J. Galloway  | J.P. Seiler     |
| E.H. Berger     | R.D. Hellweg   | L.C. Sutherland |
| S.H.P. Bly      | R.K. Hillquist | W.R. Thornton   |
| B.M. Brooks     | W.W. Lang      | L.A. Wilber     |
| A.J. Campanella | R.J. Peppin    | G.E. Winzer     |
| K.M. Eldred     | J. Pope        | G.S.K. Wong     |

Working Group S12/WG 23, Determination of Sound Power, which assisted Accredited Standards Committee S12, Noise, in the development of this standard, had the following membership.

B.M. Brooks and R.J. Peppin Co-Chairs

|                 |                  |              |
|-----------------|------------------|--------------|
| M.C. Black      | K. Cunefare      | M.A. Nobile  |
| S. Bly          | R.D. Hellweg     | J. Schmitt   |
| A.J. Campanella | A.T. Herfat      | P.D. Schomer |
| D. Collings     | S. Keith         | J. Weinstein |
|                 | G.C. Maling, Jr. |              |

Suggestions for improvements of this standard will be welcomed. They should be sent to Accredited Standards Committee S12, Noise, in care of the Standards Secretariat of the Acoustical Society of America, 35 Pinelawn Road, Suite 114E, Melville, New York 11747-3177. Telephone: 631-390-0215; FAX: 631-390-0217; E-mail: [asastds@aip.org](mailto:asastds@aip.org)

## 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 American National 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 American National Standard supplements a series of American National Standards/International Standards, the ANSI S12.50/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 American National Standard may be applicable in these cases.

## American National Standard

# Acoustics — Requirements for the Performance and Calibration of Reference Sound Sources Used for the Determination of Sound Power Levels

## 1 Scope

This American National 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 American National 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 ( $\rho c$ ) is equal to  $400 \text{ Ns/m}^3$  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 American National Standard will not apply.

This American National 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 American National 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 American National 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 American National 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.