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AMERICAN NATIONAL STANDARD

Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Precision methods for reverberation test rooms (a Nationally Adopted International Standard)

ANSI/ASA S12.51-2012 / ISO 3741:2010

Accredited Standards Committee S12, Noise

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

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ANSI/ASA S12.51-2012 / ISO 3741:2010

AMERICAN NATIONAL STANDARD

Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms

(a nationally adopted international standard)

Secretariat:

Acoustical Society of America

Approved on February 23, 2012 by:

American National Standards Institute, Inc.

Abstract

This American National Standard specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured in a reverberation test room. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source, in frequency bands of width one-third-octave, is calculated using those measurements, including corrections to allow for any differences between the meteorological conditions at the time and place of the test and those corresponding to a reference characteristic impedance. Measurement and calculation procedures are given for both a direct method and a comparison method of determining the sound power level and the sound energy level.

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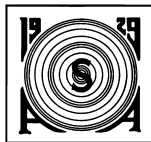
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Acoustical Society of America
ASA Secretariat
35 Pinelawn Road, Suite 114E
Melville, New York 11747-3177
Telephone: 1 (631) 390-0215
Fax: 1 (631) 390-0217
E-mail: asastds@aip.org

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Contents

1	Scope	1
1.1	General	1
1.2	Types of noise and noise sources	1
1.3	Reverberation test room.....	1
1.4	Measurement uncertainty.....	2
2	Normative references.....	2
3	Terms and definitions.....	2
4	Reference meteorological conditions.....	7
5	Reverberation test room.....	7
5.1	General	7
5.2	Volume and shape of test room	7
5.3	Sound absorption of test room.....	7
5.4	Criteria for background noise.....	8
5.5	Atmospheric temperature, humidity and pressure	10
6	Instrumentation and measurement equipment	11
6.1	General	11
6.2	Calibration	11
7	Definition, location, installation, and operation of noise source under test.....	12
7.1	General	12
7.2	Auxiliary equipment.....	12
7.3	Noise source location.....	12
7.4	Installation and mounting conditions.....	12
7.5	Operation of source during test.....	13
8	Measurements in the reverberation test room	14
8.1	General	14
8.2	Initial location of the noise source under test.....	14
8.3	Microphone positions	14
8.4	Measurement of sound pressure levels	16
8.5	Measurement of single event time-integrated sound pressure levels	19
8.6	Measurement of sound pressure levels from the reference sound source for the comparison method	20
8.7	Measurement of reverberation time	21
8.8	Measurement of meteorological conditions	21
9	Determination of sound power levels and sound energy levels.....	21
9.1	Determination of sound power levels.....	21
9.2	Determination of sound energy levels.....	26
9.3	A-weighted sound power level and sound energy level.....	30
10	Measurement uncertainty.....	30
10.1	Methodology.....	30
10.2	Determination of σ_{Omc}	31
10.3	Determination of σ_{R0}	32
10.4	Typical upper bound values of σ_{R0}	33
10.5	Total standard deviation σ_{tot} and expanded measurement uncertainty, U	34
11	Information to be recorded.....	34
11.1	General	34
11.2	Noise source under test	34

ANSI/ASA S12.51-2012 / ISO 3741:2010

11.3	Test environment	35
11.4	Instrumentation	35
11.5	Acoustical data	35
12	Test report	36
Annex A (informative)	Guidelines for the design of reverberation test rooms	37
A.1	General	37
A.2	Volume of reverberation test room	37
A.3	Shape of reverberation test room	37
A.4	Absorption of reverberation test room	38
Annex B (informative)	Guidelines for the design of rotating diffusing vanes	39
Annex C (normative)	Reverberation test room qualification procedure for the measurement of broad-band sound	40
C.1	Introduction	40
C.2	Instrumentation and equipment	40
C.3	Test procedure	40
C.4	Calculation	41
C.5	Qualification	41
Annex D (normative)	Reverberation test room qualification procedure for the measurement of discrete-frequency components	42
D.1	Introduction	42
D.2	General	43
D.3	Instrumentation and measurement equipment	43
D.4	Loudspeaker test	43
D.5	Room test	44
D.6	Computational procedure	44
D.7	Qualification	45
D.8	Multiple source locations	45
Annex E (informative)	Extension of frequency range to frequencies below 100 Hz	47
E.1	Additional frequency range	47
E.2	Supplement to Table 6	47
E.3	Supplement to Table 1 (Minimum volume of the reverberation test room as a function of the lowest frequency band of interest)	47
E.4	Supplement to Table 4 (Minimum number of microphone positions for the measurement of sound pressure level) and Table 5 (Minimum number of source locations for the measurement of sound pressure level)	47
E.5	Supplement to Table C.1	48
E.6	Supplement to Tables D.1 and D.2	48
Annex F (normative)	Calculation of octave band sound power levels and sound energy levels, A- weighted sound power levels and A-weighted sound energy levels from one-third-octave band levels	50
F.1	Sound power levels	50
F.2	Sound energy levels	51
F.3	Values of k and C_k for use in calculations	52
Annex G (informative)	Guidelines on the development of information on measurement uncertainty	54
G.1	General	54
G.2	Considerations on the total standard deviation σ_{tot}	54
G.3	Considerations on σ_{omc}	55
G.4	Considerations on σ_{R0}	56
G.5	Combined standard uncertainty	67
G.6	Measurement uncertainty based on reproducibility data	67

Tables

Table 2 —Absolute maximum background noise levels in test room	10
Table 3 — Allowable limits in the variation of atmospheric temperature and relative humidity during measurements in the reverberation test room	11
Table 4 —Minimum number of microphone positions for the measurement of sound pressure levels.....	18
Table 5 —Minimum number of source locations and value, K_S , for the measurement of sound pressure levels	19
Table 6 —Typical upper bound values of the standard deviation of reproducibility of the method, σ_{R0} , for A-weighted sound power levels and sound energy levels determined in accordance with this American National Standard	34
Table A.1 — Recommended room dimension ratios for right cuboid rooms	38
Table C.1 — Maximum allowable standard deviation of L_{pi}	41
Table D.1 — Maximum allowable sample standard deviations, s_f	42
Table D.2 — Test frequencies for alternative qualification of reverberation test room for measuring sound power levels and sound energy levels of noise sources emitting significant discrete-frequency components	46
Table E.1 — Standard deviations of reproducibility and typical total standard deviations of sound power levels and sound energy levels below 100 Hz.....	47
Table E.2 — Maximum allowable standard deviation of L_{pi}	48
Table E.3 —Maximum allowable sample standard deviations, s_f	48
Table E.4 — Test frequencies for alternative qualification of reverberation test room for measuring sound power levels and sound energy levels of noise sources emitting significant discrete-frequency components	49
Table F.1 — Values of k and C_k for mid-band frequencies of one-third-octave bands.....	53
Table G.1 — Examples of calculated total standard deviations σ_{tot} for three different cases.....	56
Table G.2 — Uncertainty budget for determinations of σ_{R0} for sound power level and sound energy level using the direct method, valid for A-weighted measurements of a source with a relatively flat frequency spectrum	60

ANSI/ASA S12.51-2012 / ISO 3741:2010

Foreword

[This Foreword is for information only, and is not a part of the American National Standard ANSI/ASA S12.51-2012 / ISO 3741:2010 American National Standard Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms.]

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 a revision of ANSI S12.51-2002 (R 2007) / ISO 3741:1999, which has been technically revised.

This Standard is identical to International Standard ISO 3741, Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms, which was prepared by Technical Committee ISO/TC 43 Subcommittee SC 1, Noise. However, in conformance with ANSI and ISO rules, the words "American National Standard" replace the words "International Standard" where they appear in the ISO document, decimal points were substituted in place of the decimal commas used in ISO documents, and American English spelling is used in place of British English spelling.

The ANSI or ANSI/ASA equivalents for the ISO standards in the ISO 3740 series and other referenced nationally adopted standards are given below:

- ANSI S12.5 / ISO 6926 is an identical national adoption of ISO 6926;
- ANSI/ASA S12.50/ISO 3740 is an identical national adoption of ISO 3740;
- ANSI/ASA S12.51/ISO 3741 is an identical national adoption of ISO 3741;
- ANSI/ASA S12.53/Part 1/ISO 3743-1 is an identical national adoption of ISO 3743-1;
- ANSI/ASA S12.53/Part 2/ISO 3743-2 is an identical national adoption of ISO 3743-2;
- ANSI/ASA S12.54/ISO 3744 is an identical national adoption of ISO 3744;
- ANSI S12.55/ISO 3745 is an identical national adoption of ISO 3745;
- ANSI/ASA S12.56/ISO 3746 is an identical national adoption of ISO 3746; and
- ANSI/ASA S12.57/ISO 3747 is an identical national adoption of ISO 3747.

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

W.J. Murphy, *Chair*
R.D. Hellweg, *Vice-Chair*

S.B. Blaeser, *Secretary*

3M Occupational Health & Environmental Safety Division E.H. Berger

Acoustical Society of America R.D. Hellweg
..... D. Lubman (Alt.)

Air-Conditioning, Heating and Refrigeration Institute S. Lind
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John Deere	K.B. Washburn
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National Council of Acoustical Consultants	J. Erdreich
.....	G.E. Winzer (Alt.)
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National Institute for Occupational Safety and Health	W.J. Murphy
.....	E. Zechmann (Alt.)

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National Institute of Standards and Technology – National Voluntary Laboratory Accreditation Program	B.A. Sandoval
National Park Service	G.R. Stanley
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Noise Control Engineering, Inc.	M.A. Bahtiarian
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.....	M.S. Binseel (Alt.)
U.S. Department of Transportation	A. Konheim
U.S. Naval Surface Warfare Center - Carderock	M. Craun
.....	VACANT (Alt.)
Université du Québec ETS	J. Voix
.....	F. Laville (Alt.)

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

P.K. Baade	R.D. Hellweg	R.J. Peppin
E.H. Berger	W.W. Lang	J. Schmitt
B.M. Brooks	D. Lubman	P.D. Schomer
A.J. Campanella	D. Michaud	L.C. Sutherland
K.M. Eldred	N.P. Miller	W.R. Thornton
L.S. Finegold	W.J. Murphy	L.A. Wilber
R.D. Godfrey	M.A. Nobile	G.E. Winzer

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, Co-Chair	
	J. Schmitt, Co-Chair	
M.C. Black	K. Cunefare	M.A. Nobile
S. Bly	R.D. Hellweg	M. O'Connell
A.J. Campanella	A.T. Herfat	P.D. Schomer
D.A. Collings	S. Keith	J. Weinstein
	G.C. Maling	

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.

Introduction

This American National Standard is one of the series ISO 3740^[2] to ISO 3747^[8], which specify various methods for determining the sound power levels and sound energy levels of noise sources including machinery, equipment and their sub-assemblies. The selection of one of the methods from the series for use in a particular application depends on the purpose of the test to determine the sound power level or sound energy level and on the facilities available. General guidelines to assist in the selection are provided in ISO 3740^[2]. ISO 3740^[2] to ISO 3747^[8] give only general principles regarding the operating and mounting conditions of the machinery or equipment for the purposes of the test. It is important that test codes be established for individual kinds of noise sources, in order to give detailed requirements for mounting, loading, and operating conditions under which the sound power levels or sound energy levels are to be obtained.

The methods given in this American National Standard require the source under test to be mounted in a reverberation test room having specified acoustical characteristics. The methods are then based on the premise that the sound power or sound energy of the source under test is directly proportional to the mean-square sound pressure averaged in space and time, and otherwise depends only on the acoustical and geometric properties of the room and on the physical constants of air.

For a source emitting sound in narrow bands of frequency or at discrete frequencies, a precise determination of the radiated sound power level or sound energy level in a reverberation test room requires greater effort than for a source emitting sound more evenly over a wide range of frequencies, because:

- a) the space- and time-averaged sound pressure along a short microphone path, or as determined with an array of a small number of microphones, is not always a good estimate of the space- or time-averaged mean-square pressure throughout the room;
- b) the sound power or sound energy radiated by the source is more strongly influenced by the normal modes of the room and by the position of the source within the room.

The increased measurement effort in the case of a source emitting narrow bands of sound or discrete tones consists of either the optimization and qualification of the test room or the use of a greater number of source locations and microphone positions (or increased path length for a moving microphone). The addition of low-frequency absorbers or the installation of rotating diffusers in the test room can help to reduce the measurement effort.

The methods specified in this American National Standard permit the determination of the sound power level and the sound energy level in one-third-octave frequency bands, from which octave band data, A-weighted frequency data, and total unweighted sound can be computed.

This American National Standard describes methods of accuracy grade 1 (precision grade) as defined in ISO 12001. The resulting sound power levels and sound energy levels include corrections to allow for any differences that might exist between the meteorological conditions under which the tests are conducted and reference meteorological conditions. For applications in reverberant environments where reduced accuracy is acceptable, reference can be made to ISO 3743-1^[3], ISO 3743-2^[4] or ISO 3747^[8].

Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms

1 Scope

1.1 General

This American National Standard specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured in a reverberation test room. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source, in frequency bands of width one-third-octave, is calculated using those measurements, including corrections to allow for any differences between the meteorological conditions at the time and place of the test and those corresponding to a reference characteristic impedance. Measurement and calculation procedures are given for both a direct method and a comparison method of determining the sound power level and the sound energy level.

In general, the frequency range of interest includes the one-third-octave bands with mid-band frequencies from 100 Hz to 10 000 Hz. Guidelines for the application of the specified methods over an extended frequency range in respect to lower frequencies are given in Annex E. This American National Standard is not applicable to frequency ranges above the 10 000 Hz one-third-octave band.

NOTE For higher frequencies, the methods specified in ISO 9295 can be used.

1.2 Types of noise and noise sources

The methods specified in this American National Standard are suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001.

The noise source under test can be a device, machine, component or sub-assembly. This American National Standard is applicable to noise sources with a volume not greater than 2 % of the volume of the reverberation test room. For a source with a volume greater than 2 % of the volume of the test room, it is possible that the achievement of results as defined in ISO 12001:1996, accuracy grade 1 (precision grade) is not feasible.

NOTE In specific cases, the source volume can be increased to a maximum of 5 % of the room volume. In such cases, the relevant noise test code indicates the possible consequences on the measurement uncertainty.

1.3 Reverberation test room

The test rooms that are applicable for measurements made in accordance with this American National Standard are reverberation test rooms meeting specified requirements (see Clause 5).