
AMERICAN NATIONAL STANDARD

Measurements of the Threshold of Hearing and Signal Detectability in a Sound Field

ANSI/ASA S3.52-2016

Accredited Standards Committee S3, Bioacoustics

Standards Secretariat
Acoustical Society of America
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Secretariat:

Acoustical Society of America

Approved on January 6, 2016 by:

American National Standards Institute, Inc.

Abstract

The standard covers requirements, conditions, and procedures for threshold-of-hearing measurements in a sound field. However, the standard may also be used for conducting other sound-field hearing tests and as a research tool for assessing the effects of listening conditions and headgear worn by the listener on detectability of various test signals. Three sound fields are referenced in the standard: the free sound field, the quasi-free sound field, and the diffuse sound field. The test signals covered by the standard are frequency-modulated tones (warble tones) and narrow-band noises. However, other calibrated signals that meet requirements of this standard may also be used. The standard applies to binaural listening to test signals presented by one or more loudspeakers in a test room. Monaural air conduction hearing thresholds may also be determined if the opposite ear can be properly occluded. Special application of the standard to the assessment of spatial hearing is presented in Annex B.

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Foreword

[This Foreword is for information only and is not a part of the American National Standard ANSI/ASA S3.52-2016 American National Standard Measurements of the Threshold of Hearing and Signal Detectability in a Sound Field. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the standard.]

This standard comprises a part of a group of definitions, standards, and specifications for use in bioacoustics. It was developed and approved by Accredited Standards Committee S3 Bioacoustics, under its approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI). The Scope of Accredited Standards Committee S3 is as follows:

Standards, specification, methods of measurements and test, and terminology in the fields of mechanical shock, and physical acoustics, including aspects of general acoustics, shock, and vibration that pertain to biological safety, tolerance, and comfort.

At the time this Standard was submitted to Accredited Standards Committee S3, Bioacoustics for approval, the membership was as follows:

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Suggestions for improvements of this standard will be welcomed. They should be sent to Accredited Standards Committee S3, Bioacoustics, in care of the Standards Secretariat of the Acoustical Society of America, 1305 Walt Whitman Road, Suite 300, Melville, New York 11747. Telephone: 631-390-0215; FAX: 631-923-2875; E-mail: asastds@acousticalsociety.org.

American National Standard

Measurements of the Threshold of Hearing and Signal Detectability in a Sound Field

1 Scope

1.1 General

This standard specifies relevant requirements for sound-field hearing tests conducted with the signals presented by means of loudspeakers in free, quasi-free, and diffuse sound fields. The requirements and conditions described in this standard are suitable for both frequency-specific hearing tests and assessment of detectability of wide-band signals. Two types of frequency-specific test signals—frequency-modulated tones and narrow-band noises—are described in the standard but other well-defined narrow- and wide-band test signals may also be used if the test conditions described in the standard are met. The main body of the standard specifies requirements for the measurement of the threshold of hearing. In addition, Annex B provides information about extending requirements of this standard to spatial hearing audiometry and directional hearing tests conducted for research purposes.

The requirements of the standard apply to hearing tests conducted in quiet. However, they also may serve as guidelines for similar sound tests conducted in the presence of other acoustic signals. If any form of acoustic masking or interference is introduced in the test, all specific information about the masking signals, their levels, and the delivery conditions shall be recorded and included with the test results.

1.2 Purpose

The purpose of ANSI/ASA S3.52 is to ensure that sound field tests of hearing, and particularly tests of hearing threshold, performed on the same individual in various clinics and laboratories shall give accurate and reproducible results. The test conditions and test stimuli described in the standard are applicable to all populations of subjects including children (play audiometry, visual-reinforced audiometry, and conditioned orientation reflex audiometry) and special listeners who do not tolerate earphones.

1.3 Applications

The main application of the standard is determination of hearing threshold levels in the frequency range from the 125 Hz to 12500 Hz range with possible extension to the 20 Hz to 18000 Hz range. The standard applies to both sound field audiometry and sound field research studies based on measurement of hearing threshold. The requirements of the standard apply to measurements made with stationary systems consisting of signal-generating circuitry, such as an audiometer, and one or more loudspeakers. In addition to threshold of hearing measurements, the standard may be used to determine the effects of hearing aids (e.g., functional gain), assistive listening devices, and various types of headgear on audibility of the test signals. The standard does not apply to sound field tests conducted with a handheld loudspeaker or conducted in virtual reality environments. Qualification tests for hearing protection devices should be made in accordance with ANSI/ASA S12.6 and ANSI/ASA S12.42 standards.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI/ASA S1.1-2013 American National Standard Acoustical Terminology

ANSI/ASA S1.4-2014/Part 1/IEC 61672-1:2013 American National Standard Sound Level Meters – Part 1: Specifications (a nationally adopted international standard)

ANSI/ASA S1.11-2014/Part 1/IEC 61260-1:2014 American National Standard Electroacoustics - Octave-band and fractional-octave-band filters – Part 1: Specifications

ANSI/ASA S3.1-1999 (R 2013) American National Standard Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms

ANSI/ASA S3.6-2010 American National Standard Specification for Audiometers

ANSI/ASA S3.20-2015 American National Standard Bioacoustical Terminology

ANSI/ASA S12.6-2008 American National Standard Methods for Measuring the Real-Ear Attenuation of Hearing Protectors

ANSI/ASA S12.42-2010 American National Standard Methods for the Measurement of Insertion Loss of Hearing Protection Devices in Continuous or Impulsive Noise Using Microphone-in-Real-Ear or Acoustic Test Fixture Procedures

IEC 60645-1: 2012 Electroacoustics - Audiometric equipment - Part 1: Equipment for pure-tone audiometry

ISO 389-7:2005 Acoustics - Reference zero for the calibration of audiometric equipment - Part 7: Reference threshold of hearing under free-field and diffuse-field listening conditions

ISO 389-7:2005/DAM1 Acoustics - Reference zero for the calibration of audiometric equipment - Part 7: Reference threshold of hearing under free-field and diffuse-field listening conditions - Amendment 1: Reference threshold of hearing at 20 Hz and 18 000 Hz under free-field listening conditions and at 20 Hz under diffuse-field listening conditions

ISO 389-9:2009 Acoustics - Reference zero for the calibration of audiometric equipment - Part 9: Preferred test conditions for the determination of reference hearing threshold levels

ISO 8253-2:1992 Acoustics - Audiometric test methods - Part 2: Sound field audiometry with pure tone and narrow-band test signals.

ISO 26101-2012 Acoustics - Test methods for the qualification of free-field environments

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply. All listed definitions are technically equivalent to definitions given in ANSI/ASA S1.1 and ANSI/ASA S3.20 but some have editorial differences or have been expanded for the users of this standard.

3.1

test subject

A person for whom the sound field audiometry test is conducted.

3.2**otologically normal person**

A person in a normal state of health who is free from all signs or symptoms of ear disease and from excessive wax in the ear canal which would block incoming sound and who has no history of undue exposure to noise and potentially ototoxic drugs.

3.3**reference point (of the test subject)**

The midpoint of a straight line connecting the ear canal openings of the **test subject** (3.1) when the test subject is placed in the listening position in the sound field.

3.4**reference axis (of the loudspeaker)**

Axis perpendicular to the radiating surface of the loudspeaker.

NOTE 1 For single radiator or horn loudspeakers, the axis passes through the geometric center of the diaphragm or the horn.

NOTE 2 For multi-unit loudspeakers, the position of the axis is defined by the manufacturer.

3.5**test axis**

Reference axis of the test space indicating 0° azimuth and 0° elevation.

3.6**hearing threshold**

For a specific signal, the minimum sound pressure level that is capable of evoking an auditory sensation for a specific test subject in a specific fraction of trials.

NOTE Hearing threshold is typically determined as the lowest sound pressure level at which responses occur in 50 % of a series of trials.

3.7**reference equivalent threshold sound pressure level**

For a specific signal and a specified manner of signal presentation, value of the sound pressure level measured at the **reference point** (3.3) that corresponds to hearing threshold of a sufficiently large number of **otologically normal persons** (3.2), of both genders, aged between 18 years and 25 years inclusive, placed individually at the reference point in the specific sound field.

NOTE Reference equivalent threshold sound pressure level is abbreviated RETSPL.

3.8**hearing level**

For a specified signal and a specified manner of signal presentation, sound pressure level at the **reference point** (3.3) in the specific sound field minus the appropriate **reference equivalent threshold sound pressure level** (3.7).

3.9**hearing threshold level**

For a specified signal and specified listening conditions, **hearing threshold** (3.6) expressed either as **hearing level** (3.8) or as sound pressure level.

NOTE A graph of hearing threshold level expressed as hearing level versus frequency is called an audiogram.