ANSI/ASA S1.26-2014
(Revision of ANSI S1.26-1995 [R2009])

AMERICAN NATIONAL STANDARD

Methods for Calculation of the Absorption of Sound by the Atmosphere

ANSI/ASA S1.26-2014

Accredited Standards Committee S1, Acoustics

Standards Secretariat
Acoustical Society of America
1305 Walt Whitman Road, Suite 300
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Secretariat:

Acoustical Society of America

Approved on August 28, 2014, by:

American National Standards Institute, Inc.

Abstract

This Standard provides the means to calculate atmospheric absorption losses of sound from any source, moving or stationary, for a wide range of meteorological conditions. The atmosphere is assumed to be still, homogeneous moist air of normal composition. Non-homogeneous atmospheres can be divided into horizontal layers within which homogeneous conditions can be assumed. Attenuation coefficients for pure-tone sounds are calculated by means of equations (or a table) over ranges of frequency, and the humidity, pressure, and temperature of the atmosphere. For sounds analyzed by fractional-octave-band filters (e.g., one-third-octave-band filters), alternative methods are provided in annexes to calculate the attenuation caused by atmospheric absorption from that specified for pure-tone sounds.

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, S3/SC 1 on Animal 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 (ANSI).
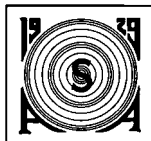
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An American National Standard implies a consensus of those substantially concerned with its scope and provisions. Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly 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.

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Foreword

[*This Foreword is for information only and is not a part of the American National Standard A*NSI/ASA S1.26-2014 *American National Standard Methods for Calculation of the Absorption of Sound by the Atmosphere. 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 acoustics. It was developed and approved by Accredited Standards Committee S1 Acoustics, under its approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI). The Scope of Accredited Standards Committee S1 is as follows:

> *Standards, specifications, methods of measurement and test, and terminology in the field of physical acoustics, including architectural acoustics, electroacoustics, sonics and ultrasonics, and underwater sound, but excluding those aspects which pertain to biological safety, tolerances, and comfort.*

This standard is a revision of ANSI S1.26-1995, which has been technically revised. The revision consists of the inclusion of wording explaining that the methods discussed will not necessarily provide similar results and updating of the normative references. This standard is the American National Standard counterpart of International Standard ISO 9613-1:1993 *Acoustics—Part 1: Calculation of the absorption of sound by the atmosphere*. The technical requirements in this American National Standard are identical to those in ISO 9613-1. This standard has some additional clauses dealing with an approximate method, and includes propagation in large rooms.

This standard contains five informative annexes.

Annex E in this American National Standard is not contained in ISO 9613-1. This annex describes an approximate, non-analytical method to provide a practical method to compute the atmospheric attenuation applicable to fractional-octave-band sound pressure levels measured at a large distance from a sound source or under highly absorptive conditions, or a combination of distance and absorptive conditions. Also, the scope of this American National Standard is not limited to sound propagation outdoors as is ISO 9613-1, but also includes propagation in rooms.

At the time this Standard was submitted to Accredited Standards Committee S1, Acoustics, for approval, the membership was as follows:

R.J. Peppin, *Chair*
A. Scharine, Vice-Chair

S.B. Blaeser, *Secretary*

3M Personal Safety Division, Detection Solutions.. P.J. Battenberg
....M. Wurm (Alt.)

Acoustical Society of America... R.J. Peppin
.... R.D. Hellweg (Alt.)

Air-Conditioning, Heating and Refrigeration Institute ....S.J. Lind
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American Industrial Hygiene Association .... D. Driscoll
.... D. Sandfort (Alt.)

Campanella Associates..A.J. Campanella

Casella USA...R. Brauch

ETS-Lindgren Acoustic Systems..D. Winker
.... M. Black (Alt.)

G.R.A.S. Sound & Vibration.. B. Schustrich
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National Council of Acoustical Consultants.. E. Logsdon
....G.E. Winzer (Alt.)

National Institute of Standards & Technology (NIST) ....R.P. Wagner
.... S. Fick (Alt.)

PCB Group...K. Cox
.... L. Harbaugh (Alt.)

Scantek, Inc. ....S. Marshall
....M. Buzduga (Alt.)

U.S. Air Force (USAF) .... R.L. McKinley
.... F. Mobley (Alt.)

U.S. Army Construction Engineering Research Laboratory ....M. Swearingen
.... M.J. White (Alt.)

U.S. Army Research Laboratory, Human Research and Engineering Directorate ....A. Scharine
....M.A. Ericson (Alt.)

U.S. Department of Labor – Mine Safety and Health Administration..J. Homer

Individual Experts of Accredited Standards Committee S1, Acoustics, were:

V. Buzduga	W.W. Lang	C. Walber
P. Hanes	V. Nedzelnitsky	L. Wu
	P.D. Schomer	

Working Group S1/WG 2 Attenuation of Sound in the Atmosphere, which assisted Accredited Standards Committee S1, Acoustics, in the development of this standard, had the following membership.

R.J. Peppin, Chair
F. Mobley

Suggestions for improvements of this standard will be welcomed. They should be sent to Accredited Standards Committee S1, Acoustics, in care of the Standards Secretariat of the Acoustical Society of America, 1305 Walt Whitman Road, Suite 300, Melville, New York 11747. Telephone: +1 (631) 390-0215; FAX: +1 (631) 923-2875; E-mail: asastds@acousticalsociety.org.

American National Standard

Methods for Calculation of the Absorption of Sound by the Atmosphere

1   Scope

1.1 This Standard specifies an analytical method to calculate the attenuation of sound as a result of atmospheric absorption for a variety of meteorological conditions when the sound from any moderate-amplitude source propagates through the atmosphere. The calculation method of the Standard applies for molar concentrations of water vapor in the atmosphere from less than 0.005 percent to greater than 5 percent and for ratios of the frequency of the sound to the atmospheric pressure from as low as 4×10^{-4} Hz/Pa (40 Hz per atmosphere) to as great as 10 Hz/Pa (1 MHz per atmosphere).

1.2 For pure-tone sounds, attenuation, using descriptor "decibels," owing to atmospheric absorption is specified by formulae in terms of an attenuation coefficient, in decibels per unit sound-propagation distance, as an analytical function of four variables: the frequency of the sound, and the temperature, humidity, and pressure of the atmosphere. Computed attenuation coefficients are provided in tabular form for ranges of the variables commonly encountered in prediction of outdoor sound propagation.

1.3 For wideband sounds analyzed by fractional-octave band filters (e.g., one-third octave band filters), an approximate method is provided for calculating the attenuation owing to atmospheric absorption from that specified for pure-tone sounds at the midband frequencies. The spectrum of the sound can be wideband with no significant discrete-frequency components or it may be a combination of wideband and discrete frequency sounds.

NOTE   The approximate method will not necessarily give the same results as the primary analytical method.

1.4 This Standard applies to an atmosphere with uniform meteorological conditions and to a stratified atmosphere in which the meteorological conditions may be considered to be uniform within layers. The procedures described in the Standard may be used to determine adjustments to be applied to measured sound pressure levels to account for differences between atmospheric absorption losses under different meteorological conditions. The calculation method may also be applied to assess the contribution of atmospheric absorption to the decay of sound pressure level in a reverberant sound field often found in rooms.

1.5 This Standard accounts for the principal absorption mechanisms present in an atmosphere devoid of significant fog or atmospheric pollutants. It does not cover sound attenuation by mechanisms other than atmospheric absorption such as wave divergence, refraction, scattering by turbulence, ground reflection, or non-linear propagation effects.

2   Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies.

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*

ISO 2533:1975, Standard atmosphere