ASA/ANSI S3/SC1.100-2014 ANSI/ASA S12.100-2014

Reaffirmed May 28, 2020
(a joint project between ASC S3/SC 1 and ASC S12)

AMERICAN NATIONAL STANDARD

Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas

Secretariat:

Acoustical Society of America

Approved on December 5, 2014:

American National Standards Institute, Inc.

Abstract

This standard specifies measurement procedures for characterizing residual sound levels in protected natural areas and quiet residential areas. The standard specifies instrumentation, measurement durations, and statistical procedures for summarizing the data. A filtering procedure is provided that can be applied to A-weighted data to exclude high frequency sound energy where appropriate or warranted. The statistical procedure for calculating exceedance values like L90 is specified.

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ANSI/ASA S3/SC1.100-2014
ANSI/ASA S12.100-2014

Accredited Standards Committee S3/SC 1, Animal Bioacoustics AND
Accredited Standards Committee S12, Noise

Standards Secretariat
Acoustical Society of America
1305 Walt Whitman Road, Suite 300
Melville, NY 11747

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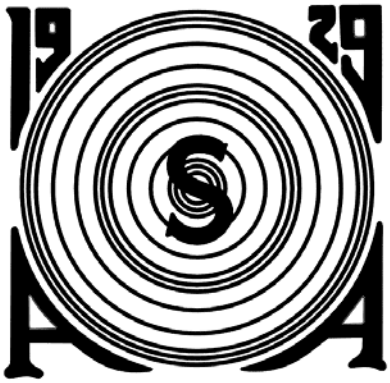

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Foreword

[*This Foreword is for information only, and is not a part of the American National Standard* ANSI/ASA S3/SC1.100-2014 / ANSI/ASA S12.100-2014 American National Standard Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas. *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 new standard, for which there is no ISO or EN counterpart, was developed and approved as a joint project between ANSI-Accredited Standards Committee S3/SC 1, Animal Bioacoustics, and ANSI-Accredited Standards Committee S12, Noise. It comprises a part of a group of definitions, standards, and specifications for use in the fields of psychological acoustics, physiological acoustics, and acoustic ecology as it affects both humans and animals. It was developed and approved by both ASC S3/SC 1 and ASC S12 under their approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI).

The Scope of **Accredited Standards Committee S3/SC 1** is as follows:

> *Standards, specifications, methods of measurement and test, instrumentation, and terminology in the field of psychological and physiological acoustics, including aspects of general acoustics which pertain to biological safety, tolerance, and comfort of non-human animals, including both risk to individual animals and to the long-term viability of populations. Animals to be covered may potentially include commercially grown food animals; animals harvested for food in the wild; pets; laboratory animals; exotic species in zoos, oceanaria or aquariums; or free-ranging wild animals.*

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> *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.*

At the time this Standard was submitted to Accredited Standards Committee S3/SC 1, Animal Bioacoustics, for approval the membership was as follows:

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M.C. Hastings, *Vice-Chair*

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Université du Québec ETS ..... J. Voix
..... F. Laville (Alt.)

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

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

Working Group S3/SC 1/WG 4, Description and Measurement of the Ambient Sound in Parks, Wilderness Areas, and Other Quiet and/or Pristine Areas, which assisted Accredited Standards Committee S3/SC 1, Animal Bioacoustics, in the development of this standard, had the following membership.

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G.R. Stanley, Co-Chair

M.A. Bahtiarian	D.J. Hingson	A.P. Nash
D.K. Delaney	R.D. Horonjeff	J. Soendergaard
L.S. Finegold	T.R. Letowski	K.G. Standlee
R.D. Hellweg	N.P. Miller	N. Timmerman

Working Group S12/WG15, Measurement and Evaluation of Outdoor Community Noise, which assisted Accredited Standards Committee S12, Noise, in the development of this standard, had the following membership.

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J. Zhang

Suggestions for improvements to this standard will be welcomed. They should be sent to Accredited Standards Committees S3/SC 1, Animal Bioacoustics, and/or S12, Noise, 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.

Introduction

Currently, no standard method exists for describing or measuring residual sound levels in protected natural areas and quiet residential areas. The main purpose of this standard is to develop procedures to estimate the residual sound levels in an area where these levels are used to evaluate the effects of a noise source, with two examples being wind turbine noise in quiet rural areas and transportation noise in U.S. National Parks and wilderness areas. A second purpose is to develop estimates of the ambient sound in the same or similar settings to those above.

It is desirable that residual sound levels be characterized in units that offer opportunities for comparison with a broad range of available information. The most commonly available noise source data are provided as A-weighted sound levels in decibels.

This standard has been written to reflect the most common measurement conventions and instrumentation, which were designed for application to human noise impacts. Other weighting schemes may ultimately be more efficient for characterizing residual sound levels for other species of animals. This standard is not intended to characterize pristine ambient conditions, or to provide sensitive methods for detecting anthropogenic noise.

A common purpose of residual sound level measurement is to evaluate the projection of a noise source into an area. In this case, one question of interest concerns, in a broad sense, the capacity of residual sounds to "mask," or inhibit perception of, a noise source. High frequency natural sounds (HFNS)—sounds above the 1 kHz octave band that are significantly above the primary frequencies of the noise source—contribute little to masking. The problem is that these high-frequency sounds can make large contributions to A-weighted sound levels that substantially exaggerate the environment's capacity to mask most anthropogenic noise sources.

The effects of discarding HFNS from measurements of A-weighted sound levels have been investigated in two settings. The Natural Sounds and Night Skies Division of the National Park Service processed hourly ambient data from 62 sites in 10 national parks. More than 20% of the one-hour-average sound levels were decreased by 3 dB or more when HFNS were excluded. Five percent of the measurements of hourly sound levels were decreased by nearly 6 dB. Spring and summer measurements from sites with high percentages of vegetation coverage showed the greatest differences. Schomer, Slauch, and Hessler (2010) evaluated over 115 community noise octave-band spectra and found the exclusion of high-frequency sounds causes A-weighted sound levels to decrease by less than 1 dB, and that the standard deviation was 0.5 dB or less. Excluding HFNS substantially reduces residual levels in national park and quiet residential settings while having a much smaller effect on measurements of urban noise levels. Annex A reproduces the Schomer *et al.* data showing the average differences and the standard deviation to these differences for various noise sources.

Elimination of the high-frequency sound has two potential additional benefits. First, elimination of all data above the 1 kHz octave band (or in the 1.6 kHz one-third octave band and above) may significantly lower the self-generated electrical noise on the order of 10 dB when compared to the self-generated A-weighted electrical noise floor of a typical Type 1 sound level meter. Annex B contains a detailed analysis of this effect for a typical, well-known Type 1 meter. Second, elimination of all data above the 1 kHz octave band significantly lowers the contributions of the wind-induced noise of rustling leaves and noise flow around the microphone windscreen. This effect is illustrated in Figures B.3 and B.4. As an example, leaf-rustle noise analyzed by Schomer and Beck (2010) has an A-weighted one-third octave-band spectrum that peaks in the 2 to 3.15 kHz range. Elimination of all data above the 1 kHz octave band lowers the resulting measured A-weighted leaf-rustle levels by about 3.5 dB when compared to the equivalent A-weighted measurement—a reduction that is quite consistent with Figure B.4.

American National Standard

Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas

1 Scope

This standard provides basic quantities and procedures for the description of residual sound levels in protected natural areas and quiet residential areas. This information supplements the basic information contained in the American National Standards listed as references. This standard specifies a method to measure residual sound in protected natural areas and quiet residential areas. This standard sets minimum requirements for the instruments used and for the sensitivity checks performed in conjunction with measurements in parks, wilderness areas, and quiet residential areas. This standard defines the A-weighted, noise-compensated (ANS-weighted metric), which is the standard A-weighting filtered to exclude sounds above the 1 kHz octave band.

The resulting data can be used to characterize residual sound levels with respect to anthropogenic noise. Data obtained in quiet residential areas can be used to assess the residual sound in relation to manmade noise sources such as wind turbine generators, compressor stations for pipelines, highways, and airports.

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 *American National Standard Acoustical Terminology*

ANSI S1.4-1983 (R 2006) *American National Standard Specification for Sound Level Meters*. This Standard includes ANSI S1.4A-1985 (R 2006) Amendment to ANSI S1.4-1983

ANSI/ASA S1.11-2004 (R 2009) *American National Standard Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters*

ANSI/ASA S1.13-2005 (R 2010) *American National Standard Measurement of Sound Pressure Levels in Air*

ANSI/ASA S12.9-2013/Part 1 *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 1: Basic Quantities and Definitions*

ANSI/ASA S12.9-1992/Part 2 (R 2013) A*merican National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 2: Measurement of Long-Term, Wide-Area Sound*

ANSI/ASA S12.9-2013/Part 3 *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 3: Short-term Measurements with an Observer Present*

ANSI/ASA S12.18-1994 (R 2009) *American National Standard Procedures for Outdoor Measurement of Sound Pressure Level*