

Reaffirmed by ANSI
October 27, 2015

ANSI S12.9-2005/Part 4
(Revision of ANSI S12.9-1996/Part 4)

AMERICAN NATIONAL STANDARD

Quantities and Procedures for Description and Measurement of Environmental Sound – Part 4: Noise Assessment and Prediction of Long-term Community Response

ANSI S12.9-2005/Part 4

Accredited Standards Committee S12, Noise

Standards Secretariat
Acoustical Society of America
35 Pinelawn Road, Suite 114E
Melville, New York 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.



AMERICAN NATIONAL STANDARD

**QUANTITIES AND PROCEDURES FOR
DESCRIPTION AND MEASUREMENT OF
ENVIRONMENTAL SOUND —
PART 4: NOISE ASSESSMENT AND PREDICTION OF
LONG-TERM COMMUNITY RESPONSE**

Secretariat:

Acoustical Society of America

Approved by:

American National Standards Institute, Inc.

Abstract

This Standard specifies methods to assess environmental sounds and to predict the annoyance response of communities to long-term noise from any and all types of environmental sounds produced by one or more distinct or distributed sound sources. The sound sources may be separate or in various combinations. Application of the method of the Standard is limited to areas where people reside and related long-term land uses. This Standard does not address the effects of intrusive sound on people in areas of short-term use such as parks and wilderness areas, nor does it address other effects of noise such as sleep disturbance or health effects. This Standard does not provide a method to predict the community response to short-term, infrequent, non-repetitive sources of sound.

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.

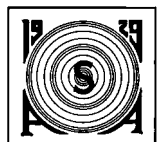
These standards are developed and published as a public service to provide standards useful to the public, industry, and consumers, and to Federal, State, and local governments.

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

© 2005 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	Descriptors for environmental sounds	4
4.1	Single-event sounds.....	4
4.2	Continuous sounds	4
4.3	Repetitive single-event sounds	5
5	Sound measurement locations	5
6	Adjustments for background sound	5
6.1	General	5
6.2	Specific requirements.....	5
7	Method to assess environmental sounds either singly or in combination	6
7.1	General environmental sounds	6
7.2	Adjustments to general environmental sound.....	8
8	Reporting assessments of environmental sounds and prediction of long-term community annoyance response	12
8.1	Use of A-weighted sound exposure and day-night average sound level.....	12
8.2	Assessment of environmental sounds	12
8.3	Prediction of long-term annoyance response of communities	12
8.4	Reporting.....	12
Annex A	Adjustments for background sound	14
A.1	Introduction	14
A.2	Mathematical development	15
A.3	Background sound adjustment situations	16
Annex B	High-energy impulsive sounds.....	18
B.1	Introduction	18
B.2	Fundamental descriptor	18
B.3	Measurement	18
B.4	Calculation of adjusted sound exposure level for high-energy impulsive sounds from C-weighted sound exposure level	18
B.5	Calculation of adjusted sound exposure level from C-weighted sound exposure level.....	18
B.6	Calculation of adjusted sound exposure level from C-weighted sound exposure	19
B.7	Use of adjusted sound exposure	19
Annex C	Sounds with tonal content	20
Annex D	Sounds with strong low-frequency content.....	21
D.1	Introduction	21
D.2	Analysis factors	21
D.3	Applicability	21

D.4	Descriptor.....	22
D.5	Adjusted sound exposures for sounds with strong low-frequency content.....	22
D.6	Use of adjusted sound exposure	23
D.7	Noise-induced rattles	23
Annex E	Onset rate for airplane flybys.....	24
Annex F	Estimated percentage of a population highly annoyed as a function of adjusted day-night sound level	25
F.1	Introduction	25
F.2	The Dose-response function.....	25
F.3	Qualifications to the dose-response function.....	26
Annex G	Assessing the complaint potential of high-amplitude impulse noise.....	29
G.1	Introduction	29
G.2	Complaint criteria	29
G.3	Complaint risk prediction.....	29
Annex H	Loudness-level weighting	31
H.1	Introduction	31
H.2	The method	31
Bibliography		35

Figures

Figure F.1	— Percentage of respondents highly annoyed by road traffic sounds, as a function of the A-weighted day-night level.....	26
Figure H.1	— Equal loudness level contours in phons from ISO 226-1987. The non-shaded area shows the frequency range where, approximately, a 10-dB change in sound pressure level corresponds to a 10-dB change in phon level. At low frequencies this relationship does not occur. For example, at 31 Hz, a 10-dB change in sound pressure level corresponds to about a 20-dB change in phon level.	33
Figure H.2	— Generalized house TL for windows open on the order of 5 cm.	33

Tables

Table 1	— Relation between sound exposure level and sound exposure for a constant sound level of 60 dB.	8
Table 2	— Adjustment factors and level adjustments for assessment of all types of environmental sounds.....	11
Table F.1	— Annual-average adjusted A-weighted day-night sound levels and corresponding total adjusted day-night sound exposures and percentages of a population highly annoyed	28
Table G.1	— Complaint Risk Criteria.....	30
Table H.1	— Coefficients for calculation loudness level from band sound pressure level. The table also includes the house filter characteristics shown in Figure H.2.	34

Foreword

[This Foreword is for information only, and is not a part of the American National Standard ANSI S12.9 - 2005/Part 4 American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 4: Noise Assessment and Prediction of Long-Term Community Response.]

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 S12.9-1996/Part 4, which has been technically revised. The changes in this edition harmonize with the new material added to ISO 1996-1:2003. This includes a minor change to high-energy impulse noise assessment (less than 1 dB) so that it is totally in sync with ISO. Second, as appropriate, ISO assessment adjustments have been included. Also, some new cautionary notes from ISO are added to the estimation of "highly annoyed" as notes to the informative annex. A new Annex G addresses complaints in the limited situation of high-energy impulsive noise.

The current edition of ISO 1996-1:2003 actually began as the text of ANSI S12.9 - 1996/Part 4. However, the ISO standard was substantially revised during the WG and committee deliberations. For example, ISO recognizes the more general Day-Evening-Night Sound Level in contrast to S12's Day-Night Sound Level. Nighttime hours are not given in ISO because they vary from country to country. The terms "background" sound and "ambient" sound are NOT used in ISO because they have diametrically opposed meanings in different countries and regions. There are many other differences of this nature. ISO uses "rating" sound level; ANSI uses "adjusted" sound level, etc.

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

R.D. Hellweg, *Chair*

R.D. Godfrey, *Vice-Chair*
S.B. Blaeser, *Secretary*

Acoustical Society of America B.M. Brooks
..... P.D. Schomer (Alt.)

Aearo Company E.H. Berger

Air-Conditioning and Refrigeration Institute R. Seel
..... D. Brown (Alt.)

Alcoa Inc. W.D. Gallagher

American Industrial Hygiene Association	D. Driscoll
.....	J. Banach (Alt.)
American Speech-Hearing-Language Association	L.A. Wilber
.....	V. Gladstone (Alt.)
American Society of Heating, Refrigeration, and Air-Conditioning	R.J. Peppin
.....	E. Rosenberg (Alt.)
Bruel & Kjaer Instruments, Inc.	M. Alexander
.....	J. Chou (Alt.)
Caterpillar, Inc.	K.G. Meitl
.....	D.G. Roley (Alt.)
Compressed Air and Gas Institute	J.H. Addington
.....	D.R. Bookshar (Alt.)
Council for Accreditation in Occupational Hearing Conservation	J. Banach
.....	E.H. Berger (Alt.)
Emerson Electric – Copeland Corporation	A.T. Herfat
General Motors	D. Moore
Howard Leight Industries	V. Larson
.....	E. Woo (Alt.)
International Safety Equipment Association	J. Birkner
.....	J.C. Bradley (Alt.)
Information Technology Industry Council	R.D. Hellweg
.....	J. Rosenberg (Alt.)
Institute of Noise Control Engineering	B. Tinianov
.....	M. Lucas (Alt.)
James, Anderson & Associates	R.R. Anderson
.....	R.R. James (Alt.)
John Deere	K. Cone
Larson Davis Laboratories	L. Davis
.....	K. Cox (Alt.)
National Council of Acoustical Consultants	J. Erdreich
.....	G.E. Winzer (Alt.)
National Hearing Conservation Association	K. Michael
National Institute for Occupational Safety and Health	W.J. Murphy
Noise Control Engineering, Inc.	M. Bahtiaran
.....	R. Fischer (Alt.)
Noise Pollution Clearinghouse	L. Blomberg
North American Insulation Manufacturers Association	R.D. Godfrey
Plantronics, Inc.	A.K. Woo

Power Tool Institute, Inc...... W.D. Spencer
..... M. Hickok (Alt.)

Quest Technologies, Inc...... M. Wurm
..... P. Battenberg (Alt.)

Rubber Manufacturers Association S. Butcher
..... A. Hartke (Alt.)

SAE C. Michaels

U.S. Air Force (USAF) R. McKinley

U.S. Army Aeromedical Research Lab W. Ahroon
..... N. Alem (Alt.)

U.S. Army Center for Health Promotion and Preventive Medicine..... W.A. Russell
..... W. Whiteford (Alt.)

U.S. Army Construction Engineering Research Laboratories M. White
..... L. Pater (Alt.)

U.S. Department of Transportation..... A. Konheim

U.S. Army Human Research and Engineering Directorate T.R. Letowski
..... L. Babeu (Alt.)

U.S. Naval Surface Warfare Center Carderock M. Craun
..... 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. 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 15, Measurement and Evaluation of Outdoor Community Noise, which assisted Accredited Standards Committee S12, Noise, in the development of this standard, had the following membership.

	P.D. Schomer, Chair	
G.A. Daigle	L.S. Finegold	G.A. Luz
K.M. Eldred	L. Pater	A.H. Marsh
A.G. Konheim		

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

0.1 Part 1 of ANSI S12.9 defines day-night average sound level and other descriptors of community noise. Part 2 of ANSI S12.9 describes measurement procedures. ANSI S12.9/Part 5 provides a recommended relation between long-term usages of land and day-night average sound level for purposes of long-term land-use planning. Since the early 1970s, many agencies within the United States of America have used day-night average sound level as the fundamental descriptor to predict the community response to environmental sounds.

0.2 The 1978 seminal paper by T.J. Schultz demonstrated the efficacy of day-night average sound level for predicting the annoyance response of a community as a result of noise from highway traffic, railroad, aircraft, and some industrial sites. Implementation of the concept of day-night average sound level for prediction of community response often combined the sound exposures from such sources.

0.3 Day-night average sound level has been used to predict the annoyance response of communities to types of noises that were not included in the Schultz database for the relation between the percentage of a population expressing high annoyance and the corresponding day-night average sound level. These additional types of noises include sounds with special characteristics, such as impulsiveness, dominant pure tones, rapid onset, and strong low-frequency content.

0.4 Technical reports and articles published in refereed engineering and scientific journals demonstrated that the community response to these sounds may be predicted, provided suitable adjustments are applied. A practical procedure to apply these adjustments is provided by this Standard.

0.5 For situations where activity interference is the major concern, use of adjusted day-night average sound level or adjusted total day-night sound exposure may not be appropriate. For example, day-night average sound level without adjustments may be a better predictor of speech interference than adjusted day-night average sound level. Descriptors such as maximum A-weighted sound level, time-above, or speech interference level may be even more appropriate for predicting speech interference.

American National Standard

QUANTITIES AND PROCEDURES FOR DESCRIPTION AND MEASUREMENT OF ENVIRONMENTAL SOUND — PART 4: NOISE ASSESSMENT AND PREDICTION OF LONG-TERM COMMUNITY RESPONSE

1 Scope

1.1 This Standard specifies methods to assess environmental sounds and to predict the potential annoyance response of a community to outdoor long-term noise from any and all types of environmental sounds from one or more discrete or distributed sound sources. The sound sources may be separate or in various combinations. Application of the prediction method is limited to areas where people reside and to related long-term land uses.

NOTE The long-term period is typically one year. However, the user of this Standard can employ these methods for shorter periods of time, but they should report this change and not attempt to predict percent highly annoyed using Clause 8.3 or Annex F, since the Annex F data all represent long-term situations.

1.2 This Standard describes adjustments for sounds that have special characteristics so that the long-term community response to such sounds can be predicted by a method that is based on day-night average sound level or total day-night sound exposure. Sounds, such as from highway traffic, are evaluated directly by sound exposure or sound level without adjustment. The prediction method is directly analogous to the use of day-night average sound level to predict the response of a community to general environmental sounds.

1.3 This Standard does not address the effects of short-term exposure of people to intrusive sounds in locations such as parks and wilderness areas. The Standard also does not address other effects of noise such as sleep disturbance or health effects. This Standard does not provide a method to predict the response of a community to short-term, infrequent, non-repetitive sources of sound.

1.4 This Standard introduces the application of new descriptors: adjusted sound exposure and adjusted sound exposure level. The new descriptors are closely related to sound exposure and sound exposure level, respectively. The new descriptors are introduced to facilitate the prediction of the response of communities to the wide range of outdoor sounds covered by the scope of the Standard.

1.5 The sounds are assessed either singly or in combination, allowing for consideration, when necessary, of the special characteristics of impulsiveness, tonality, onset rate, and low-frequency content. In the same manner as sound exposure and sound exposure level are used to generate total day-night sound exposure or total day-night average sound level, adjusted sound exposure or adjusted sound exposure level are used to generate adjusted total day-night sound exposure or adjusted day-night average sound level.

1.6 Annoyance is not the only possible measure of community response. One frequently cited measure is numbers of complaints, sometimes normalized to numbers of inhabitants. Complaints can be particularly relevant near factories and plants, by airports and military installations, etc. Complaints do not correlate well with long-term average metrics such as DNL (see Refs. 7 and 8 for

example). Unfortunately, in general, metrics to predict the likelihood and prevalence of complaints do not yet exist with sufficient accuracy. One notable exception is the high-energy impulse sound generated by military activities and similar civilian noise sources, and informative Annex G provides procedures for assessing the risk of noise complaints from such sources.

1.7 The addition of adjustments eliminates the possibility to measure the total adjusted sound exposure or sound exposure level in a general situation that comprises a variety of sound sources (e.g., the combination of a highway leading to an airport and the airport itself). As a possible measurable alternative, this Standard introduces a new metric based on the equal-loudness level contours that were contained in ISO 226:1987. This new method uses the equal-loudness level contours as a set of dynamic filters that vary both with amplitude and frequency. This method is described in informative Annex H.

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.

- [1] ANSI S1.1-1994 (R 2004) *American National Standard Acoustical Terminology*.
- [2] ANSI S12.9-1988/Part 1 (R 2003) *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 1*.
- [3] ANSI S12.9-1992/Part 2 (R 2003) *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 2: Measurement of Long-Term Wide-Area Sound*.
- [4] ANSI S12.9-1993/Part 3 (R 2003) *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 3: Short-term Measurements with an Observer Present*.
- [5] ANSI S12.9-1998/Part 5 (R 2003) *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound - Part 5: Sound Level Descriptors for Determination of Compatible Land Use*.
- [6] ANSI S1.13-2005 *American National Standard Methods for the Measurement of Sound Pressure Levels in Air*.

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in ANSI S1.1-1994 and the following apply:

3.1(a) adjusted sound exposure. Frequency-weighted sound exposure adjusted for the change in annoyance caused by certain impulsive sounds, the presence of prominent discrete-frequency tones, sounds that startle because of their rapid onset rate, sounds with strong low-frequency content, and the presence of masking background sound. Unit, pascal-squared second (Pa^2s); symbol, *N*.

NOTE 1 Adjustments and frequency weightings for various types of sounds are given in Clause 7.

NOTE 2 The unit of pascal-squared second for adjusted sound exposure has been abbreviated as “pasque.”

3.1(b) reference sound exposure. The product of the square of the reference sound pressure of 20 μPa and the reference time of 1 s. Unit, pascal-squared second (Pa^2s); symbol, E_0 .

3.1(c) adjusted sound exposure level. Ten times the base-10 logarithm of the ratio of the adjusted sound exposure to the reference sound exposure E_0 . Unit, decibel (dB); symbol, L_{NE} .

3.2 adjusted total day-night sound exposure. Frequency-weighted sound exposure for a 24-hour day calculated by adding adjusted sound exposure obtained during the daytime (0700-2200 hours) to ten times adjusted sound exposure obtained during the nighttime (0000-0700 and 2200-2400 hours). Unit, pascal-squared second (Pa^2s); symbol, N_{dn} .

3.3(a) adjusted day-night average sound pressure. Square root of ratio of adjusted total day-night sound exposure to 86,400 s. Unit, pascals (Pa).

3.3(b) adjusted day-night average sound level. Ten times the base-10 logarithm of the ratio of the square of the adjusted day-night average sound pressure to the square of the reference sound pressure of 20 μPa . Unit, decibel (dB); symbol, L_{Ndn} .

3.4 impulsive sound. Sound characterized by brief excursions of sound pressure (acoustic impulses) that significantly exceed the ambient environmental sound pressure. The duration of a single impulsive sound is usually less than one second.

NOTE At the time of publication, no mathematical descriptor existed to unequivocally define the presence of impulsive sound or to separate impulsive sounds into categories.

3.4.1 highly impulsive sound. Sound from one of the following enumerated categories of sound sources: small-arms gunfire, metal hammering, wood hammering, drop hammering, pile driving, drop forging, pneumatic hammering, pavement breaking, metal impacts during rail-yard shunting operation, and riveting.

3.4.2 high-energy impulsive sound. Sound from one of the following enumerated categories of sound sources: quarry and mining explosions, sonic booms, demolition and industrial processes that use high explosives, military ordnance (e.g., armor, artillery and mortar fire, and bombs), explosive ignition of rockets and missiles, explosive industrial circuit breakers, and any other explosive source where the equivalent mass of dynamite exceeds 25 g. Normally, for single impulsive sounds of concern for this Standard, the A-weighted sound exposure level will exceed 65 dB and the C-weighted sound exposure level will exceed 85 dB.

3.4.3 regular impulsive sound. Impulsive sound that is not highly impulsive sound or high-energy impulsive sound.

3.5 onset rate. Nominally, the average rate of change of sound level during the onset of a noise event. Mathematically, onset rate is the rate of change of the A-weighted event sound level between the time the event sound level first exceeds the ambient sound level by 10 dB, and the time the event sound level first exceeds a level that is 10 dB less than the event's maximum fast-time-weighted sound level. Onset rate is defined for those event sound levels for which the maximum A-frequency-weighted, fast-time-weighted sound level exceeds the ambient sound level by at least 30 dB. Unit, decibels per second (dB/s).

NOTE 1 The nominal 125-ms time constant of fast time weighting normally is not small enough to accurately determine onset rate. Onset rate should be determined from the time variation of the level of the squared sound pressure. A digital system that provides a series of short-time-average sound levels may be used. In this case, the averaging time for each sound level in the series should be no greater than 1/10 and no less than 1/25 of the time span over which the onset rate is determined. A digital or analog system with exponential time weighting also may be used. In this case, the exponential time constant should be no greater than 1/4 and no less than 1/10 of the time span over which the onset rate is determined.

NOTE 2 A determination of onset rate should not be unduly influenced by anomalous fluctuations in the sound level.

3.6 time above. The time per stated unit time interval that the sound pressure level exceeds a criterion level (e.g., 30 s per hour). The frequency weighting or filtering (e.g., A-weighting), time weighting or integration time interval, and the unit time interval all must be stated. Typical Units: seconds (s) or minutes.

4 Descriptors for environmental sounds

4.1 Single-event sounds

4.1.1 Descriptors

Sounds from single events such as the passby of a truck, the flyby of an airplane, or an explosion at a quarry are all examples of single-event sounds. Each sound can be characterized by many descriptors. These descriptors include physical quantities and the corresponding levels in decibels. The level of a descriptor and its corresponding physical quantity form a descriptor pair. Three descriptor pairs often are used to describe the sound of single events. For each of these, frequency-weighting A is understood except for high-amplitude impulsive sounds or sounds with strong low-frequency content. The preferred three descriptor pairs are:

peak (frequency-weighted) sound pressure and peak (frequency-weighted) sound pressure level;

maximum exponential-time-weighted sound pressure and maximum sound level; and
sound exposure and sound exposure level.

NOTE 1 For the above descriptor pairs, the frequency weighting should be specified if frequency-weighting A is not employed, e.g., as peak C-weighted sound pressure level, C-weighted sound exposure level.

NOTE 2 For maximum sound pressure (and maximum sound level), the exponential-time-weighting should be specified, e.g., as fast (F) or slow (S).

4.1.2 Event duration

Event duration shall be specified relative to some characteristic of the sound such as the time of occurrence of the maximum sound level or the time some threshold was exceeded. For example, duration may be the total time that the sound level is within 10 dB of the maximum sound level.

4.2 Continuous sounds

Environmental sounds from sources such as transformers, fans, or cooling towers are examples of continuous sounds. Amplitudes of continuous sounds may be constant or slowly varying. Each sound can be characterized by many descriptors. Two descriptor pairs are commonly used to describe a continuous sound. For each of these, frequency-weighting A is commonly used. The two preferred descriptor pairs are:

maximum (exponential-time-weighted) sound and maximum sound level; and

time-average sound pressure and time-average (equivalent-continuous) sound level.

NOTE 1 For both of the above descriptors, the frequency weighting should be specified if frequency-weighting A is not employed.

NOTE 2 For maximum (exponential-time-weighted) sound (and maximum sound level), the exponential-time weighting should be specified, e.g., as fast (F) or slow (S).

NOTE 3 See Clauses 5.1.4, 5.1.5, and 5.1.6 in ANSI S12.9-1988/Part 1 (R2003) for definitions of these quantities.

4.3 Repetitive single-event sounds

Repetitive single-event environmental sounds typically are recurrences of single-event sounds. For example, during a day, the sound from traffic on a highway is the sum of the sound from multiple individual vehicle passbys. In this Standard, all repetitive single-event sounds utilize the descriptor for the particular single-event sounds and the corresponding number of events.

5 Sound measurement locations

All sounds, except high-energy impulsive sounds, shall be measured or predicted as if they had been measured by a microphone outdoors, over acoustically absorptive ground (grass), at a height of approximately 1.2 m and with no nearby reflecting surfaces except the ground. Alternative microphone locations may be used, but their acoustical characteristics shall be specified. An example of an alternative location is outside an open, upper-story window in a high-rise apartment building where the purpose is to predict or assess the environmental sound at that location. High-energy impulsive sounds shall be measured or predicted as if they had been measured by a microphone within 50 mm of a hard reflecting surface (e.g., a building wall, roof, or ground plane, as appropriate).

NOTE 1 A reflecting surface is required because sonic booms, which are one form of high-energy impulsive sounds, have traditionally been measured or predicted for a location on a reflecting ground plane or structure.

NOTE 2 To ensure comparable data, sonic booms should be measured on a reflecting ground plane or other equivalent structure.

6 Adjustments for background sound

6.1 General

Annex A discusses a general method to include adjustments for background sound. The general method is applicable to three cases: (1) the sound of concern is very noticeable and detectable in the background setting of interest, (2) the sound of concern is virtually unnoticeable and undetectable in the background setting of interest, and (3) the sound of concern is in a range such that it may be noticeable and detectable only for a portion of the time.

6.2 Specific requirements

When the conditions of 6.1(2) apply and the sound is virtually unnoticeable and undetectable in the background setting of interest, then its sound exposure shall not be included in a calculation of the total sound exposure from multiple sound sources. If some particular sound is excluded, then the physical background setting shall be specified. For example, this setting may be "urban residential not near an arterial street, outdoors," or "suburban residential indoors with windows partially open," or "urban residential near an arterial street, indoors with windows closed."

NOTE Direct measurements may be used to determine the background sound level prevailing for the environment. Procedures in Part 3 of ANSI S12.9 should be used to measure the background sound level.