ANSI S12.18-1994
(ASA 110-1994)

Reaffirmed by ANSI
June 23, 2004

Reaffirmed by ANSI
June 15, 2009

AMERICAN NATIONAL STANDARD

Procedures for Outdoor Measurement of Sound Pressure Level

Secretariat
Acoustical Society of America

Approved 12 May 1994
American National Standards, Inc.

ABSTRACT

This American National Standard describes procedures for the measurement of sound pressure levels in the outdoor environment, considering the effects of the ground, the effects of refraction due to wind and temperature gradients, and the effects due to turbulence. This standard is focused on measurement of sound pressure levels produced by specific sources outdoors. The measured sound pressure levels can be used to calculate sound pressure levels at other distances from the source or to extrapolate to other environmental conditions or to assess compliance with regulation. This standard describes two methods to measure sound pressure levels outdoors. METHOD No. 1: general method, outlines conditions for routine measurements. METHOD No. 2: precision method, describes strict conditions for more accurate measurements. This standard assumes the measurement of A-weighted sound pressure level or time-averaged sound pressure level or octave, 1/3-octave or narrow-band sound pressure level, but does not preclude determination of other sound descriptors.

AMERICAN NATIONAL STANDARDS ON ACOUSTICS

The Acoustical Society of America 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, and general-interest representatives). The standards are published by the Acoustical Society of America through the American Institute of Physics 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.

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Foreword

[This Foreword is not a part of American National Standard for Outdoor Measurement of Sound Pressure Level, ANSI S12.18-1994 (ASA Catalog No. 110-1994)]

This standard provides guidelines for measuring and reporting sound pressure levels associated with a specific source and observed under different environmental conditions outdoors. This standard presents requirements for the documentation of the procedures and results to permit interpretation and independent evaluation of the results.

This standard has been developed under the jurisdiction of Accredited Standards Committee S12, Noise, using the American National Standards Institute (ANSI) Accredited Standards Committee Procedure. The Acoustical Society of America provides the Secretariat for Accredited Standards Committee S12, Noise.

Accredited Standards Committee S12, Noise, under whose jurisdiction this standard was developed, had the following scope:

> *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 S12, Noise, for approval, the membership was as follows:

D. L. Johnson, *Chair*
P. D. Schomer, *Vice Chair*
A. Brenig, *Secretary*

Acoustical Society of America	D. L. Johnson, W. J. Galloway (*Alt.*)
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Aluminum Company of America (ALCOA)	S. I. Roth
American Academy of Otolaryngology—Head & Neck Surgery, Inc.	L. A. Michael (*Alt.*)
American College of Occupational Medicine	P. J. Brownson, J. Sataloff (*Alt.*)
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Compressed Air and Gas Institute (CAGI)	J. H. Addington
Computer and Business Equipment Manufacturers Association	L. F. Luttrell
David Taylor Research Center	D. J. Vendittis
Edison Electronic Institute	J. Fox, M. C. Mingoia (*Alt.*)

Fastener Industry Noise Control Research Program	E. H. Toothman, J. C. McMurray (*Alt.*)
U. S. Department of Transportation	A. Konheim
Industrial Safety Equipment Association	A. M. Bovi, R. Campbell (*1st Alt.*), F. E. Wilcher (*2nd Alt.*)
Larson-Davis Laboratories	R. Anderson, L. Davis (*Alt.*)
National Council of Acoustical Consultants	J. Erdreich, R. L. Richards (*Alt.*)
National Electrical Manufacturers Association (NEMA)	D. Rawlings
National Hearing Conservation Association (NHCA)	J. Franks, E. H. Berger (*Alt.*)
Power Tool Institute, Inc.	R. Callahan, D. Keller (*Alt.*)
U. S. Army Aeromedical Research Laboratory	B. Mozo, J. H. Patterson (*Alt.*)
U. S. Army Construction Engineering Laboratory (USA-CERL)	P. D. Schomer, M. White (*Alt.*)
U. S. Department of the Air Force	R. L. McKinley
U. S. Department of the Army, Walter Reed Army Medical Center	R. M. Atack
U. S. Department of the Navy, Bureau of Medicine and Surgery	J. Page, L. Marshall (*Alt.*)

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

P. K. Baade	W. J. Galloway	L. H. Royster
R. G. Bartheld	R. Guernsey	W. R. Thornton
R. W. Benson	R. K. Hillquist	H. E. von Gierke
L. Beranek	D. L. Johnson	L. A. Wilber
E. H. Berger	W. W. Lang	G. E. Winzer
K. M. Eldred	G. C. Maling, Jr.	G. S. K. Wong
R. S. Gales	A. H. Marsh	R. W. Young

Working Group S12/WG27, Outdoor Measurement of Sound Pressure Level, which assisted Accredited Standards Committee S12, Noise, in the development of this standard, had the following membership:

G. A. Daigle, Chair

C. D. Bohl	R. Raspet
S. I. Hayek	J. M. Sabatier
J. S. Lamancusa	L. C. Sutherland
J. Nicolas	D. Thomson
R. J. Peppin	W. L. Willshire
A. D. Pierce	

Suggestions for improvements of this standard will be welcomed. They should be sent to the Accredited Standards Committee S12, at the Standards Secretariat, in care of the Acoustical Society of America, 120 Wall Street, 32nd Floor, New York, New York 10005-3993. Telephone (212) 248-0373; FAX (212) 248-0146.

American National Standard

Outdoor Measurement of Sound Pressure Level

0 Introduction

This Standard is concerned with the measurement of sound pressure levels outdoors under a variety of conditions. The basic purpose of this standard is to establish uniform procedures for obtaining sound pressure level data in the presence of the effects of the ground and meteorology outdoors.

The purpose of sound pressure level measurements fall into two broad categories: sound pressure levels measured in order to characterize a specific source and sound pressure levels measured in order to characterize an ambient environment. Primary interest in this standard is focused on sound pressure levels obtained outdoors from specific sources.

This standard is an application of the fundamental standard ANSI S1.13. Whereas the focus of ANSI S1.13 is the basic requirements for the measurement of sound pressure levels for their own sake, the focus of the current standard is the requirements for sound pressure level measurements undertaken outdoors for the specific purpose of source characterization. The current standard specifies requirements in addition to those given in ANSI S1.13.

The procedures for measurement of long-term environmental sound levels outdoors at one or more locations in a community for such purposes as noise prediction validation, regulation and environmental assessment or compatible land use planning are covered by other American National Standards such as ANSI S12.9. The procedures recommended by ANSI S12.9 sample outdoor sound by accepting the environmental and meteorological conditions "as is" within broad limits, thereby providing a statistical sampling of the environmental levels from a variety of sources and meteorological conditions. The current standard specifically excludes outdoor measurement of total environmental sound in a community. However, guidance is given in this standard to obtain an estimate of the ambient sound levels.

The measurement of sound pressure level may not always suffice for the quantitative characterization of the sound produced by a source. The total acoustic power radiated by a source of sound is usually preferable to provide a better measure of source output. Since acoustic power is usually calculated from measured values of time mean square sound pressure which depend on the acoustic environment, it is necessary to design the measurement environment carefully if the accuracy required for sound ratings and comparisons is to be achieved. All aspects of the determination of sound power of sources are covered by other American National Standards such as ANSI S12.30 through S12.36. The current standard specifically excludes those sound pressure level measurements which are obtained in order to permit calculation of the sound power radiated by a source.

This standard describes procedures to measure sound pressure levels from specific sources outdoors. Sound pressure levels from a specific source outdoors are a function of source height, receiver height, the type of ground, and the local atmospheric conditions. Therefore, measured sound pressure levels do not generally obey the simple inverse square law of a 6 dB decrease in level for each doubling of distance. The application of the procedures recommended by this standard will yield reproducible sound pressure levels from measurements of the same source at the same microphone location on different days. The measurements obtained using this standard could be used to adjust sound pressure levels from the same source obtained at different sites for reliable comparison or could be used to calculate sound pressure levels at other distances from the source or to extrapolate to other environmental conditions or to assess compliance with community noise ordinances.

This standard describes two methods for measuring sound pressure levels outdoors. METHOD #1: general method, outlines conditions for routine measurements. METHOD #2: precision method, describes strict conditions for precise measurements. In planning a series of sound pressure measurements, the purpose of the measurements should be kept clearly in mind.

The two methods for sound pressure level measurements in this standard are summarized in Table 1. The method selected depends upon the required accuracy of the measurements. In many situations, the measurement procedure of the general method may be entirely adequate. The precision method is

used when more precise measurements are required or for an analysis of the sound pressure levels in frequency bands from measurements made under prescribed meteorological and ground conditions over an appropriate time interval.

METHOD #1: general method, is for routine measurements and is utilized if meteorological variables fall within broad but predetermined limits. No effort is made to control the acoustical environment; that is, the environment is in an "as is" condition. This method usually will utilize a hand held sound level meter to provide a frequency weighted and time-averaged sound pressure level, but does not preclude instruments for frequency band analysis.

METHOD #2: precision method, is for more reproducible measurement of sound pressure levels if the meterorological and ground conditions fall within strict limits. The acoustical environment may be in an "as is" condition, or guidelines are given to modify or find a controlled acoustical environment for better accuracy. Procedures are suggested to adjust the measured sound pressure levels to reference conditions. The precision method is suited for frequency band analysis, but also provides more accurate frequency weighted sound pressure levels if required.

1 Scope, purpose, and applications

1.1 Scope

This standard describes methods for measuring sound pressure levels in the outdoor environment, taking into account the effects of refraction due to wind and temperature gradients, the effects of atmospheric turbulence, the effects of variable ground impedance, and wind noise.

This standard assumes A-frequency weighting or the use of octave, 1/3-octave, or narrow-band filters, but does not preclude the use of other frequency weighting or other sound descriptors.

This standard prescribes selected meteorological conditions under which sound pressure level measurements shall be made. Certain meteorological conditions are reproducible and correspond to quite stable sound propagation conditions. These optimal conditions yield reproducible measurements and allow the comparison of sound pressure levels measured at different times.

The standard does not prescribe standardized receiver locations. Sound pressure levels may be measured at receiver locations of interest, within certain prescribed limits.

Measurement conditions shall be carefully documented and noted in the report describing the sound pressure level measurements. The measured sound pressure levels shall apply only to the stated conditions and shall not represent the sound pressure levels under other conditions, sites, receiver locations, or sources. In some cases, guidance is provided to adjust the measured sound pressure levels to reference conditions, other sites, or other receiver location.

This standard does not include procedures for measurement of long-term, time-average environmental sound levels in a community for environmental assessment or planning for compatible land uses.

Sound pressure levels measured for determining the sound power radiated by a source are not covered by this standard.

1.2 Purpose

The purpose of this standard is to specify procedures for measuring and reporting sound pressure levels from specific sources outdoors and to specify a set of reproducible atmospheric conditions to obtain reproducible measurements.

1.3 Applications

This standard is applicable to the measurement of sound pressure levels from specific sources outdoors. The measurements take into account the source height, receiver height, the type of ground, and the local atmospheric conditions. A major application of this standard is obtaining reproducible sound pressure levels from the same source at the same microphone location on different days. Another application is to adjust sound pressure levels from the same source measured at different sites or distances for reliable comparison. The sound pressure levels measured using this standard can be used to calculate sound pressure levels at other distances from the source or to extrapolate to other environmental conditions. The measurements can be used in conjunction with other standards and procedures to obtain a more accurate test for compliance with community noise regulations.

2 References to other standards

The following standards contain provisions which, through reference in this document, constitute pro-