

ANSI S12.9-1992/Part 2
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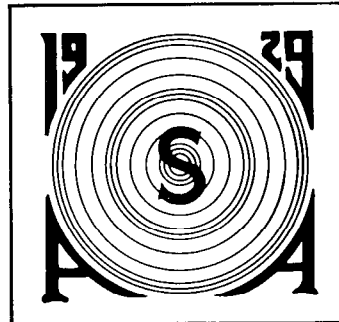
AMERICAN NATIONAL STANDARD
**QUANTITIES AND PROCEDURES
FOR DESCRIPTION AND
MEASUREMENT OF
ENVIRONMENTAL SOUND. PART 2:
MEASUREMENT OF LONG-TERM,
WIDE-AREA SOUND**

Accredited Standards Committee S12, Noise

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**ANSI S12.9-1992/Part 2
(ASA 105-1992)**

**AMERICAN NATIONAL STANDARD
Quantities and Procedures for Description and
Measurement of Environmental Sound. Part 2:
Measurement of long-term, wide-area sound**

**ACCREDITED STANDARDS COMMITTEE S12,
NOISE**

ABSTRACT

This standard is the second in a proposed series of parts concerning description and measurement of outdoor environmental sound. This standard describes recommended procedures for measurement of long-term, time-average environmental sound outdoors at one or more locations in a community for environmental assessment or planning for compatible land uses and for other purposes such as noise prediction validation and regulation. Sound may be produced by one or more separate, distributed sound sources such as a highway, factory, or airport, or by all contributing sound sources. For spatial or temporal samples of environmental sound in a community, requirements are given for the number of sound-measurement locations and the duration of the sound-sampling intervals needed to obtain average values for long-term environmental sound levels that are within stated accuracy limits for Class A, Class B, or Class C measurements. The purpose of this standard is to provide for a commonality for measurements of outdoor environmental sound as it may affect people in and around dwellings.

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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

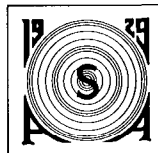
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FOREWORD

[This Foreword is not a part of American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound. Part 2: Measurement of long-term, wide-area sound, ANSI S12.9-1992/Part 2 (ASA Catalog No. 105-1992)]

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, has 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

This standard is the second in a proposed series of parts concerning description and measurement of outdoor environmental sound. This standard describes recommended procedures for measurement of long-term, average environmental sound levels outdoors at one or more locations in a community. The first part in this series is ANSI S12.9-1988, American National Standard Quantities and Procedures for Description and Measurement of Outdoor Environmental Sound Part 1. The first part deals largely with definitions for standard quantities; this new part deals largely with procedures.

This series uses the three parts of ISO 1996-1987, Description and Measurement of Environmental Noise, as a point of departure, but there are marked differences.

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

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Suggestions for improvements in this standard will be welcomed. They should be sent to **Accredited Standards Committee S12, Noise, at the Standards Secretariat, in care of the Acoustical Society of America, 335 East 45th Street, New York, NY 10017-3483. Telephone (212) 661-9404.**

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American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound. Part 2: Measurement of long-term, wide- area sound

1 SCOPE

This standard describes recommended procedures for measurement of long-term, time-average environmental sound outdoors at one or more locations in a community for environmental assessment or planning for compatible land uses and for other purposes such as noise prediction validation and regulation. Sound may be produced by one or more separate, distributed sound sources such as a highway, factory, or airport, or by all contributing sound sources. For spatial or temporal samples of environmental sound in a community, requirements are given for the number of sound-measurement locations and the duration of the sound-sampling intervals needed to obtain average values for long-term environmental sound levels that are within stated accuracy limits for Class A, Class B, or Class C measurements.

2 PURPOSE

The purpose of this standard is to provide for a commonality for measurements of outdoor environmental sound as it may affect people in and around dwellings.

3 APPLICATIONS

This standard is applicable to measurement of outdoor environmental sound in a community. Typical applications include:

- (a) assessment of the general community noise environment and establishment of baseline environmental sound levels;
- (b) evaluation of the general noise environments of various areas within a city, or determination of areas of greatest noise impact;
- (c) identification of the principal community sound sources responsible for major contributions to the general noise environment;

- (d) comparison of the environmental sound levels in a city with those in other cities;
- (e) measurement of environmental noise levels with respect to the evaluation of public attitudes toward noise, or the results of a noise attitudinal survey;
- (f) development of a technical basis for a community noise reduction strategy which might include various measures such as educational programs, a noise ordinance, housing site setbacks from heavily traveled roads, and the inclusion of barrier walls and beams around proposed housing developments;
- (g) guidance for environmental sound measurement elements of planning land use, and highway traffic rates and patterns;
- (h) providing the technical basis for measurement of environmental sound levels to be included in associated enforcement efforts;
- (i) demonstration of compliance with community noise limits established by cognizant local, state, or federal departments or agencies; and
- (j) repeat measurements of community sound levels to determine trends or effectiveness of noise control efforts.

4 REFERENCES TO OTHER STANDARDS

[The following standards contain provisions which, through reference in this document, constitute provisions of this American National Standard. At the time of approval by the American National Standards Institute, Inc. (ANSI), the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.]

- (1) ANSI S12.40-1990, American National Standard Sound Level Descriptors for Determination of Compatible Land Use.

- (2) ANSI S12.4-1986 (R 1993), American National Standard Method for Assessment of High-Energy Impulsive Sounds with Respect to Residential Communities.
- (3) ANSI S1.13-1971 (R 1986), American National Standard Methods for the Measurement of Sound Pressure Levels.
- (4) ANSI S12.7-1986 (R 1993), American National Standard Methods for Measurements of Impulse Noise.
- (5) ANSI S12.9-1988 (R 1993), American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound. Part 1.
- (6) IEC 804:1985, Integrating-Averaging Sound Level Meters.
- (7) ANSI S1.40-1984 (R 1990), American National Standard Specification for Acoustical Calibrators.
- (8) IEC 942:1988, Sound Calibrators.

(a) **simple stratified:** each sampling area in a community is divided into as many subsampling areas as there are spatial criteria under consideration. Sound levels in each subsampling area are sampled independently of those in other areas.

(b) **quota stratified:** total area is randomly sampled until the respective number of sites for each criterion are selected.

5.1.5 multi-stage spatial sampling: sampling of sound levels at measurement sites selected by combinations of sampling techniques in which the community is divided into study areas. Subsets of these study areas are selected as study areas for sound measurements by one sampling technique. Measurement sites for sampling of sound levels are chosen from within each selected study area using a second sampling technique.

5.1.6 cluster spatial sampling: cluster spatial sampling is a specific variation of multi-stage spatial sampling. A specific set of small study areas, called clusters, is selected from the community using one sampling technique. No study areas are defined for the remainder of the community. Measurement sites for sampling of sound levels are chosen from within each selected study area using either the same or another sampling technique.

5 DEFINITIONS

5.1 Spatial Sampling

5.1.1 deterministic spatial sampling: sampling of sound levels at measurement sites selected by person(s) who believe the levels at these sites to be representative of the sound levels in the total area from which the sites are selected.

5.1.2 systematic spatial sampling: sampling of sound levels at measurement sites selected by a predetermined, statistically unbiased procedure, for example, at equally spaced points along a line (linear systematic sampling), at logarithmically spaced points along a line (logarithmic systematic sampling), or at the intersection points of an orthogonal grid of lines (two-way linear systematic sampling).

5.1.3 random spatial sampling: sampling of sound levels at randomly selected measurement sites.

5.1.4 stratified spatial sampling: sampling of sound levels at measurement sites classified by a spatial criterion such as land use and selected according to a random or systematic technique. Two types of stratified spatial samples include:

5.2 Survey Area

5.2.1 macro survey area: a sufficiently large geographic area such that the *exact* location of any selected sound measurement site is not important. For example, in a macro survey area any housing lot in a selected block or neighborhood may be an equally good sound measurement site. The size of a macro survey area ranges from a few city blocks to an entire community.

5.2.2 micro survey area: a sufficiently small geographic area such that variations in the location of a measurement site either horizontally or vertically can affect the measured long-term, time-average environmental sound level. For measurement of traffic noise, a typical micro survey area includes an intersection and the streets leading into the intersection.

5.3 Noise Zone

A noise zone is a collection of all areas exposed to sounds produced by a particular kind of noise source, and typically comprises several geographically non-

continuous areas. For example, the ensemble of all commercial and industrial areas within a community constitutes the commercial-industrial noise zone. No location within a community may be categorized by more than one noise zone. When more than one significant noise source is present in a given area, the noise source with the highest day-night average sound level, in the absence of any other source(s), shall be used to identify the type of noise zone. One noise zone may contain, be contained by, or traverse another.

5.3.1 airport noise zone: collection of all areas in which aircraft activity is predicted to produce a day-night average sound level equal to or greater than a specified level such as 65 decibels (dB).

5.3.2 railroad noise zone: those areas which comprise the collection of linear strips extending on each side of well-traveled railroad tracks. The width of a railroad noise zone is a function of railroad activity according to the following guideline (The width corresponds to the outer boundary of a day-night average sound level contour of approximately 65 dB for a railroad track at ground level, without any trackside noise barriers, carrying typical rail traffic. However, this is only a rough approximation and is not intended to replace a rigorous noise analysis of railroad environmental sound levels.):

Equivalent number of train operations per day $N = N_{\text{day}} + 10 N_{\text{night}}$	Railway noise zone width from the track centerline (meters)
less than 5	No railroad zone
5 to 7	30
8 to 10	45
11 to 16	60
17 to 19	75
20 to 35	90
36 to 50	120
51 to 80	150
81 to 140	180
141 to 250	240
251 to 400	300

Railroad yards are considered stationary sources and are not included within a railroad noise zone.

5.3.3 roadway noise zone: collection of those areas which comprise linear strips extending on each side of a roadway, the width of which is a function of the

type of roadway or the average daily traffic count in all lanes. Roadway zones are classified as follows (The width corresponds to the outer boundary of a day-night average sound level contour of approximately 65 dB for a roadway at ground level, without any noise barriers, carrying typical road traffic. However, this is only a rough approximation and is not intended to replace a rigorous environmental sound analysis of roadway noise levels.):

Average daily traffic (ADT)	Roadway noise zone width from outer edge of pavement (meters)
less than 1200	6
1200 to 4000	12
4000 to 12 000	25
12 000 to 36 000	50
greater than 36 000	100

5.3.4 commercial-industrial noise zone: collection of those areas not falling within airport, railroad, or roadway noise zones in which the predominant land use is commercial or industrial.

5.3.5 stationary source noise zone: those areas not falling within airport, railroad, roadway, or commercial-industrial noise zones in which noise from large stationary sound sources predominate.

5.3.6 residential noise zone: collection of those areas not falling within airport, railroad, roadway, commercial-industrial, or stationary source noise zones in which the predominant land use is residential. Subclasses of a residential noise zone based upon population density are as described in the following table:

Density description	Density (people/kilometer ²)
Very low	less than 300
Low	300 to 800
Medium	800 to 2400
High	2400 to 7000
Very high	greater than 7000

NOTE: The commercial-industrial noise zone (see Sec 5.3.4) and the residential noise zone (see Sec 5.3.6) are established for purposes of implementing spatial sampling procedures as defined in Sec 8.3. These two zones are not necessarily distinguished by any sound source(s) within the zone itself.