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AMERICAN NATIONAL STANDARD

QUANTITIES AND PROCEDURES FOR DESCRIPTION AND MEASUREMENT OF ENVIRONMENTAL SOUND — PART 5: SOUND LEVEL DESCRIPTORS FOR DETERMINATION OF COMPATIBLE LAND USE

ANSI S12.9-1998/Part 5

Accredited Standards Committee S12, Noise

Standards Secretariat
Acoustical Society of America
120 Wall Street, 32nd Floor
New York, New York 10005-3993

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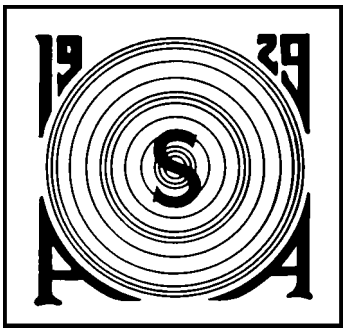

American National Standard

Quantities and Procedures for Description and Measurement of Environmental Sound — Part 5: Sound Level Descriptors for Determination of Compatible Land Use

Secretariat

Acoustical Society of America

Approved 27 January 1998

American National Standards Institute, Inc.

Abstract

This Standard provides guidance on the compatibility of various human uses of land with the acoustical environment. This Standard uses the yearly average total day-night adjusted sound exposure or the yearly average adjusted day-night average sound level to characterize the acoustical environment. Yearly average total day-night adjusted sound exposure and yearly average adjusted day-night average sound level are defined in Part 4 of ANSI S12.9. An informative annex provides guidance to local authorities for designation of land uses compatible with existing or predicted yearly average total day-night adjusted or non-adjusted sound exposure or yearly average adjusted or non-adjusted day-night average sound level. Ranges of the yearly average total day-night adjusted sound exposure or yearly average adjusted day-night average sound level are outlined, within which a specific region of compatibility may be drawn by local authorities. These ranges take into consideration the difference in sound level from outside to inside buildings as commonly constructed in that locality and living habits there.

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Standards Secretariat
Acoustical Society of America
120 Wall Street, 32nd Floor
New York, New York 10005-3993

Telephone: +1 212 248 0373
Telefax: +1 212 248 0146
E-mail: asastds@aip.org

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Foreword

[This Foreword is for information only and is not an integral part of American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound — Part 5: Sound Level Descriptors for Determination of Compatible Land Use, ANSI S12.9-1998/Part 5.]

This American National Standard supplements the four previous Parts of this series of Standards. **Part 1** presents definitions of quantities for description and measurement of outdoor environmental sounds. **Part 2** describes methods to measure long-term environmental sounds over wide areas. **Part 3** presents methods to measure short-term environmental sound when an observer is present to operate the instruments. **Part 4** presents methods to assess noise and predict the long-term community response to noise. This **Part 5** of ANSI S12.9-1998 supersedes and replaces ANSI S12.40-1990, and its predecessor, ANSI S3.23-1980.

This Standard contains two informative annexes.

This Standard was developed under the jurisdiction of Accredited Standards Committee S12, Noise, which 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.*

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

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G. S. K. Wong
R. W. Young

Working Group S12-WG15, Measurement and Evaluation of Outdoor Community Noise, which assisted Accredited Standards Committee S12, Noise, in the preparation of this Standard, had the following membership:

P. D. Schomer, *Chairman*

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A. J. Campanella	D. L. Johnson	K. S. Pearsons
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Suggestions for improvement of this Standard will be welcomed. They should be made in writing to Accredited Standards Committee S12, Noise, in care of the Standards Secretariat, Acoustical Society of America, 120 Wall Street, 32nd floor, New York, New York 10005-3993, USA. Telephone: +1 212 248 0373; FAX: +1 212 248 0146; E-mail: asastds@aip.org.

American National Standard

Quantities and Procedures for Description and Measurement of Environmental Sound – Part 5: Sound Level Descriptors for Determination of Compatible Land Use

0 Introduction

0.1 The compatibility of various land uses with the outdoor noise environment at a receiver site depends on acoustical and non-acoustical factors.

(i) *Acoustical factors:* the sound level at the receiver's outdoor location and its variation with time; the sound isolation provided by the buildings where people experience the effects of outdoor noise; and the noise environment generated indoors by indoor sources, including sounds produced by people themselves.

(ii) *Non-acoustical factors:* the type of human activity associated with a specific land use; the differing responses of individuals to the same noise environment; attitudes toward the noise sources and the persons responsible for creating the noise; familiarity with an intruding noise through previous experiences; the disturbance of an activity or the annoyance caused by the noise; specific requirements of individual communities; the cost of achieving lower average sound levels; and the technical feasibility of reducing the sound levels.

0.2 Many rating methods and measurement procedures have been proposed for assessing the compatibility between the noise environment and human activity. To assess the environmental acceptability of a site for various land uses, it is desirable to use a single measure that applies to sounds from all sources, individually and in combination, contributing to the noise at a site.

0.3 This Standard specifies yearly average total day-night adjusted sound exposure and yearly average adjusted or non-adjusted day-night average sound level as the acoustical measures to be used in assessing compatibility between various land uses and an outdoor noise environment. Total day-night adjusted sound exposure and adjusted day-night average sound level are similar to non-adjusted total day-night sound exposure and day-night average sound level. The difference is that the sound exposures for sounds with special characteristics such as impulsiveness, dominant pure tones, rapid onset, and sounds with strong low-frequency content are adjusted by a factor before they are added into the total. For some noise environments, the total day-night sound exposure or the day-night average sound level without the special adjustments may be more appropriate for assessments of compatible land use.

NOTE–Annex A contains designated land uses, such as sports arenas, where the total day-night sound exposure or the day-night average sound level without the special adjustments may be more appropriate for assessments of compatible land use.

0.4 Part 4 of ANSI S12.9 describes the calculation of total day-night adjusted sound exposure and adjusted day-night average sound level. 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 long-term measurement procedures. Part 3 of ANSI S12.9 describes short-term measurement procedures with an observer present.

0.5 Definitions of the descriptors of sound are exact and are specified with the same precision as any physically measurable acoustical quantity. In contrast to the physical measurement of the sound, the assessment of the relation of land use to prevailing noise is significantly less precise, in view of the non-acoustical factors described in 0.1.

0.6 The ranges of yearly average total day-night adjusted and non-adjusted sound exposure or yearly average adjusted and non-adjusted day-night average sound level noted in the annex for various land uses reflect the statistical variability of the responses of large groups of people to noise. Any particular value of adjusted or non-adjusted day-night average sound level may not, therefore,

accurately assess an individual's response to an actual noise environment.

0.7 Guidelines given in the annex for yearly average total day-night adjusted sound exposure and yearly average adjusted day-night average sound level were based on studies of noise-induced annoyance and other forms of noise-induced activity interference. A discussion of the data on these relationships is given in annex G to Part 4 of ANSI S12.9.

1 Scope

1.1 This Standard provides guidelines for assessing the compatibility of various human uses of land with the actual or projected outdoor noise environment at a site. The total noise environment is characterized by the yearly average total day-night adjusted or non-adjusted sound exposure or the yearly average adjusted or non-adjusted day-night average sound level. This Standard is based on the long-term annoyance response of communities as measured by the percent of a community that is highly annoyed.

1.2 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 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, or non-repetitive sources of sound.

2 Normative references

The following Standards contain provisions that, through reference in this text, 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. 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. Information on the most recent editions is available from the ASA Standards Secretariat.

[1] 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.*

3 Definitions

For the purposes of this Part 5, the following definitions apply. Definitions for related quantities are given in Part 1 of ANSI S12.9 (ANSI S12.9-1988/Part 1), in Part 4 of ANSI S12.9 (ANSI S12.9-1996/Part 4), and in ANSI S1.1-1994.

3.1 compatible land use. Land use consistent with the outdoor noise environment such that the yearly average total day-night adjusted sound exposure or the yearly average adjusted day-night average sound level at a site is not greater than the compatibility limit designated for that land use by local authorities.

3.2 land use. Existing or intended use of a specifically delineated land area or parcel.

3.3 land use category. A logical grouping of a set of related land uses.

EXAMPLE – An example category might be family housing. It might include single family detached dwellings, duplexes, mobile homes, and multi-family low rise dwellings.

Annex A
(informative)
Land Use Compatibility with Yearly Average Total Day-Night Adjusted Sound Exposure and Yearly Average Adjusted Day-Night Average Sound Level.

A.1 Land Uses

A.1.1 According to this annex, compatibility of a land use with the outdoor noise environment is assessed by comparing the predicted or measured yearly average total day-night adjusted or non-adjusted sound exposure or the yearly average adjusted or non-adjusted day-night average sound level at a site with the guidance criteria given in figure A.1.

A.1.2 Land-use categories are usually associated with comprehensive or master plans that detail present and future land uses. Adjustments or modifications of the descriptions of the land-use categories may be desirable after consideration of specific local conditions. These guidelines were developed without detailed consideration of the costs or technical feasibility of their implementation in any particular community.

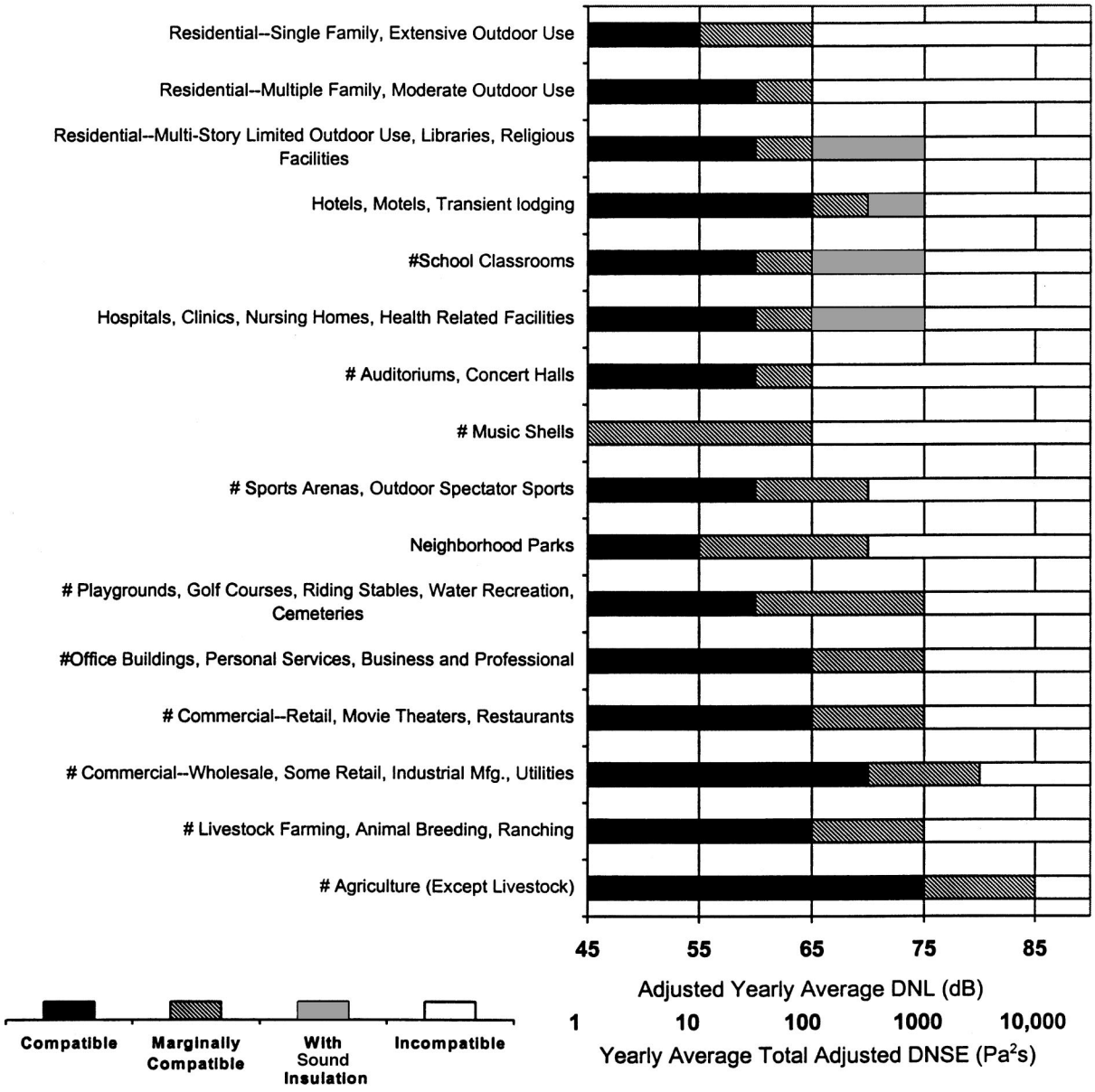

Figure A.1. — Land use compatibility with yearly average total adjusted day-night sound exposure (DNSE) or yearly average adjusted day-night average sound level (DNL) at a site for buildings as commonly constructed. At specific receiver locations, it may be appropriate to use sound exposure and sound exposure level without inclusion of the special adjustments from Part 4 of ANSI S12.9. A # sign is placed in front of the description of such land uses.

A.1.3 Determination of land use should be based upon the application of professional planning procedures utilizing comprehensive, or master, land use planning, zoning, and site design procedures, or a combination thereof. Sometimes a parcel of land can be suitable for more than one kind of use; when such a condition exists, or is proposed, determination of compatibility should be based upon the land use considered to be most adversely affected by the actual or projected outdoor noise environment.

A.2 Land Use Compatibility

A.2.1 A land use usually can be considered compatible with the outdoor noise environment at a site

if the yearly average total day-night adjusted sound exposure or the yearly average adjusted day-night average sound level lies within or below the upper boundary of the range identified in figure A.1 and labeled ''compatible.''

A.2.2 A land use usually can be considered incompatible with the noise environment at a site, if the yearly average total day-night adjusted sound exposure or the yearly average adjusted day-night average sound level lies within or above the lower boundary of the range identified in figure A.1 and labeled ''incompatible.''

A.2.3 Within the intermediate range, yearly average total day-night adjusted sound exposure or the yearly average adjusted day-night average sound level identified in figure A.1 and labeled ''marginally compatible,'' a local authority should designate a certain yearly average total day-night adjusted sound exposure or the yearly average adjusted day-night average sound level as the compatibility limit for each land use.

EXAMPLE – A city planning commission can decide that for residential single-family land use, with extensive outdoor living, the compatibility limit is yearly average total day-night adjusted sound exposure or the yearly average adjusted day-night average sound level of 10 (Pa^2s) or 55 (dB), respectively. Accordingly, in this city, this residential land use would be deemed compatible with the outdoor noise environment wherever the yearly average total day-night adjusted sound exposure or the yearly average adjusted day-night average sound level is not greater than 10 Pa^2s or 55 dB, respectively.

NOTE – This Standard is based on attitudinal survey studies that contain respondent reports of long-term annoyance. Largely, this body of literature does not deal with complaints. Community reaction, as used by the U.S. Environmental Protection Agency, includes complaints, appeals to local officials and legal action. Community reaction is very responsive to ambient noise (EPA, 1974). Complaints are triggered by short-term, infrequent increases in the noise level (Luz, Raspet and Schomer, 1983) whereas annoyance increases over a period of months or years of exposure (Fidell *et al.*, 1985). Users interested in predicting community reaction, such as complaints, are advised to apply the correction factors as originally given by Rosenblith and Stevens (1953) or as listed in Table D-7 of the EPA Levels Document (1974). In using this table, the pure tone/impulse correction should be ignored, since this factor is already incorporated into the present standard. When predicting complaints to short-term events, it may be better to predict DNL only during the total time period encompassed by the events.

A.3 Compatibility for common construction techniques

For buildings used for human activities, figure A.1 assumes that the difference between the average sound level outside a building and the level inside that building due to the outside noise is that for buildings as commonly constructed in the given locality, without special sound insulating features.

A.4 Compatibility for special sound insulation

A.4.1 Figure A.1 includes four categories of land use that involve buildings which may be made compatible with the outdoor noise environment by inclusion of special sound-insulating features not usually specified in the construction.

A.4.2 These land uses involve buildings where outdoor living or open windows are of secondary importance. For each land use category where outdoor living or open windows are of secondary importance, it is anticipated that the local authority will designate a certain yearly average total day-night adjusted sound exposure or a certain yearly average adjusted day-night average sound level as the ''compatibility limit with sound insulation.'' This limit should lie within the range of yearly average total day-night adjusted sound exposures or within the range of yearly average adjusted day-night average sound levels identified in figure A.1 and labeled ''with sound insulation.''

A.4.3 It is further anticipated that the local authority will require buildings needing special sound insulation to be so designed and constructed. This construction should be such that yearly average total day-night adjusted sound exposure or the yearly average adjusted day-night average sound level inside usually occupied rooms, due to noise outside, does not exceed 1 Pa^2s or 45 dB, respectively.

Annex B
(informative)
Bibliography

NOTE – The following references, are available in the open literature or through the National Technical Information Service (NTIS). NTIS numbers are given at the end of each reference.

B.1 EPA, (1974). ''Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,'' U.S. Environmental Protection Agency, Office of Noise Abatement and Control, EPA 550/9-74-004, Washington D.C., March 1974. NTIS—PB 239429.

B.2 Fidell, S., Horonjeff, R., Mills, J., Baldwin, E., Teffeteller, S., and Pearsons, K., (1985). Aircraft noise annoyance at three joint air carrier and general aviation airports,'' *Journal of the Acoustical Society of America*. **77**(3), 1054-1068, 1985.

B.3 Luz, George, *et. al.*, (1983). ''An analysis of community complaints to noise,'' *Journal of the Acoustical Society of America*, **73**(4), 1229-1235, April 1983.

B.4 Rosenblith, W.A., and K.N. Stevens, (1953). ''Handbook of Acoustic Noise Control. II. Noise and Man,'' Report WADC TR 52-204, U.S. Air Force Aerospace Medical Laboratory, Wright-Patterson Air Force Base, OH, 1953. NTIS—AD 012-015.