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Standard Guide for Applying Environmental Noise Measurement Methods and Criteria¹

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1. Scope

1.1 This guide covers many measurement methods and criteria for evaluating environmental noise, some of which are required to be used for specific purposes by governmental regulations. It is intended to provide users who may not be familiar with them with an overview of the wide variety of available methods and criteria. It includes the following:

- 1.1.1 The use of weightings, penalties, and adjustment or normalization factors;
- 1.1.2 Types of noise measurements and criteria, indicating their limitations and best uses;
- 1.1.3 Sources of criteria;
- 1.1.4 Recommended procedures for criteria selection;
- 1.1.5 A catalog of sources of selected available criteria; and
- 1.1.6 Suggested applications of sound level measurements and criteria.

1.2 *Criteria Selection*—Thorough evaluation of noise issues requires consideration of many characteristics of both the sound and the environment into which it is introduced. This guide will assist users in selecting criteria for the following:

- 1.2.1 Evaluating the effect of existing or potential outdoor sounds on a community considering the magnitude and other characteristics of the sound and environment;
- 1.2.2 Establishing or revising local noise ordinances, codes, or bylaws, including performance standards in zoning regulations; and
- 1.2.3 Identifying and evaluating compliance with regulatory requirements that do not specify an acoustical measurement method or criterion or which are unclear.

1.3 *Reasons for Criteria*—This guide discusses the many reasons for noise criteria, ways sound can be measured and specified, and advantages and disadvantages of the most widely used types of criteria. The guide refers the user to appropriate documents for more detailed information and

guidance. Users needing further general background on sound and sound measurement are directed to the books listed in the References section.

1.4 *Criteria in Regulations*—Certain criteria are specified to be used by government regulation, law, or ordinance for specific purposes. Any investigation or evaluation of a community noise issue must start with identifying applicable regulations and evaluating compliance with them. This document discusses but is not limited to regulations and ordinances. Due to the wide variation in local regulations, those are discussed more generally, and specific criteria are provided only from national government regulations. Regulations typically specify measurement methods and criteria for purposes of the regulation. Local ordinances must be written for ease of enforcement and cannot address all situations satisfactorily without becoming too complex. Such ordinances are also often prepared without competent guidance and can be too restrictive in some cases and not restrictive enough in others. Other regulations that determine government spending for noise control must balance that cost to the general public against impacts on individuals.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

C634 Terminology Relating to Building and Environmental Acoustics

¹ This guide is under the jurisdiction of ASTM Committee E33 on Building and Environmental Acoustics and is the direct responsibility of Subcommittee E33.09 on Community Noise.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

E966 Guide for Field Measurements of Airborne Sound Attenuation of Building Facades and Facade Elements

E1014 Guide for Measurement of Outdoor A-Weighted Sound Levels

E1503 Test Method for Conducting Outdoor Sound Measurements Using a Statistical Sound Analysis System

2.2 *ASA/ANSI Standards:*³

ASA/ANSI S1.1 Acoustical Terminology

ASA/ANSI S1.4/Part 1/IEC 61672-1 Electroacoustics – Sound Level Meters – Part 1: Specifications

ASA/ANSI S1.4-1983 Specifications for Sound Level Meters

ASA/ANSI S1.11/Part 1/IEC 61260-1 Electroacoustics – Octave-Band and Fractional-Octave-Band Filters – Part 1: Specifications

ASA/ANSI S1.13 Measurement of Sound Pressure Levels in Air

ANSI S1.43 Specifications for Integrating-Averaging Sound Level Meters

ASA/ANSI S3.4 Procedure for the Computation of Loudness of Steady Sounds

ASA/ANSI S3.14 Rating Noise with Respect to Speech Interference

ASA/ANSI S12.4 Method for Assessment of High-Energy Impulsive Sounds with Respect to Residential Communities

ASA/ANSI S12.7 Methods for Measurement of Impulse Noise

ASA/ANSI S12.9 Quantities and Procedures for Description and Measurement of Environmental Sound – Part 1: Basic Quantities and Definitions; Part 2: Measurement of Long-Term, Wide-Area Sound; Part 3: Short Term Measurements with an Observer Present; Part 4: Noise Assessment and Prediction of Long-Term Community Response; Part 5: Sound Level Descriptors for Determination of Compatible Land Use

ASA/ANSI S12.65 Rating Noise with Respect to Speech Interference

ASA/ANSI S12.100 Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas

2.3 *ISO Standards:*³

ISO 532-1 Acoustics — Methods for calculating loudness — Part 1: Zwicker method

ISO 532-2 Acoustics — Methods for calculating loudness — Part 2: Moore-Glasberg method

ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures

2.4 *IEC Standards:*⁴

IEC 61260-1 Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications

IEC 61672-1: 2002 Electroacoustics – Sound level meters – Part 1: Specifications

IEC 61672-1: 2013 Electroacoustics – Sound level meters – Part 1: Specifications

2.5 *DIN Standard:*⁵

DIN 45692 Measurement technique for the simulation of auditory sensation of sharpness (in German)

2.6 *United States Military Standard:*⁶

MIL STD 1474E Department of Defense Design Criteria Standard Noise Limits

3. Terminology

3.1 *General*—This guide provides guidance for various measurement methods and criteria initially defined in other documents. Most acoustical terms used in this standard are defined in either Terminology C634 or within this standard with their abbreviations and symbols for use in equations. The definition of terms explicitly given within this standard take precedence over definitions given in Terminology C634. For interpretation of this document, the definitions within Terminology C634 and this standard take precedence over any other definitions of defined terms found in any other documents, including other documents that are referenced in this standard.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *community noise equivalent level, CNEL, (dB), n*—see *day-evening-night average sound level*.

3.2.2 *day-evening-night average sound level, DENL, (dB), L_{*den}*—where * is a letter denoting the frequency weighting (understood to be A if deleted), (dB), *n*—a time-average sound level computed for an average calendar day period with the addition of 4.77 dB or 5 dB to all levels between 7:00 pm and 10:00 pm, and 10 dB to all levels after 10:00 pm and before 7:00 am. A-weighting is understood unless clearly stated otherwise.

3.2.2.1 *Discussion*—Various standards and regulations define both CNEL and DENL differently in terms of the level added to sound during the evening period. Earliest definitions indicated the average acoustic energy was to be multiplied by 3 which is equivalent to a 4.77 dB addition, but some more recent documents define the quantity with a 5 dB addition. In critical situations, the definition in a particular regulation or standard should be used.

3.2.3 *day-night average sound level, DNL, L_{*dn}*—where * is a letter denoting the frequency weighting (understood to be A if deleted), (dB), *n*—a time-average sound level computed for an average calendar day period with the addition of 10 dB to all sound after 10:00 pm and before 7:00 am. A-weighting is understood unless clearly stated otherwise.

3.2.4 *loudness, (sone), n*—that attribute of sound sensation for which sounds may be described on a scale from soft to loud or by a value in sones calculated from measured data.

3.2.4.1 *Discussion*—One sone is the perceived loudness of a 1000 Hz tone of 40 dB sound pressure level. A sound that is *n* times as loud is *n* sones.

⁵ Available from Beuth Verlag GmbH (DIN-- DIN Deutsches Institut für Normung e.V.), Burggrafenstrasse 6, 10787, Berlin, Germany, <http://www.en.din.de>.

⁶ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from International Electrotechnical Commission (IEC), 3 rue de Varembe, Case postale 131, CH-1211, Geneva 20, Switzerland, <http://www.iec.ch>.