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# Standard Guide for Measurement of Outdoor A-Weighted Sound Levels[1]

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## INTRODUCTION

This is one of a series of standards on the measurement and evaluation of community noise. Others in the series include Test Method E1503 for conducting outdoor sound measurements using a digital statistical analysis system, Guide E1779 which covers the preparation of a measurement plan for conducting outdoor sound measurements, and Guide E1780 which covers measurement of sound received from a nearby fixed source

## 1. Scope

1.1 This guide covers the measurement of A-weighted sound levels outdoors at specified locations or along particular site boundaries, using a general purpose sound-level meter.

1.2 Three distinct types of measurement surveys are described:

1.2.1 Survey around a site boundary,

1.2.2 Survey at a specified location,

1.2.3 Survey to find the maximum sound level at a specified distance from a source.

1.3 The data obtained using this guide are presented in the form of either time-average sound levels (abbreviation TAV and symbol $L_{AT}$, also known as equivalent sound level or equivalent continuous sound level abbreviated LEQ and with symbol $L_{AeqT}$) or A-weighted percentile levels (symbol $L_X$).

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

C634 Terminology Relating to Building and Environmental Acoustics

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

E1779 Guide for Preparing a Measurement Plan for Conducting Outdoor Sound Measurements

E1780 Guide for Measuring Outdoor Sound Received from a Nearby Fixed Source

2.2 *ANSI Standard:*[3]

ANSI S1.4 Specification for Sound Level Meters

ANSI S1.4A Specification for Sound Level Meters

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

## 3. Terminology

3.1 *Definitions*—For definitions of acoustical barrier, impulsive sound, measurement set and percentile levels, see Terminology C634[4].

## 4. Significance and Use

4.1 There are numerous situations for which outdoor sound level data are required. These include, but are not limited to, the following:

4.1.1 Documentation of sound levels before the introduction of a new sound source (for example, assessment of the impact due to a proposed use).

4.1.2 Comparison of sound levels with and without a specific source (for example, assessment of the impact of an existing source).

[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.

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

[4] Terminology C634–81a was used in the development of this guide.

4.1.3 Comparison of sound levels with criteria or regulatory limits (for example, indication of exceedence of criteria or non-compliance with laws).

4.2 This guide provides a means for selecting measurement locations, operating a sound level meter, documenting the conditions under which the measurements were performed, and recording the results.

4.3 This guide provides the user with information to (*1*) make and document the sound level measurements necessary to quantify relatively steady or slowly varying outdoor sound levels over a specific time period and at specific places and (*2*) make and document the physical observations necessary to qualify the measurements.

4.4 The user is cautioned that there are many nonacoustical factors that can strongly influence the measurement of outdoor sound levels and that this guide is not intended to supplant the experience and judgment of experts in the field of acoustics. The guide is not applicable when more sophisticated measurement methods or equipment are specified. This guide, depending as it does on simplified manual data acquisition, is necessarily more appropriate for the simpler types of environmental noise situations. As the number of sources and the range of sound levels increase, the more likely experienced specialists with sophisticated instruments are needed.

4.5 This guide can be used by individuals, regulatory agencies, or others as a measurement method to collect acoustical data for many common situations. Criteria for evaluating or analyzing the data obtained are beyond the scope of this guide.

4.6 Note that this guide is only a measurement procedure and, as such, does not address the methods of comparison of the acquired data with the specific criteria. No procedures are provided for estimating or separating the influences of two or more simultaneously measured sounds. This guide can be useful in establishing compliance when the measured data are below a specified limit.

4.7 Paragraph 8.2.1 outlines a procedure that can be used for a survey of the site boundary; paragraph 8.2.2 for a survey of specified monitoring points; and paragraph 8.2.3 for determining the location and magnitude of maximum sound level.

## 5. Apparatus

5.1 *Acoustical Measurements*:

5.1.1 *Sound Level Meter* (required) Type 2, or better, integrating averaging, as defined by ANSI S1.43, and ANSI S1.4, ANSI S1.4A with statistical analysis capability, and, with at least a 60-dB dynamic range.

5.1.1.1 The instrument should have an a-c output port to permit use of headphones.

5.1.1.2 The instrument shall be equipped with an A-Weighting network. It is recommended that the instrument also be equipped with a C-weighting or a Z-weighting, or both.

NOTE 1—Z-weighing is an unweighted (flat) network, that is sometimes called “Linear” by manufacturers.

5.1.2 *Microphone Windscreen* (required), recommended by the sound level meter manufacturer.

5.1.3 *Acoustical Calibrator* (required), with adaptors necessary to fit the microphone.

5.1.4 *Set of Headphones* (desirable), compatible with and electrically connected to the a-c output of the sound level meter. Monitoring the output of the sound level meter with headphones may enable the operator to detect equipment malfunctions or anomalies in the data caused by wind, humidity, and electrical interference.

5.1.5 *Tripod* (desirable), to ensure a steady and repeatable microphone position.

5.2 *Physical Measurements*:

5.2.1 To ensure the precision of values derived from these measurements, the accuracy of distance measurements shall be within 5 %. Any instrument that provides this degree of accuracy is satisfactory.

5.2.2 *Pocket Compass* (desirable), used for site layout work and for determination of wind direction.

5.2.3 *Site Map* (optional).

5.3 *Meteorological Measurements*—Any of the many available general-accuracy meteorological instruments may be used in order to enable the measurement of:

5.3.1 Wind speed (5-km/h or 2.5-mph increments),

5.3.2 Wind direction (in octants),

5.3.3 Relative humidity (in 10 % increments),

5.3.4 Dry bulb temperature (in 2°C or 5°F increments).

## 6. Calibration

6.1 The calibration of the sound level meter shall be checked using an acoustical calibrator immediately before and after each measurement set, in a manner prescribed by the manufacturer. Adjustments, if required, shall be made at this time. If the change in the calibration reading, as shown on the sound level meter, is 1 dB or greater, the data gathered since the preceding calibration are considered invalid and should be discarded. It is strongly recommended that an instrument that shows an unexplained calibration drift greater than 1.5 dB over a 24 h or less be taken out of service until the cause of the drift can be identified and remedied.

6.2 The sound level meter and the acoustical calibrator shall have been thoroughly calibrated with equipment traceable to a recognized standards organization, and following recommendations of the instrument manufacturer with 1 year, or a period specified the measurement plan, prior to starting the measurements. Included in this calibration shall be checks of frequency response, amplifier sensitivity, internal noise, and verification of correct operation of meter circuits and microphone.

## 7. Interference

7.1 Interfering noise must be identified and accounted for. A sound can be interference if it is concentrated in a small area and not representative of the sound that is to be documented. A measurement plan should address how such sounds are to be treated. It may be advisable for many types of sound sources to avoid interferences by testing at night. If it is determined that a given sound is an interference, the measurement location might be moved to a position where the contribution of the interfering sound is acceptably minimized or, if possible, the conduct of the survey may be modified so as to avoid the influence of the interference. Some of the more common sources of interference are discussed in the following: