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Standard Guide for Selection of Standards on Environmental Acoustics¹

This standard is issued under the fixed designation E 1433; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide is intended to assist acoustical consultants, architects, specifiers, and others in understanding ASTM standards in environmental acoustics, so that building specifications and other documents can accurately refer to relevant standards. The full standards are found in alphanumeric order in Volume 04.06 of the *Annual Book of ASTM Standards*.

1.2 The scope of Committee E-33 is: “The development of standards on the characteristics and performance of materials, products, systems, and services relating to the acoustical environment and the promotion of related knowledge.” Only standards under the jurisdiction of Committee E-33 are included in this guide. Additional standards related to environmental acoustics may be found under the jurisdiction of other ASTM committees.

1.3 None of the discussions herein is sufficiently detailed to substitute for reading the full standard. Only a careful reading of a standard will provide a complete understanding of its function. This guide is specifically **NOT** to be used as a direct reference in building specifications. Only the original standard gives sufficient information to serve as a specification reference.

2. Referenced Documents

2.1 ASTM Standards:

- C 367 Test Methods for Strength Properties of Prefabricated Architectural Acoustical Tile or Lay-In Ceiling Panels²
- C 384 Test Method for Impedance and Absorption of Acoustical Materials by the Impedance Tube Method²
- C 423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method²
- C 522 Test Method for Airflow Resistance of Acoustical Materials²
- C 634 Terminology Relating to Environmental Acoustics²
- C 635 Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings²

- C 636 Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels²
- E 84 Test Method for Surface Burning Characteristics of Building Materials³
- E 90 Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions²
- E 336 Test Method for Measurement of Airborne Sound Insulation in Buildings²
- E 413 Classification for Rating Sound Insulation²
- E 477 Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers²
- E 492 Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine²
- E 497 Practice for Installing Sound-Isolating Lightweight Partitions²
- E 557 Practice for Architectural Application and Installation of Operable Partitions²
- E 580 Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint²
- E 596 Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures²
- E 597 Practice for Determining a Single-Number Rating of Airborne Sound Isolation for Use in Multi-Unit Building Specifications²
- E 717 Guide for Preparation of the Accreditation Annex of Acoustical Test Standards²
- E 756 Test Method for Measuring Vibration-Damping Properties of Materials²
- E 795 Practices for Mounting Test Specimens During Sound Absorption Tests²
- E 859 Test Method for Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members³
- E 966 Guide for Field Measurement of Airborne Sound Insulation of Building Facades and Facade Elements²
- E 989 Classification for Determination of Impact Isolation Class (IIC)²

¹ This guide is under the jurisdiction of ASTM Committee E-33 on Environmental Acoustics and is the direct responsibility of Subcommittee E33.04 on Application of Acoustical Materials and Systems.

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² *Annual Book of ASTM Standards*, Vol 04.06.

³ *Annual Book of ASTM Standards*, Vol 04.07.



- E 1007 Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures²
- E 1014 Guide for Measurement of Outdoor A-Weighted Sound Levels²
- E 1041 Guide for Measurement of Masking Sound in Open Offices²
- E 1042 Classification for Acoustically Absorptive Materials Applied by Trowel or Spray²
- E 1050 Test Method for Impedance and Absorption of Acoustical Materials Using a Tube, Two Microphones, and a Digital Frequency Analysis System²
- E 1110 Classification for Determination of Articulation Class²
- E 1111 Test Method for Measuring the Interzone Attenuation of Ceiling Systems²
- E 1123 Practice for Mounting Test Specimens for Sound Transmission Loss Testing of Naval and Marine Ship Bulkhead Treatment Materials²
- E 1124 Test Method for Field Measurement of Sound Power Level by the Two-Surface Method²
- E 1130 Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index²
- E 1179 Specification for Sound Sources Used for Testing Open Office Components and Systems²
- E 1222 Test Method for Laboratory Measurement of the Insertion Loss of Pipe Lagging Systems²
- E 1264 Classification for Acoustical Ceiling Products²
- E 1265 Test Method for Measuring Insertion Loss of Pneumatic Exhaust Silencers²
- E 1289 Specification for Reference Specimen for Sound Transmission Loss²
- E 1332 Classification for Determination of Outdoor-Indoor Transmission Class²
- E 1374 Guide for Open Office Acoustics and Applicable ASTM Standards²
- E 1375 Test Method for Measuring the Interzone Attenuation of Furniture Panels Used as Acoustical Barriers²
- E 1376 Test Method for Measuring the Interzone Attenuation of Sound Reflected by Wall Finishes and Furniture Panels²
- E 1408 Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems²
- E 1414 Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum²
- E 1503 Test Method for Conducting Outdoor Sound Measurements Using a Digital Statistical Analysis System²
- E 1573 Test Method for Evaluating Masking Sound in Open Offices Using A-Weighted and One-Third Octave Band Sound Pressure Levels²
- E 1574 Test Method for Measurement of Sound in Residential Spaces²

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms pertaining to acoustics used in this guide, see Terminology C 634.

4. Significance and Use

4.1 Each current standard under the jurisdiction of Committee E-33 on Environmental Acoustics is listed, divided into sections under the jurisdiction of the various subcommittees as follows:

- E33.01 on Sound Absorption
- E33.02 on Open Plan Spaces
- E33.03 on Sound Transmission
- E33.04 on Application
- E33.05 on Research
- E33.06 on International Standards
- E33.07 on Definitions and Editorial
- E33.08 on Mechanical and Electrical System Noise
- E33.09 on Community Noise

4.2 The ASTM designation, title, use, result or purpose, and a brief summary of each standard is provided. These give enough explanation about the standard to permit one to understand its application, and to differentiate one standard from another.

NOTE 1—The sequence of these standards does not indicate their relative importance. The user is encouraged to carefully assess the applicability of standards to a situation and select the documents most suited to the circumstances. Comments given may assist in selecting the standard best suited to a specific need.

DESCRIPTION OF STANDARDS

5. Sound Absorption

5.1 Sound absorption is the dissipation of sound energy, typically within a room or space. The scope of Subcommittee E33.01 on Sound Absorption is: “the development of test methods and specifications for the sound absorption and other physical properties of materials, products, and systems as designed or used for the absorption of airborne sound.”

5.1.1 *Test Method C 384—Test Method for Impedance and Absorption of Acoustical Materials by the Impedance Tube Method:*

5.1.1.1 *Use*—Intended primarily as a research screening tool, useful for manufacturers and/or researchers in evaluating the absorption of materials. It is also valuable for evaluating small units, such as anechoic wedges. It can be used to rank order the absorption and impedance characteristics of materials.

5.1.1.2 *Result*—Normal Incidence Sound Absorption Coefficients, Normal Specific Impedance Ratios.

5.1.1.3 *Discussion*—A sound wave traveling down a tube is reflected back by the test specimen, producing a standing wave that can be explored with a probe microphone. The normal absorption coefficient is determined from the standing wave ratio. In addition, an impedance ratio at any one frequency can be determined using the position of the standing wave with reference to the face of the specimen (see also Test Method E 1050). Values do not necessarily correlate with those of Test Method C 423.

5.1.2 *Test Method C 423—Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method:*

5.1.2.1 *Use*—Primary method for evaluating sound absorption capabilities of building materials and systems. One can use the sound absorption coefficients and volume of room.



Sabins per unit, to determine how much material is needed to limit room reverberation or reduce noise to a desired level, or both.

5.1.2.2 Result—Sound Absorption Coefficients, Noise Reduction Coefficient (NRC), Absorption figures in Sabins, Sabins/Unit.

5.1.2.3 Discussion—Random noise is turned on long enough for the sound pressure in a reverberant room to reach a steady state. When the signal is turned off, the sound pressure level decreases. The rate of decrease (decay) in a specified frequency band is measured. The absorption of the room and its contents is calculated both before and after placing the specimen in the room. The increase in absorption due to the specimen, divided by the area of the specimen is the absorption coefficient. Noise Reduction Coefficient is the average of the four absorption coefficients of the third-octave bands centered on 250, 500, 1000, and 2000 Hz, rounded to the nearest 0.05. NRC is a single number rating and is convenient for ranking building materials and systems. However, in some critical applications, study of all available frequency data is advised to determine suitability.

5.1.3 Test Method C 522—Test Method for Airflow Resistance of Acoustical Materials:

5.1.3.1 Use—Indicates sound absorbing properties in some materials where airflow resistance is related to sound absorption.

5.1.3.2 Result—Airflow resistance (R), Specific Airflow resistance (r), Airflow resistivity (r_0).

5.1.3.3 Discussion—The specific airflow resistance of an acoustical material is one of the properties that determine its sound-absorptive and sound-transmitting properties. The specific air flow resistance is given by the formula $R = P/U$, where P = air pressure difference across the specimen, U = volume velocity of airflow through it. The specific airflow resistance measured by this method may differ from the specific resistance measured by the impedance tube method in Test Method C 384.

NOTE 2—Caution: Materials exist that do not allow any airflow yet exhibit excellent sound absorption.

5.1.4 Practices E 795—Practices for Mounting Test Specimens During Sound Absorption Tests:

5.1.4.1 Use—Reference to specific mounting methods helps laboratory operators simulate expected field applications. It also helps specifiers by allowing comparison of materials tested in similar mountings.

5.1.4.2 Result—A letter designation describing the method of mounting a Test Method C 423 test specimen.

5.1.4.3 Discussion—These practices cover test specimen mountings to be used during tests performed in accordance with Test Method C 423. Sound absorption of a material covering a flat surface depends not only on the physical properties of the material, but also on the way in which the material is mounted over the surface. The mountings specified in these practices are intended to simulate, in the laboratory, conditions that exist in normal use.

5.1.5 Test Method E 1050—Test Method for Impedance and Absorption of Acoustical Materials Using a Tube, Two Microphones, and a Digital Frequency Analysis System:

5.1.5.1 Use—This is not just an alternative to Test Method C 384 using digital instruments. It is a completely different method, but is used to find a value for the same property. Test Method C 384 can also use digital instruments.

5.1.5.2 Result—Normal Incidence Sound Absorption Coefficients, Normal Specific Acoustic Impedance Ratios.

5.1.5.3 Discussion—A broadband noise is produced on one end of a tube, the other end of which contains a test specimen. The plane wave produced is detected by two microphones located at different positions along the tube. A digital frequency analyzer measures the output from the two microphones. Results match Test Method C 384.

6. Open Plan Spaces

6.1 Open Plan spaces represents a specialized area of environmental acoustics in which sound absorption, surface reflections, and transmission loss all play important roles. The scope of Subcommittee E33.02 is “development of test methods and practices relating to materials, products, and systems used for the control of acoustics in open plan spaces, such as offices, schools, etc.”

6.1.1 Guide E 1041—Guide for Measurement of Masking Sound in Open Offices:

6.1.1.1 Use—Measures variation of masking sound over time and throughout a space, and its correlation to a specified sound spectrum. Can be used as an acceptance or problem-solving tool by specifiers.

6.1.1.2 Result—Spatial and temporal uniformity.

6.1.1.3 Summary—This guide describes the measurement of masking sound in an open office environment. The masking sound will usually be associated with a masking system. However, in certain positions and frequency ranges, HVAC equipment may affect or determine the masking sound spectrum. While intended primarily for open offices, this guide has been effectively used in closed, or mixed open and closed, offices.

6.1.2 Classification E 1110—Classification for Determination of Articulation Class:

6.1.2.1 Use—Provides a single figure rating that can be used for comparing building systems for speech privacy. The rating is designed to correlate with transmitted speech intelligence between office spaces.

6.1.2.2 Result—Articulation Class (AC).

6.1.2.3 Summary—Weighting factors are applied to the one-third octave band attenuation data determined in Test Methods E 1111, E 1375, E 1376, and others of the series. The weighted data are then totaled and rounded to the nearest multiple of ten to yield the Articulation Class (AC). A single number rating is convenient for ranking building materials and systems. However, for critical applications, a study of all available frequency is advised to determine suitability.

6.1.3 Test Method E 1111—Test Method for Measuring the Interzone Attenuation of Ceiling Systems:

6.1.3.1 Use—Provides measurements of the sound reflective characteristics of ceiling systems when used in conjunction with partial-height space dividers. It may also be used to rate full height space dividers when used in a mix of closed and open offices.

6.1.3.2 Result—Interzone attenuation.