Designation: E1111 – 07

StandardTest Method for Measuring the Interzone Attenuation of Open Office Components[1]

This standard is issued under the fixed designation E1111; 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.

INTRODUCTION

This test method describes the measurement and evaluation of acoustical performance of components affecting speech privacy in open-plan spaces. The maximum privacy theoretically available at normal working distances in open-plan spaces, with partial height space dividers (screens), is insufficient without the assistance of relatively elevated background masking sound levels. Thus, the provision of adequate speech privacy in open-plan offices and schools is one of the most difficult tasks in the architectural acoustics field. This test method provides a means of objectively measuring the relevant acoustical characteristics of three major components of open-plan spaces, the ceiling system, furniture panels used as acoustical barriers, and wall finishes which attenuate reflected sound. Furniture panels may be tested for their capacity as an acoustical barrier and/or the degree to which they may reduce reflected sound.

1. Scope

1.1 This test method covers the measurement of the interzone attenuation for three components of open-plan spaces:

1.1.1 Ceiling systems when used in conjunction with partial-height space dividers. This arrangement is commonly used in offices to achieve speech privacy between work zones in the absence of full-height partitions. This test method is applicable to any ceiling configuration, including, for example, a pattern of sound-reflective panels in an otherwise sound-absorptive ceiling. This test method generally requires use of a fixed space divider height of 1.50 m (60 in). In recognition of trends toward alternate divider heights in open office environments, measurements with an alternate divider height may be conducted in accordance with this standard.

1.1.2 Furniture panels used as acoustical barriers in open-plan spaces to provide speech privacy or sound isolation between working positions.

1.1.3 Vertical panels, including wall finishes such as sound-absorbent panels, and furniture panels or screens which may reflect sound. It may not be applicable to such items as window finishes or furniture other than panels if these differ significantly from flat wall panels.

1.1.4 The combination of results from the various components of an open-plan office is beyond the scope of this standard.

1.2 Unless otherwise qualified, all dimensions specified in this test method shall be understood to have a tolerance of ±6 mm (±¼ in.) The values stated in SI units are to be regarded as the standard. The values given in parentheses are provided for information only.

1.3 *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]

C423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

C634 Terminology Relating to Building and Environmental Acoustics

E795 Practices for Mounting Test Specimens During Sound Absorption Tests

E1110 Classification for Determination of Articulation Class

E1179 Specification for Sound Sources Used for Testing

[1] This test method is under the jurisdiction of ASTM Committee E33 on Building and Environmental Acoustics and is the direct responsibility of Subcommittee E33.02 on Speech Privacy.

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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.

Open Office Components and Systems
E1374 Guide for Open Office Acoustics and Applicable ASTM Standards
2.2 *ANSI Standards:*
S1.4 Specification for Sound Level Meters[3]
S1.6 Preferred Frequencies and Band Numbers for Acoustical Measurements[3]
S1.11 Specification for Octave Band and Fractional-Octave-Band Analog and Digital Filters[3]

3. Terminology

3.1 *The following terms used in this test method have specific meanings that are defined in Terminology C634:*

3.1.1 acoustical barrier, ambient noise, diffraction, level, (sound) absorption coefficient, sound pressure levels, pink noise, white noise.

3.2 *Definitions of Terms Defined in Other Standards not included in Terminology C634:*

3.2.1 The term *source point* is defined in Specification E1179.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *furniture panel*—a furnishing that does not extend to the ceiling, and that is used to subdivide an open-plan space and provide a degree of visual and acoustical privacy. Furniture panels include interlocking systems furniture and freestanding screens.

3.3.2 *nominal reference level*—for a one-third octave-band, the arithmetic mean of sound pressure levels measured at specified positions relative to the source in a region free from reflections.

3.3.3 *interzone attenuation*—at a specified position, for a one-third octave band, the difference between the nominal reference level and the sound pressure level at the specified point.

3.3.4 *nominal interzone attenuation*—for a one-third octave-band, at a specified point, the arithmetic mean interzone attenuation calculated using the interzone attenuation for the point in question and for two adjacent positions 0.30 m (1 ft) along the survey path.

4. Summary of Test Method

4.1 The test facility is essentially an expanse of floor and ceiling in which all surfaces excluding the floor and test specimen have negligible sound reflections. The facility may be set up in a laboratory, in a mock-up of a proposed building, or in a completed building. The configuration of the room will depend on the open-plan component being tested.

4.1.1 For testing a ceiling system, a standard space divider is positioned with such dimensions and construction that sound generated on one side can reach a measuring point on the other side only by way of diffraction over the top of the space divider and by reflection from the ceiling. With the diffracted component fixed by the dimensions of the space divider and by the height of the source and measurement position, the difference between the sound pressure levels measured on each side of the space divider provides a comparative measure of the contribution of ceiling system reflection to the total sound transmission. See Fig. 1.

4.1.2 For a furniture panel tested as an acoustical barrier, the panel is arranged such that it blocks the direct path of sound from the sound source to the measuring microphones. Sound generated by the sound source on one side of the furniture panel under test reaches the other side chiefly by diffracting

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

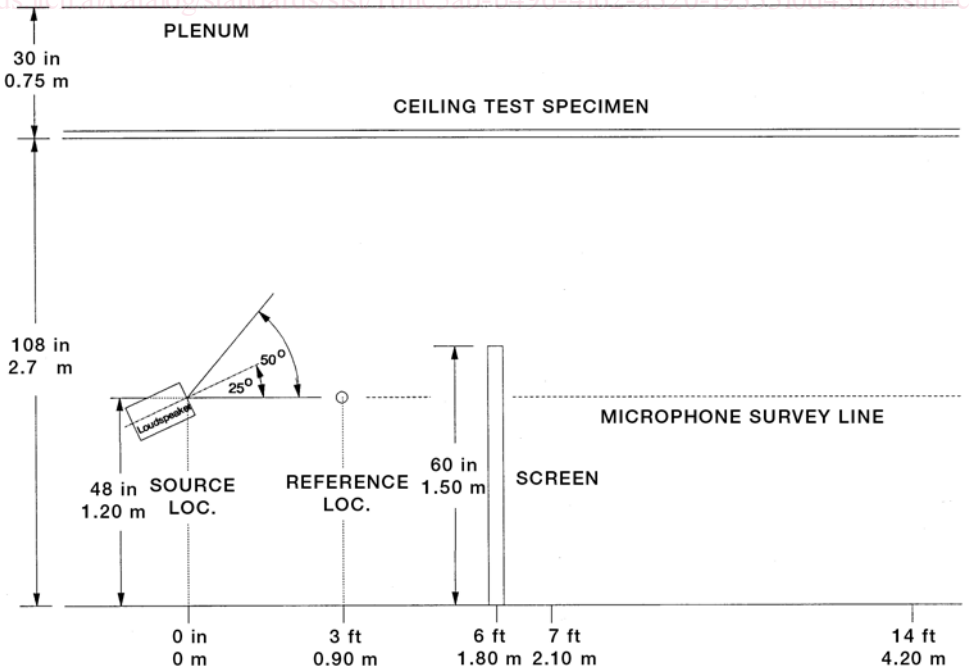

FIG. 1 Ceiling Test Configuration, Elevation (speaker is horizontal for other tests)

over its top edge. A potential secondary path is transmission through the panel. The differences in sound pressure levels measured on each side of the furniture panel provide a measure of its effectiveness as an acoustical barrier. See Figs. 2 and 3.

4.1.3 For wall finishes and furniture panels tested for their capacity in suppressing reflected sound, the sound is generated on one side of a standard barrier that extends from floor to ceiling, with a gap at the end facing the test specimen, and is partially reflected by the test specimen to reach the other side. The difference in magnitude of the sound pressure levels measured on the source and receiving side of the barrier provides a measure of the attenuation of reflected sound attributable to the properties of the test specimen. Sound-absorbent specimens will reflect less energy around the barrier than sound-reflective specimens. Two test conditions are established in this test method. Specimens that are wall finishes are applied over a sound-reflective side wall, whereas specimens that are furniture panels are placed against a sound-absorptive side wall. See Fig. 4.

4.2 When the test is conducted in a mock-up of a proposed building or in a completed building, strict adherence to the test method may not be possible in that the conditions of ceiling height and plenum depth, etc., cannot be met because of the building design. Under these circumstances, the measurements apply only to that situation and other identical situations.

5. Significance and Use

5.1 Providing speech privacy in open-plan spaces depends upon many factors, the most significant of which are the following: *(1)* the shadow zone of part-height space dividers and the diffraction of sound from the edges of space dividers; *(2)* the primary sound reflective properties of the ceiling system; *(3)* the level of masking sound present in the space; and *(4)* the distance between speaker and listener. Guide E1374 provides additional detail on the factors contributing to speech privacy in open-plan spaces.

5.2 In this test method the third factor, masking sound, is eliminated and the fourth factor, the distance between speaker and listener, is standardized for all specimen types. For the measurement of ceiling systems, the first factor, the shadow zone, is also standardized for each divider height used. Experience has indicated that results obtained by this test method may not fairly represent the speech privacy that may be achievable with non-flat ceiling systems. For the measurement of furniture panels used as acoustical barriers, the second of these factors, the sound reflectance of the ceiling, is standardized. For the measurement of reflective and absorptive vertical surfaces used as wall finishings or furniture panels, the first and second factors are standardized and all paths between the speaker and listener reflecting only off of the ceiling are eliminated.

5.3 This test method provides standardized techniques to assess the contribution of specific components of an open-plan space. The test method specifies an acoustical testing environment for each component type that isolates its contribution from the contribution of other components, which may in actual open-plan environments contribute significantly to the overall speech privacy.

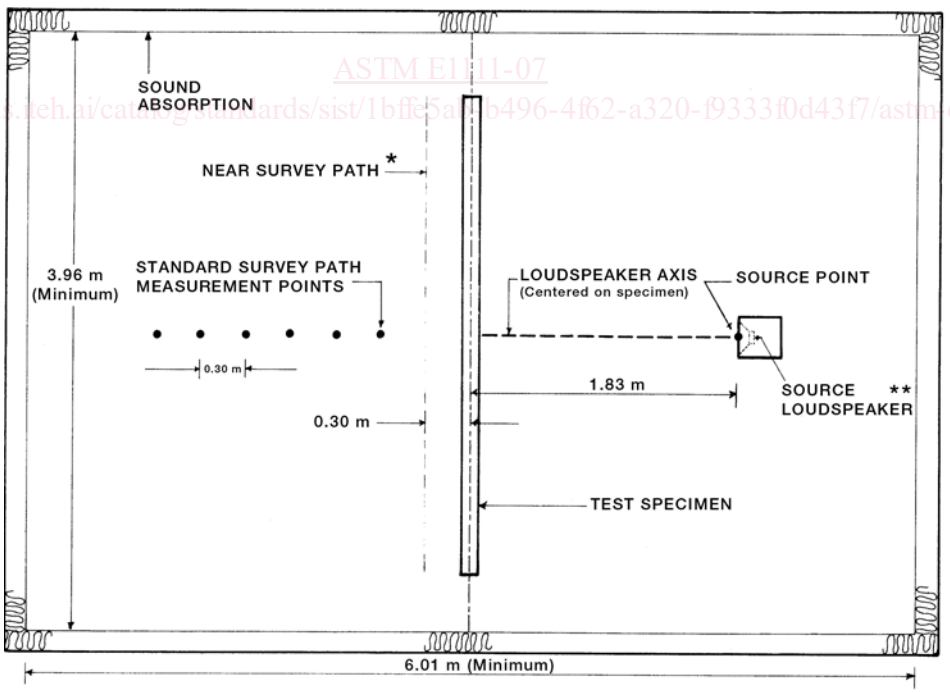

FIG. 2 Test Configuration for Furniture Panels as Acoustical Barriers with Standard Survey Positions, (Plan View)

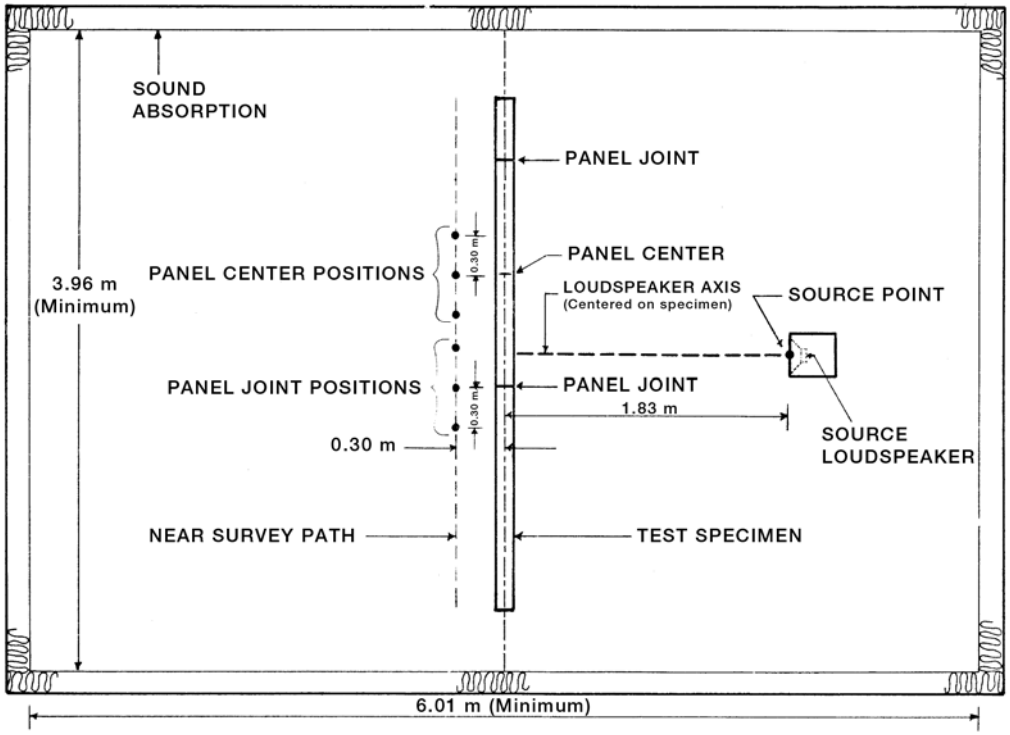

FIG. 3 Test Configuration for Furniture Panels as Acoustical Barriers with Near Survey Positions, (Plan View)

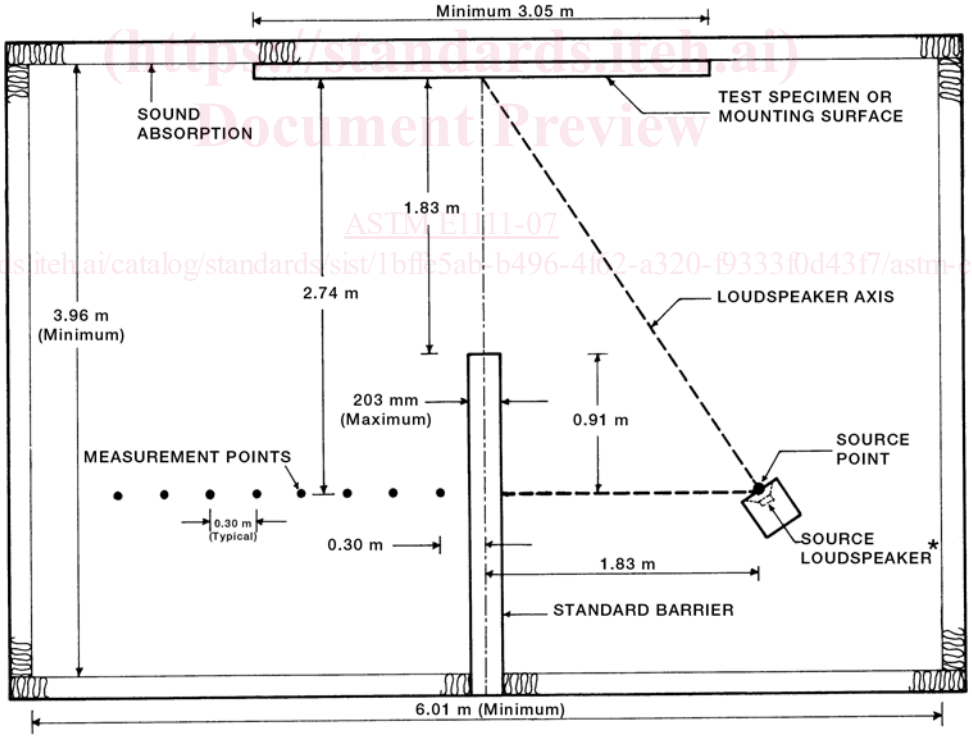

FIG. 4 Test Configuration for Furniture Panels as Acoustically Reflecting Surfaces, (Plan View)

5.4 The significance of test results obtained by this test method must also be considered with regard to the attainable measurement accuracy. The attainment of speech privacy in the presence of masking sound is critically dependent upon sound level of the speech relative to the masking sound; a change as small as 2 dB in either the speech or masking sound may change the privacy from significant to insignificant. The