Designation: E 1111 – 02

Standard Test Method for Measuring the Interzone Attenuation of Ceiling Systems[1]

This standard is issued under the fixed designation E 1111; 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 is one of a series for the measurement and evaluation of acoustical parameters 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 to cope with normal speech 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 one component in the open-plan space, the ceiling system.

1. Scope

1.1 This test method[2] is intended to provide measurements of the sound reflective characteristics of ceiling systems when used in conjunction with partial-height space dividers. This arrangement is commonly used in offices and schools 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, as specified, is primarily restricted to measurements with a fixed space divider height of 1.50 m (60 in.), a ceiling height of nominally 2.70 m (108 in.), a source height of 1.20 m (48 in.), and microphone positions at 1.20 m (48 in.) height. 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.

1.2 *Laboratory Accreditation*—A procedure for accrediting a laboratory for purposes of this test method is given in Annex A1.

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.*

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

2. Referenced Documents

2.1 *ASTM Standards:*

C 423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method[3]

C 634 Terminology Relating to Environmental Acoustics[3]

E 1110 Classification for Determination of Articulation Class[3]

E 1179 Specification for Sound Sources Used for Testing Open Office Components and Systems[3]

2.2 *ANSI Standards:*

S1.6 Preferred Frequencies and Band Numbers for Acoustical Measurements[4]

S1.11 Specification for Octave Band and Fractional-Octave-Band Analog and Digital Filters[4]

S1.12 Specification for Laboratory Standard Microphones[4]

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

[1] This test method is under the jurisdiction of ASTM Committee E33 on Environmental Acoustics and is the direct responsibility of Subcommittee E33.02 on Open Plan Spaces.

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[2] This test method is similar to a procedure developed by the U.S. Government General Services Administration, Public Buildings Service, designated 'PBS-C.2, Test Method for the Sufficient Verification of Speech-Privacy Potential Based on Objective Measurements including Methods for the Rating of Functional Interzone Attenuation and NC-Background.' August 1972.

[3] *Annual Book of ASTM Standards,* Vol 04.06.

[4] Available from the American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

3.1.1 *nominal reference level*—for a one-third octave-band, the arithmetic mean of sound pressure levels measured between the source point and the space divider at specified positions.

3.1.2 *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 point in question.

3.1.3 *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 0.3 m (1 ft) to either side.

4. Summary of Test Method

4.1 The test facility (Fig. 1) is essentially an expanse of floor and ceiling in which all vertical surfaces 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 standard space divider is of 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 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.

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 The substitution of moveable part-height space dividers for fixed full-height partitions between work zones in open-plan offices and schools may introduce problems of inadequate speech privacy or distraction between zones. A space divider placed between zones serves as a partial sound barrier, but its effectiveness can be compromised by reflection of sound over the space divider by the ceiling. An evaluation of the sound reflective characteristics of a ceiling system may therefore serve as a useful design tool in providing the speech privacy required in a given open-plan layout. Although the potential speech privacy may be limited by other components of the open-plan space, this document is concerned only with ceiling system performance in association with a specified space divider construction.

5.2 The provision of speech privacy in open-plan spaces is dependent 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.

NOTE 1—The first factor is standardized in this test method and the third is eliminated. Experience has indicated that results obtained by this test method may not fairly represent the speech privacy that may be achievable with nonflat ceiling systems.

5.3 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 noise 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 perceived speech intelligibility. The normally accepted test accuracies for

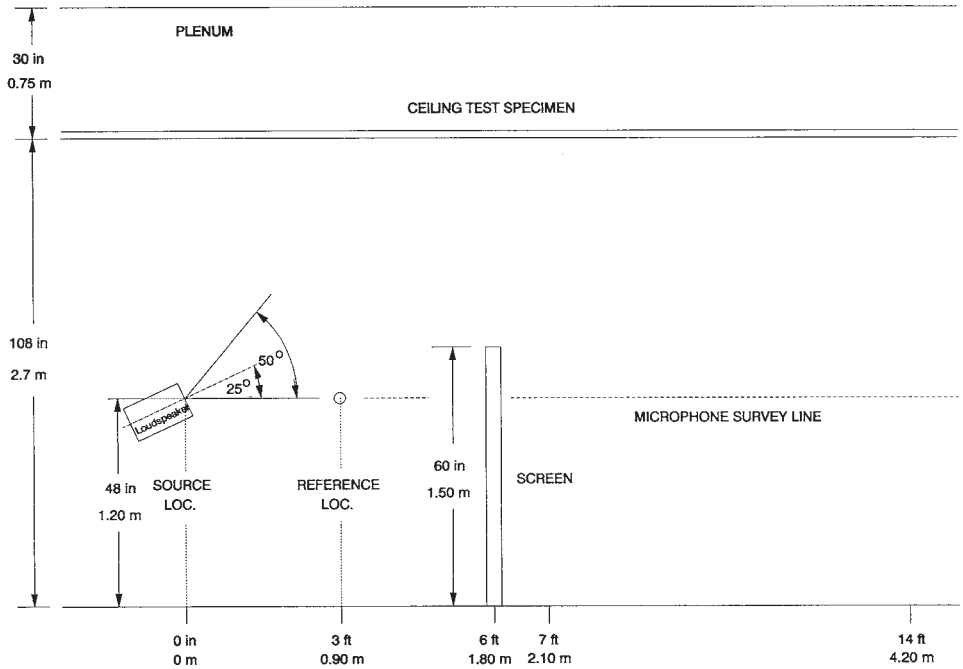

FIG. 1 Ceiling Test Facility