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Standard Guide for Office Acoustics and Applicable ASTM Standards[1]

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ε[1] NOTE—Title editorially corrected in February 2018.

INTRODUCTION

Office environments include open and closed spaces with varying acoustical performance requirements depending on space function and occupant needs. Sound control tools and methods are identified which combine to provide appropriate amounts of speech privacy, freedom from distraction and acoustic comfort whether in focus, private, collaborative or other office areas.

1. Scope

1.1 This guide discusses the principles and interactions that affect the acoustical performance of open and closed offices. It describes the application and use of the relevant series of ASTM standards.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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

1.4 *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]

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

E90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

E336 Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings

E795 Practices for Mounting Test Specimens During Sound Absorption Tests

E1007 Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures

E1110 Classification for Determination of Articulation Class

E1111 Test Method for Measuring the Interzone Attenuation of Open Office Components

E1130 Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index

E1179 Specification for Sound Sources Used for Testing Open Office Components and Systems

E1414 Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum

E1573 Test Method for Measurement and Reporting of Masking Sound Levels Using A-Weighted and One-Third-Octave-Band Sound Pressure Levels

E2638 Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room

E2964 Test Method for Measurement of the Normalized Insertion Loss of Doors

3. Summary of Guide

3.1 *Acoustical Performance*—Acoustics in open and closed office spaces must be considered during the design stage in order to provide occupants with an appropriate degree of speech intelligibility and speech privacy while minimizing noise distraction as appropriate for the space usage. Speech privacy and distraction are controlled by the ratio of intruding voice level to background sound. In the open plan, a degree of speech privacy, noise control and comfort can be achieved if

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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.

component selection and interaction are understood. A successful open plan office is the result of careful coordination of many components, including those which influence the transmission of sound, such as the ceiling, furniture and furnishings, flooring, wall treatments and lighting; the heating, ventilating and air-conditioning system which limits maximum background noise levels and the sound masking system which controls minimum background sound levels. (See Section 6.) In closed plan offices, many of the same considerations are taken into account with the important addition of partition construction methods.

3.2 This guide delineates the role and interaction of these components and the application of relevant ASTM Standards.

4. Significance and Use

4.1 This guide is intended for the use of architects, engineers, office managers, and others interested in designing, specifying, or operating office environments.

4.2 It is not intended to be applied to other environments, for example, open plan schools.

4.3 While this guide attempts to clarify the many interacting variables that influence acoustical performance, it is not intended to supplant the experience and judgment of experts in the field of acoustics. Competent technical advice should be sought for success in the design of offices, including comparisons of test results carried out according to ASTM standards.

5. General Office Acoustical Considerations

5.1 *Signal to Noise Ratio*—Noise intrusion and the level of acoustical privacy between work spaces, in either open or closed plan, is determined by the degree to which the sounds from a nearby work space exceed the background sound levels. It is essential that both the spread of sound from voices and other sources and the background sound are carefully controlled. The following attributes apply regardless of the source of the intruding sound.

5.1.1 The sound source amplitude, directivity, and orientation.

5.1.2 The total attenuation of the sound due to a combination of distance and shielding by intervening barriers and attenuation due to sound absorptive surfaces.

5.1.2.1 *Absorption*—In the open plan office, the goal is to maximize attenuation with distance in order to improve sound isolation. This may require a highly absorptive ceiling, some absorption on the floor, and careful treatment of some vertical surfaces. Where the highest level of sound attenuation is required, the ideal is to approach the conditions of the outdoors, where there are no reflecting surfaces. In both open and closed spaces, absorption reduces sound reflection and reverberation which contributes to acoustic comfort.

5.1.2.2 *Sound Barriers*—Sounds passing through, over or around a physical barrier will be reduced in level. Barriers, such as walls, windows, doors and workstation partitions are an essential part of both open and closed plan acoustical design. The acoustical performance of each will depend on their design and construction.

5.1.3 The strengthened spread of sound due to reflections from office surfaces such as the ceiling, furniture panels, light fixtures, walls, and windows.

5.1.4 The level and spectrum of background sound at the listener's ear generated by sources other than speech. To ensure predictable levels of speech privacy where insufficient levels of continuous minimum background sound exist, electronic sound masking systems offer the best means of raising the ambient sound level in a tunable (optimized) manner.

5.2 *Density*—Occupant density affects both the number and proximity of people in a given space. Higher density results in both greater noise and distraction from increased quantity of conversation and activity.

5.3 *Layout*—The open office layout must consider needs for isolation and concentration or collaboration and ease of communication between workstations as appropriate. Where the need for concentration is of higher importance, the layout can be designed to assist in minimizing noise intrusion. For example, individual work stations should be positioned relative to columns, walls, and each other to avoid uninterrupted sound paths between contiguous work stations. Occupant orientation is also important, because there is a significant difference in the sound level when a talker faces a listener versus the talker facing away from the listener, of the order of 9 dBA. In a closed plan space, door openings on either side of a corridor should be staggered.

5.4 *Undivided Workspaces*—Collaborative open office design has all but eliminated vertical barriers in order to foster communication and interaction between coworkers. For job functions requiring freedom from distraction in the open plan, it may be achieved with the inclusion of appropriate sound barriers. In open spaces with workstation partitions below seated head height, acoustical performance may be improved by the addition of acoustical absorption and sound masking, but an expectation of speech privacy or significant noise isolation is unrealistic in this circumstance.

5.5 *Intrusive Noises*—Distraction caused by raised voices or noisy equipment may not be sufficiently controlled by open office constructions. Spaces requiring increased speech privacy and noise isolation such as conference rooms should be designed using appropriately higher sound isolation criteria. Noise generating devices and occupant functions should be located in isolated enclosed rooms or areas to minimize noise intrusion into other work spaces. For example, speaker phones and call centers can generate high sound levels. These should be contained in special work areas affording adequate noise isolation from the surrounding spaces. Care should be exercised in eliminating or minimizing the noise generation aspects. Open office etiquette guidelines should be established and enforced.

5.6 *Component Testing*—ASTM test methods exist for testing components and systems for open plan offices. These include measuring the attenuation between work stations by the ceiling path, the effect of barriers such as furniture panels, the effect of flanking or reflections from vertical surfaces (see Test Method E1111), measurement of masking sound in the open office (see Test Method E1573), and the determination of the