



Standard Guide for Measurement of Masking Sound in Open Offices¹

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INTRODUCTION

This guide is one of a set of standards for evaluating the performance of acoustical components in an open office. It is intended to allow evaluation of certain characteristics of masking sound in an open office space. Other methods in this set cover sound attenuation between work stations provided by partial height space dividers and by acoustical ceiling systems.

1. Scope

1.1 This guide describes the measurement of masking sound in an open office environment. The objectives of the measurements are to determine the uniformity of masking sound both in time and from position to position, and how closely the masking sound matches a spectrum specified by others. The masking sound will usually be associated with a masking system, however, in certain positions and frequency ranges, heating, ventilating, or air conditioning equipment (HVAC) may affect the masking sound spectrum.

1.2 *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:

C 634 Terminology Relating to Environmental Acoustics²

2.2 ANSI Standards:

S1.11 Specification for Octave, Half-Octave and One-Third Octave Band Filter Sets³

S1.4 Specification for Sound Level Meters³

3. Terminology

3.1 *Definitions*—The acoustical terminology used in this guide is consistent wherever possible with Terminology C 634.

3.2 *Definitions of Terms Specific to This Standard*—Other terms required for this guide are as follows:

3.2.1 *masking sound*—sound within an office space that reduces the intelligibility of intruding speech and the distraction

from activity noise. Masking sound may be produced by masking systems, HVAC systems, or other sources.

3.2.2 *masking system*—the electronic equipment used to generate and distribute masking sound throughout a space.

3.2.3 *spatial uniformity*—a condition where the one-third octave band sound pressure levels at different positions throughout a space do not vary significantly from the arithmetic mean sound pressure level. The amount of allowable variation is specified by others such as a consultant or designer.

3.2.4 *temporal uniformity*—*at a given position*, a condition where the average sound pressure level measured in a one-third octave band over a short time interval does not differ significantly from the average sound pressure level in that band measured over a long time interval. The amount of allowable variation is specified by others such as a consultant or designer.

4. Summary of Guide

4.1 The procedure for evaluating temporal uniformity is to measure the range and mean of sound pressure levels encountered over a time interval in a series of one-third octave bands at one or more locations.

4.2 The procedure for evaluating spatial uniformity is to measure the range and mean of sound pressure levels in one-third octave bands encountered at locations throughout the space and calculate the local standard deviation. For furnished spaces, the measurement locations are typical open office work stations. For unfurnished spaces, the measurement locations are located along one or more straight line traverses. In order to minimize differences in measured values due to nearby reflecting surfaces, the one-third octave band sound pressure levels assigned to a particular location is itself an average of four measurements taken at four positions.

4.2.1 At each microphone location the sound pressure level is measured at four microphone positions (for example, the four points of a compass). These four values are used to calculate the local standard deviation.

4.3 In order to evaluate how closely the masking sound matches a specified spectrum, the mean or range of data acquired for evaluating spatial uniformity may be compared to

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

³ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

the specified spectrum.

5. Significance and Use

5.1 In an open office, the degree of speech privacy between work stations depends, in part, upon the masking of speech provided by background sound and usually requires a masking system for adequate privacy. The spectrum shape and overall sound level produced by a masking system must be correctly adjusted. In order to provide consistent acoustical privacy it is desirable that the masking sound not vary appreciably from position to position or not vary over short periods of time.

5.1.1 It is not clear to what extent one-third octave band sound pressure levels may differ from position to position or vary with time and be characterized as acceptable or unacceptable. One purpose of this guide is to encourage the measurement of data to allow development of such criteria (see Note 1).

NOTE 1—Although only one-third octave band sound pressure levels are allowed under this standard, the user of this standard is encouraged to also make A-weighted measurements for possible future justification for using A-weighted values in a revised standard.

5.2 Another purpose of this guide is to provide a means of evaluating the performance of a masking system as installed in an open office space. This guide could be used for the following:

5.2.1 To compare the relative performance of different masking systems.

5.2.2 To evaluate how well the masking sound generated by a masking system meets a specified spectrum and to what degree the masking sound differs from position to position or varies with time.

6. Test Space

6.1 The test space shall include the entire office area served by the masking system or as otherwise specified.

6.2 The ceiling system of the test space shall be complete including light fixtures and air diffusers.

6.3 The floor covering and all wall finishes shall be completely installed prior to testing.

6.4 To provide the most meaningful information concerning the ability of the masking sound to provide consistent privacy, it is preferable to test with interior furnishings in place since furniture may influence the distribution of masking sound within the space. However, the method may also be used for unfurnished spaces.

6.5 The office space shall be unoccupied during the tests.

7. Test Signal and Instrumentation

7.1 The test signal used for this evaluation may be any of the following:

7.1.1 The masking sound due to HVAC systems, the masking system, and any other noise sources.

7.1.2 The masking sound due to the masking system alone.

7.1.3 The masking sound due to the HVAC system alone.

7.2 If the intent is to evaluate the performance of the combination of sounds from the masking system and other noise sources associated with HVAC or other equipment, the method shall be carried out with the masking system adjusted as intended to be used in the occupied space. The masking

system shall not be adjusted to a higher sound level.

7.3 If the intent is to evaluate the performance of the masking system alone, then the ambient sound pressure level in each one-third octave band for each measurement shall be at least 10 dB lower than the sound pressure level of the test signal. This may require that the sound pressure levels of the masking system be temporarily raised above the design level to provide the test signal. In no event shall calculations be made to eliminate the effects of background noise.

7.4 If the intent is to evaluate the performance of the masking sound generated only by the HVAC system and other building noise sources, the masking system must be switched off.

7.5 The measurement frequency bandwidths shall be one-third octave. The overall frequency response of the filters for each test band shall conform to ANSI Specification S 1.11 for Class III filters.

7.6 The minimum frequency range for all tests shall be contiguous one-third octave bands with center frequencies from 100 to 8000 Hz. One-third octave bands beyond this range may be investigated if desired.

7.7 Test data may be acquired on-site or tape recorded for later analysis.

7.8 A random incidence microphone shall be used, that is, one that has its flattest frequency response for sounds arriving at random angles.

8. Measurement of Temporal Distribution

8.1 At least one microphone location shall be selected subject to the following conditions:

8.1.1 The measurement locations shall be at ear-height for a seated person in the open office environment, that is the microphone shall be located 1.2 m (4 ft) above the floor.

8.1.2 The locations should be at least 1 m (3.3 ft) from any vertical surfaces such as walls, columns, desks, or office furniture. In the event that this criterion cannot be met, the selected locations shall be as far as possible from the closest surfaces.

8.2 In each one-third octave band, the minimum, maximum, and average sound pressure levels encountered during a 1-min interval shall be measured. The minimum and maximum readings shall be obtained using a sound level metering circuit meeting the requirements of ANSI "slow" response or may be average sound pressure levels measured over a 1 s interval. The data for successive bands may be obtained simultaneously or sequentially.

9. Measurement of Spatial Distribution

9.1 A minimum of one measurement location for each 500 m² (5400 ft²) of floor space, but no less than ten locations, shall be selected subject to the following conditions:

9.1.1 The measurement locations shall be seated ear-height positions within the open office environment, that is, the microphone shall be located 1.2 m (4 ft) above the floor.

9.1.2 The locations should be at least 1 m (3.3 ft) from any vertical surfaces such as walls, columns, desks, or office furniture. In the event that this cannot be met, the selected locations shall be as far as possible from the closest surfaces.

9.1.3 For furnished spaces, the measurement locations shall