Designation: E 596 – 96 (Reapproved 2002)ε1

Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures[1]

This standard is issued under the fixed designation E 596; 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.

This standard has been approved for use by agencies of the Department of Defense.

ε[1] NOTE—Equation 6 was editorially updated in September 2003.

1. Scope

1.1 This test method covers the reverberation room measurement of the noise reduction of sound-isolating enclosures.

1.2 The noise isolation class may be determined from the noise reduction measured in accordance with this test method.

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:*

C 423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method[2]

C 634 Terminology Relating to Environmental Acoustics[2]

E 413 Classification for Rating Sound Insulation[2]

2.2 *ANSI Standards:*

S1.4 Specification for Sound Level Meters[3]

S1.11 Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters[3]

3. Terminology

3.1 *Definitions and Symbols*—Except as noted in 3.2, the terms and symbols used in this test method are defined in Terminology C 634.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *sound-isolating enclosure*—any enclosure that completely encloses a space, is intended to provide sound isolation for the enclosed space, and can be tested in a reverberation room.

3.2.2 *useful volume of a sound isolating enclosure*—the part of the space inside the enclosure in which the noise reduction is of interest. For example, in an audiometric booth, the useful volume is the part of the space inside the booth where a test subject's head is likely to be during audiometric tests.

4. Summary of Test Method

4.1 The enclosure to be tested is placed in a reverberation room and prepared for testing. The background noise levels inside the enclosure and in the reverberation room are measured in one-third octave bands. After bands of random noise are produced in the reverberation room, one-third octave band sound pressure levels are measured at several points in the reverberation room and at appropriate points inside the enclosure. The noise reduction in each one-third octave band is the difference between the space-averaged sound pressure level in the reverberation room and the space-averaged sound pressure level inside the enclosure. The noise isolation class (NIC) may be determined from the noise reduction data.

5. Significance and Use

5.1 The noise reduction of an enclosure is a property of the enclosure, the location of the sound source used to measure noise reduction, and the space in which the enclosure is placed. It is not a property of the enclosure alone, and its measurement under different conditions can be expected to give different results. When the noise reduction is measured in accordance with this test method, the sound source is outside the enclosure and the sound field outside the enclosure approximates a diffuse sound field. Measurements made in accordance with this test method can be expected to be reproducible from one laboratory to another.

5.2 The noise reduction measured in accordance with this test method may be used for the following purposes:

5.2.1 To rank the order of sound-isolating enclosures according to noise isolation class, NIC.

5.2.2 To estimate the highest one-third octave band sound pressure levels that can occur outside the enclosure without exceeding specified sound pressure levels inside the enclosure.

[1] This test method is under the jurisdiction of ASTM Committee E33 on Environmental Acoustics and is the direct responsibility of Subcommittee E33.03 on Sound Transmission.

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

[3] Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

5.2.3 To estimate the one-third octave band sound pressure levels that will occur inside the enclosure with specified sound pressure levels outside.

5.3 The noise reduction measured in accordance with this test method may not estimate accurately the isolation that the enclosure will provide when it is used to isolate a noise source inside it from the space outside. The user should be cautious when using noise reductions measured by this test method to evaluate enclosures used to enclose noise sources.

5.4 Sound-isolating enclosures are frequently made from prefabricated modular panels. The noise reduction measured by this test method applies to the complete enclosure and not to individual panels from which it is made and cannot be used to infer the sound transmission loss of the individual panels.

5.5 Specifications for sound-isolating enclosures may include reference to noise reduction and noise isolation class measured in accordance with this test method.

6. Reverberation Room

6.1 *Sound Diffusion*—The sound field in the reverberation room shall closely approximate a diffuse field when the enclosure to be tested is in place for testing. In general, the requirements for the reverberation room are those listed in the section dealing with *Reverberation Room* of Test Method C 423. These requirements include:

6.1.1 The effective room volume (actual room volume minus the volume occupied by the enclosure) should not be less than 200 m^3.

NOTE 1—Experience and experimental data have shown that as long as the requirements of 9.1.2 and 9.5 are satisfied, the room volume is not critical.

6.1.2 The sound absorption in the reverberation room shall be made as low as possible in order to achieve the best possible simulation to an ideal diffuse field and in order to keep the region dominated by the direct field of the source as small as possible. Within the frequency range described below the sound absorption of the reverberation room should be no greater than the following:

$$A = V^{2/3}/3 \quad (1)$$

where:

V = room volume, m^3, and
A = room sound absorption in metric sabins.

For frequencies below $f = 2000/V^{1/3}$(where the number 2000 is an empirical constant with the units seconds per metre), somewhat higher absorption may be desirable to accommodate other test requirements (for example, ANSI S1.32, ISO 3741); in any case, the absorption should be no greater than three times the value given by Eq 1. For frequencies above 2000 Hz, atmospheric absorption may make it impossible to avoid a slightly higher value of sound absorption.

6.1.3 Diffusing devices such as rotating and stationary diffusing surfaces are useful for creating an adequate approximation to a diffuse sound field.

6.2 *Background Noise*:

6.2.1 The sound pressure level of the background noise inside the enclosure should be at least 10 dB below the level of the test signal. If the difference between the level of the test signal and the background noise level is less than 10 dB and greater than 5 dB, the adjusted value of the signal level is calculated by:

$$L_a = 10 \log (10^{.1L_c} - 10^{.1L_b}) \quad (2)$$

where:

L_a = adjusted signal level, dB,
L_c = level of combined signal and background noise, dB, and
L_b = level of background noise, dB.

If the difference between the level of the test signal and the background noise level is not at least 5 dB, then subtract 2 dB from the level of the combined signal and background noise and use this adjusted level. When the difference between the signal level and the background noise level is less than 5 dB, the measurements provide only an estimate of the lower limit of the noise reduction of the enclosure. Identify such limited measurements in the test report.

6.2.2 Structureborne noise within the reverberation room structure can excite the enclosure to be tested and cause the sound pressure level within the enclosure to be higher than would be measured due to the test signal alone. Therefore, the reverberation room floor should be adequately isolated against structureborne vibrations which are propagated into the reverberation room from the outside.

NOTE 2—When the background noise inside the enclosure is the same as the background noise in the reverberation room, it is likely that either the vibration isolation (if any) between the enclosure and the reverberation room floor is ineffective or the measured background noise is the internal noise of the measuring instruments.

6.3 *Construction*—In accordance with 6.1.2, the reverberation room should be constructed of materials that have low sound absorption coefficients. Normally, when a reverberation room is to be used to measure sound absorption, sound power level, or sound transmission loss, it must be constructed using materials and design details that will provide needed sound insulation against outside noise sources. If a reverberation room is to be constructed solely for testing sound-isolating enclosures in accordance with this test method, the sound isolation requirements are not so critical, and lighter materials may be used as long as the requirements of 6.1 and 6.2 are met.

7. Measuring Instrumentation

7.1 The minimum instrumentation required for this test method is:

7.1.1 A microphone and amplifier that satisfy the requirements of ANSI S1.4 for Type 1 or better sound level meters with the exception that A and B-weighting networks are not required.

NOTE 3—A flat characteristic is desirable and, when available, should be used in place of the C-weighting network.

7.1.2 A one-third octave filter set satisfying the requirements of ANSI S1.11 for a one-third octave band filter set, Order 3 or higher, Type 1 or better. The nominal center frequencies of the filters shall be those frequencies that are within the frequency range where the noise reduction is to be measured. This frequency range shall include all of the