Designation: E 336 – 05

Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings[1]

This standard is issued under the fixed designation E 336; 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.

INTRODUCTION

This test method is part of a set of standards for evaluating the sound-insulating properties of building elements. It is designed to measure the sound isolation between two rooms or to estimate lower limits for sound transmission through a partition element installed as an interior part of a building. Others in the set cover the airborne sound transmission loss of an isolated partition element in a controlled laboratory environment (Test Method E 90), the laboratory measurement of impact sound transmission through floors (Method E 492), the measurement of impact sound transmission in buildings (Method E 1007), the measurement of sound transmission through building facades and facade elements (Method E 966), the measurement of sound transmission through a common plenum between two rooms (Method E 1414), and the measurement of sound transmission through door panels and systems (Method E 1408).

1. Scope

1.1 The sound isolation between two spaces in a building is determined by a combination of the direct transmission through the nominally separating building element (as normally measured in a laboratory) and any transmission along a number of indirect paths, usually referred to as flanking paths. Fig. 1 illustrates the direct paths and some possible structural flanking paths. Additional non-structural flanking paths may include transmission through common air ducts between rooms, or doors to the corridor from adjacent rooms.

1.2 The main part of this test method defines procedures and metrics to assess the sound isolation between two rooms in a building separated by a common partition including both direct and flanking transmission paths. Appropriate measures and their single number ratings are the noise reduction (NR) and noise isolation class (NIC), the normalized noise reduction (NNR) and normalized noise isolation class (NNIC), and the apparent transmission loss (ATL) and apparent sound transmission class (ASTC). With the exception of the ATL and ASTC under specified conditions, these procedures are only applicable when both room volumes are less than 150 m^3.

NOTE 1—The word "partition" in this test method includes all types of walls, floors, or any other boundaries separating two spaces. The boundaries may be permanent, operable, or movable.

1.3 Annex A1 provides methods to assess the sound transmission through a partition or partition element with the influence of flanking transmission reduced. These methods may be used when it must be demonstrated that a partition has achieved a specified minimum sound attenuation. The results are the field transmission loss (FTL) and field sound transmission class (FSTC).

1.4 Annex A2 provides methods to measure the sound isolation between portions of two rooms in a building separated by a common partition including both direct and flanking paths when at least one of the rooms has a volume of 150 m^3 or more. The results are the noise reduction (NR) and noise isolation class (NIC).

1.5 *This standard may involve hazardous materials, operations, and equipment. 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]

C 634 Terminology Relating to Environmental Acoustics

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

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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.

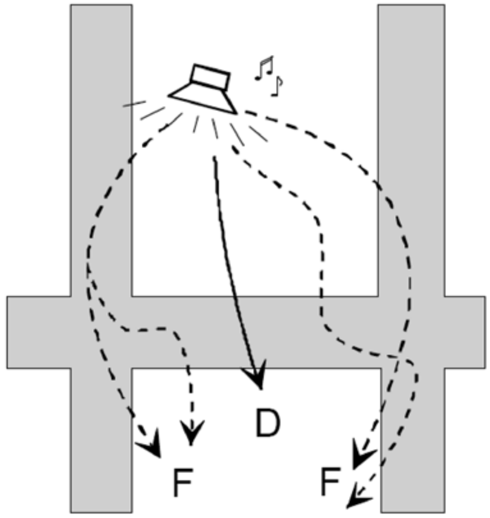

FIG. 1 Direct (D) and Some Indirect or Flanking Paths (F and Dotted) in a Building

E 90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
E 413 Classification for Rating Sound Insulation
E 2235 Test Method for the Measurement of Decay Rates for Use in Sound Insulation Test Methods
2.2 *ANSI Standards:*
S1.4 Specification for Sound Level Meters[3]
S1.10 Pressure Calibration of Laboratory Standard Pressure Microphones[3]
S1.11 Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters[3]
2.3 *IEC Standard:*
IEC 60804 Specification for Integrating-Averaging Sound Level Meters[4]

3. Terminology

3.1 The following terms used in this test method have specific meanings that are defined in Terminology C 634:

3.1.1 airborne sound; background noise; decay rate; decibel; diffuse sound field; field sound transmission class, FSTC; field transmission loss, FTL; flanking transmission; pink noise; receiving room; sabin; self-noise; sound absorption; sound attenuation; sound insulation; sound isolation; sound pressure level; sound transmission loss, TL; source room

NOTE 2—The unqualified term *average sound pressure level* in this document means that sound pressure levels were averaged over the measurement region for specified periods of time.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *apparent transmission loss, ATL, n—of a partition installed in a building, in a specified frequency band* is operationally defined as:

$$ATL = \bar{L}_1 - \bar{L}_2 + 10 \log\left(\frac{S}{A_2}\right) \quad (1)$$

where:
S = the area of the partition common to both source and receiving rooms,
A_2 = the sound absorption in the receiving room,
$\bar{L}_1$ = the source room average sound pressure level, and
$\bar{L}_2$ = the receiving room average sound pressure level resulting from the combined effect of direct and flanking transmission.

3.2.1.1 *Discussion*—Throughout this test method, log is taken to mean $\log_{10}$, unless otherwise indicated.

3.2.1.2 *Discussion*—This definition attributes all the power transmitted into the receiving room, by direct and flanking paths, to the area of the partition common to both rooms. If flanking transmission is significant, the ATL will be less than the TL for the partition. Apparent Transmission Loss is equivalent in meaning to Apparent Sound Reduction Index used by ISO 140-4.

3.2.2 *apparent sound transmission class, ASTC, n*—a single number rating obtained by applying the classification procedure of Classification E 413 to apparent transmission loss data.

3.2.3 *direct transmission, n*—sound that travels between a source and a receiving room only through the common (separating) building element.

3.2.4 *noise reduction, NR, n—in a specified frequency band*, the difference between the sound pressure levels in two enclosed rooms divided by a partition, due to one or more sound sources in one of the rooms, with the sound pressure levels averaged throughout the rooms when both rooms are less than 150 cubic meters, and averaged over a space 1 to 2 meters from the dividing partition on both sides of the partition when one or both rooms are 150 cubic meters or larger.

3.2.5 *noise isolation class, NIC, n*—a single-number rating calculated in accordance with Classification E 413 using measured values of noise reduction.

3.2.6 *normalized noise reduction, NNR, n—between two rooms of less than 150 cubic meters, in a specified frequency band*, the value that the noise reduction, NR, in a given field

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

[4] Available from International Electrotechnical Commission (IEC), 3 rue de Varembé, Case postale 131, CH-1211, Geneva 20, Switzerland.

test would have if the reverberation time in the receiving room were 0.5 s. NNR is calculated as follows:

$$NNR = NR + 10 \log\left(\frac{T}{0.5}\right) \quad (2)$$

where:
NR = noise reduction, dB, and
T = reverberation time in receiving room, s.

3.2.6.1 *Discussion*—The normalized noise reduction is intended to approximate the noise reduction that would exist between two ordinarily furnished rooms.

3.2.7 *normalized noise isolation class, NNIC, n*—a single-number rating for noise isolation between two rooms both less than 150 cubic meters calculated in accordance with Classification E 413 using measured values of normalized noise reduction. (See *normalized noise reduction*.)

4. Summary of Test Method

4.1 The source and receiving rooms are selected, the location and number of sound sources chosen, and measurement spaces in each room defined.

4.2 Sound is produced in the source room and sound pressure levels are sampled spatially in the measurement spaces in both the source and receiving rooms.

4.3 Sound decay rates are measured as necessary depending on the result to be reported.

4.4 If a value for the Field Transmission Loss is to be measured, the requirements and procedures of Annex A1 must be satisfied.

4.5 Results and single number ratings are calculated and reported.

5. Significance and Use

5.1 The main part of this standard uses procedures originally developed for laboratory measurements of the transmission loss of partitions. These procedures assume that the rooms in which the measurements are made have a sound field that reasonably approximates a diffuse field. Sound pressure levels in such rooms are reasonably uniform throughout the room and average levels vary inversely with the logarithm of the room sound absorption. Not all rooms will satisfy these conditions. Practical experience and controlled studies (**1**)[5] have shown that the test method is applicable to smaller spaces normally used for work or living, such as rooms in multi-family dwellings, hotel guest rooms, meeting rooms, and offices with volumes less than 150 cubic meters. The measures appropriate for such spaces are NR, NNR, and ATL. The corresponding single number ratings are NIC, NNIC and ASTC. The ATL and ASTC may be measured between larger spaces that meet a limitation on absorption in the spaces to provide uniform sound distribution.

5.2 Annex A2 was developed for use in spaces that are very large (volume of 150 m^3 or greater). Sound pressure levels during testing can vary markedly across large rooms so that the degree of isolation can vary strongly with distance from the common (separating) partition. This procedure evaluates the isolation observed near the partition. The appropriate measure is NR, and the appropriate single number rating is NIC.

5.3 It is sometimes necessary to demonstrate that the sound insulation of a partition meets or exceeds a specific criterion. Annex A1 provides additional requirements, and describes how shielding procedures can be used to reduce flanking transmission in stages to show that a partition has achieved a minimum value of the FTL or minimum value of the FSTC which may meet or exceed the criterion. If it is demonstrated that no significant flanking exists through shielding of all potential flanking paths, then, and only then, FTL and FSTC may be reported without qualification.

NOTE 3—Measuring the sound transmission loss properties of a partition itself to demonstrate that it meets or exceeds a specific criterion is very difficult in the field due to the presence of flanking (**2, 3**). Room volume and absorption requirements must also be met.

5.4 Several metrics are available for specific uses:

5.4.1 *Noise Reduction (NR) and Noise Isolation Class (NIC)*—Describe the sound isolation between two spaces in the condition found. The measurement method varies depending on the size of the spaces. When each space is less than 150 cubic meters, sound levels are averaged over the space. NR values for such spaces when unfurnished will usually be lower than values measured when the spaces are furnished. These values relate directly to the sound attenuation experienced by occupants of the spaces for the condition evaluated, including the effects of flanking and room absorption, and not just to the performance of a partition. When either of the spaces is 150 cubic meters or more, sound levels are measured in an area close to the partition on each side. These results include some effect of room absorption and flanking, but the effect of room absorption is less when measured close to the partition.

5.4.2 *Normalized Noise Reduction (NNR) and Normalized Noise Isolation Class (NNIC)*—Give the sound isolation between two residential or office spaces adjusted to standardized room conditions. This normalization is usually done to compensate for a lack or excess of furnishings in the rooms. NNR and NNIC shall not be used for spaces of 150 cubic meters or larger. These values are intended to relate to the sound attenuation experienced by occupants of the spaces if the spaces were normally furnished.

5.4.3 *Apparent Transmission Loss (ATL) and Apparent Sound Transmission Class (ASTC)*—Describe the apparent sound insulation of a partition separating two spaces. All sound transmission, including any flanking transmission, is ascribed to the partition. The actual transmission loss of the partition will usually be higher than the apparent transmission loss.

5.4.4 *Field Transmission Loss (FTL) and Field Sound Transmission Class (FSTC)*—These results should theoretically approach the actual sound insulation of a partition or partition element as would be measured in a laboratory, but in practice they often do not. These values may be reported only if the stringent requirements of Annex A1 to reduce flanking transmission are met. Since all flanking is removed to obtain these metrics, they do not reflect the sound attenuation experienced by the occupants when flanking transmission is significant.

[5] The boldface numbers in parentheses refer to the list of references at the end of this standard.

NOTE 4—Since the metric ASTC includes the effect of direct and flanking transmission, the ASTC will be less than or equal to the FSTC. The difference depends on the magnitude of the flanking transmission. Thus, the ASTC can be used to demonstrate that a partition at least meets an FSTC requirement and may exceed it. If ASTC is measured under conditions that do not satisfy the more stringent requirements in Annex A1, this may introduce other variations.

6. Test Equipment

6.1 *Sound Sources and Signals*—Sound sources shall be loudspeaker systems driven by power amplifiers. The input signal to the amplifiers shall be random noise containing an approximately continuous distribution of frequencies over each test band. White or pink electronic noise sources satisfy this condition.

NOTE 5—Ideally, loudspeaker systems should be omnidirectional. In practice, using multiple driver elements to cover different frequency ranges and placing and aiming sources into trihedral corners of the room will normally be adequate.

6.1.1 The sound power of the source(s) must be sufficient to raise the signal level in the receiving room far enough above background noise to meet the requirements of 11.8.

6.2 *Measuring Equipment*—Microphones, amplifiers, and electronic circuitry to process microphone signals and perform measurements shall satisfy the requirements of ANSI S1.4 for Type 1 sound level meters, except that B and C weighting networks are not required.

6.2.1 Measurement quality microphones 13 mm or smaller in diameter and that are close to omnidirectional below 5000 Hz shall be used.

NOTE 6—If measurements are to be made above 5000 Hz, a diffuse-field (random-incidence) microphone or corrector is preferred.

6.2.1.1 If multiple microphones are used, they shall all be of the same make and model.

6.3 *Bandwidth and Filtering*—The overall frequency response of the electrical system, including the filter or filters in the source and microphone sections, shall for each test band conform to the specifications in ANSI S1.11 for a one-third-octave band filter set, Order 3 or higher, Type 1 or better.

6.3.1 The minimum range of measurements shall be a series of contiguous one-third-octave bands with mid-band frequencies from 125 to 4000 Hz.

NOTE 7—It is desirable that the frequency range be extended to include at least the 100 and 5000-Hz bands.

6.4 *Calibrators*—The field calibrator used for sensitivity checks shall be an acoustic or electrostatic calibrator providing a nominal sine wave having less than 10 % distortion and amplitude stability to within 0.2 dB at a frequency in the range from 200 to 1250 Hz.

7. Calibration and Sensitivity Checks

7.1 A thorough calibration of acoustical instrumentation by a calibration laboratory at regular intervals is necessary to help assure that the equipment is operating within instrument standards and manufacturer's specifications. The appropriate calibration interval depends on several factors including the complexity of the instrument, frequency of use, frequency of field use and transportation, manufacturer recommendations, and history of reliability or problems as observed in prior calibrations.

NOTE 8—ANSI S1.10 provides more information on calibration.

7.2 If equipment is sensitive to line voltage variations, use a line-voltage regulator.

7.3 Perform sensitivity checks of the entire measuring setup (including the microphone, all cables, and instruments) with the same calibration equipment before and after the measurements. If the calibration values differ by more than 0.5 dB, the results are invalid and measurements shall be repeated.

8. Test Site Conditions

8.1 The test specimen is usually defined to be all building elements that separate and define the source and receiving rooms. These shall not be modified by any temporary means to improve performance except when attempting to measure the field transmission loss in accordance with Annex A1. Any permanent modifications made after the beginning of testing shall be reported.

8.2 Flanking transmission in the structure adjacent to the partition will be present. No efforts to suppress such structural flanking transmission shall be made.

8.3 Major flanking due to doors or other openings into common areas adjacent to the source and receiving rooms may exist. Efforts to suppress such major flanking may be made only if the intent of the test is to evaluate the partition between rooms and structural flanking. Such efforts must be reported.

8.4 *Drying and Curing Period*—Test specimens that incorporate materials for which there is a curing or drying process (for example, adhesives, plasters, concrete, mortar, and damping compound) shall age for a sufficient interval before testing (unless the intent is to evaluate a partition that is not fully cured). Aging periods for common materials are recommended in Test Method E 90 and summarized in Table 1 of this test method. If materials have not aged as shown in Table 1, testing shall be repeated after an appropriate period until no significant change is observed in results.

9. Room Selection

9.1 When measurements are being made to determine sound isolation between a particular pair of rooms, the choice of source and receiving room may be specified by the party requesting the test. When this is not specified and the rooms are

TABLE 1 Recommended Minimum Aging Periods Before Testing

Material	Recommended Minimum Aging Period
Masonry	28 days
Plaster:	
Thicker than 3 mm (1/8 in.)	28 days
Thinner than 3 mm (1/8 in.)	3 days
Wallboard Partitions:	
With water-base laminating adhesives	14 days
With non-water-base laminating adhesives	3 days
With typical joint and finishing compounds	12 h
Other	As appropriate for caulking and adhesive compounds involved

significantly different in size and furnishings, if NR is to be measured in just one direction, it shall be measured in the direction expected to produce the lowest result.

NOTE 9—Since NR and NIC are not normalized to the receiving room absorption it is possible that there will be a significant difference in NR and NIC values measured when the source and receiving rooms are interchanged. This is especially true when the rooms are of substantially different size and degree of room absorption (which is often determined by the type and amount of furnishings).

NOTE 10—Results from a single pair of rooms should not be used to represent conditions typical of many similar spaces due to the many unknown variables that could exist.

9.2 *Room Volume and Shape*—Volume and shape requirements must be met depending on the quantity to be measured.

9.2.1 NR may be measured between any two spaces where each is less than 150 m^3 using the procedures in Section 11. If either space is 150 m^3 or greater, NR may be measured using the procedures of Annex A2 to replace those in Section 11.

9.2.2 ATL and NNR may be measured between two spaces where each has a volume of at least 25 m^3 and the smallest dimension is at least 2.3 m. NNR shall not be measured between spaces where either has a volume of 150 m^3 or more.

NOTE 11—The uncertainty of the space average sound pressure level increases with decreasing frequency and with decreasing room volume.

9.2.3 ATL may be measured between spaces where either is 150 m^3 or more in volume only if at all frequencies, the room absorption, A, for each room is less than:

$$A = V^{2/3} \tag{3}$$

where:

V = the room volume. If V is in cubic meters (cubic feet), then A is in square meters (sabins).

9.2.4 FTL may be measured only if all the requirements of Annex A1 are met.

10. Sound Sources

10.1 *Location*—Place the sound source(s) at least 5 m from the separating partition unless the room dimensions prohibit this, in which case place them in the corners of the room most distant from the separating partition.

NOTE 12—Sound sources should be far enough away from the test partition that the direct field reaching the latter is as small as possible compared to the reverberant field. (When the isolating partition is a vertical wall, sources are usually placed in corners away from the isolating partition. When the isolating partition is a floorceiling structure, the source usually must be placed in the lower room.) Pointing loudspeakers into corners reduces the direct field from the loudspeakers in the source room and is recommended.

10.2 If more than one source position is used, the distance between positions shall be at least 2 m. If more than one source is used simultaneously, they shall be driven by separate noise generators and amplifier channels so the outputs are uncorrelated.

NOTE 13—Multiple sources may be necessary to achieve an even sound distribution for noise reduction measurements in some large irregular absorptive spaces.

NOTE 14—It is highly desirable to use more than one source location as results, especially at low frequencies, may be influenced by the position of the source in the room. If desired, measurements may be repeated for several loudspeaker positions and the values averaged to provide a less biased result.

11. Measurement of Average Sound Pressure Levels

11.1 The test method requires two sets of average sound pressure levels with the source(s) operating in the source room. The first are those in the source room. The second are those in the receiving room measured with the effect of background noise removed if necessary.

11.2 *Averaging Time*—When measuring sound pressure levels in all frequency bands simultaneously at fixed locations, the minimum averaging time shall be 10 s for measurements down to 125 Hz. If frequency bands are measured sequentially, the averaging time may be 5 s at 250 Hz and above. The minimum averaging time, T_a, at frequency f that is less than 250 Hz must be computed from:

$$T_a = \frac{1240}{f}\ \mathrm{s} \tag{4}$$

NOTE 15—This provides 95 % confidence limits of ± 0.5 dB. For more information, see Ref (**5**).

11.2.1 When using mechanically or manually scanned microphones, integration times shall be at least 30 s. Longer times may be required to cover the entire volume to be measured.

11.3 *Measurement Space*—Microphones shall be placed or scanned in an area more than 1 m from all major extended surfaces. The distance from all sources shall be at least 1 m when the room volume is less than 25 m^3, at least 1.5 m when the room volume is less than 100 m^3, and at least 2 m in larger rooms.

11.3.1 If the requirements of 11.3 prevent adequate sampling of the measurement region then measurements may be made as close as 0.5 m to room surfaces (**4**), but must never be less than 1 m from the isolating partition in the receiving room.

11.4 *Spatial Sampling Method*—There are three permissible methods to spatially sample the measurement space: fixed microphone positions, mechanically operated microphones, and manually scanned microphones.

11.4.1 When measuring background noise, the same methods, microphone positions, sweep pattern, measurement periods and instrument range settings as used for the measurement of level in the receiving room due to the sound source shall be used.

11.4.2 *Fixed Microphone Positions*—If fixed microphone positions are used, at least six positions shall be used in each room. The positions shall be at least 1 m apart. If and only if the space is too small to allow this, the distance between microphones or number of microphone or both may be reduced. Do not use microphone arrangements that are obviously symmetrical, such as all in the same vertical or horizontal plane.

NOTE 16—To provide independent samples of the sound field, stationary microphones in an ideal diffuse sound field would be spaced at least one-half wavelength apart at the lowest frequency of interest (**4**).

11.4.2.1 *Determination of Space-Average Levels*—When multiple measurements are made in the same room, use the following equation to obtain the average sound pressure level which is a space and time average level:

$$\bar{L} = 10 \log\left[\frac{1}{n}\sum_{i=1}^{n} 10^{L_1/10}\right] \quad (5)$$

where:

L_1 = the level measured at the *i*th microphone position and there are *n* locations in the room.

11.4.3 *Moving Microphones*—Moving microphones may be used in conjunction with sound level meters or the equivalent that give integrated levels in accordance with IEC 60804. Whether mechanically or manually moved, the microphone speed shall not exceed 0.5 m/s.

11.4.3.1 *Mechanically Operated Microphones*—A single microphone continuously moving along a defined traverse such as a circular path may be used if the restrictions given in 11.3 are met at all points on the path. The radius of a circular path must be at least 1 m, and larger if the dimensions of the room allow. The plane of the path shall not be parallel to any surface of the room.

NOTE 17—The minimum radius is required to achieve the equivalent of the minimum required number of points at low frequencies. The number of equivalent fixed microphone positions for a straight-line traverse of length L is $2L/\lambda$ and for a circular or closed traverse of length L is $(2L/\lambda) - 1$, where λ is the wavelength of interest (**6**).

11.4.3.2 In larger rooms, multiple locations of the microphone traverse may be necessary to adequately sample the room. Avoid patterns that overlap; the size of the path and the number of locations should be adjusted to give adequate coverage. The results of multiple scans shall be averaged using Eq 5.

11.4.3.3 *Manually Scanned Microphones*—When the size of the measurement space allows, the operator shall stand within the space and turn slowly moving the microphone to sample as much of the measurement space as possible without going outside the measurement space. The microphone shall be held well away from the operator's body (a boom serves to increase the distance). For larger rooms, the operator shall walk slowly moving the microphone in a circular path of at least 0.5 m diameter in front to evenly sample as much as practical of the measurement space. For very small rooms where it is impractical for operator to stand within the measurement space and hold the microphone away from the body, the operator shall stand to the side of the measurement space and extend the microphone into the measurement space. The microphone speed shall remain as constant as practical. The operator shall take care to assure that the path does not significantly sample any part of the room volume for more time than other parts. Take care when moving the microphone and its cable, and when walking, especially when measuring sound in the receiving room. The measured data can be contaminated by footstep sounds or extraneous signals due to inadvertent contact between the microphone and the operator's body.

11.5 *Receiving Room Level*—With the sound source(s) operating at a constant level, measure the average sound pressure level at each frequency in the receiving room.

11.5.1 When measurements are made in areas with fluctuating background noise, the operator shall listen to the noise in the receiving room during measurements of the receiving room level. If any intermittent interfering sounds are heard during the measurements, the measurements must be repeated until no such sounds are heard during the collection period.

11.6 *Source Room Level*—With the sound source(s) operating at a constant level, measure the average sound pressure level at each frequency in the source room taking care to avoid the direct field of the sound sources, see 11.3.

11.7 *Background Noise Level*—With the sound source(s) shut off, measure the average sound pressure level at each frequency in the receiving room using the same instrument range setting used to measure receiving room levels and a minimum averaging time of 30 s at each microphone position.

NOTE 18—A longer integration time is needed for the measurement of background noise since its level may vary significantly with time.

11.7.1 Compare the receiving room levels and background noise levels. If at any frequency the background noise level is within 10 dB of the receiving room level, increase the source level if possible to achieve at least a 10 dB difference at each frequency and repeat all level measurements.

11.7.2 It may be necessary to filter the spectrum of the noise source to concentrate the available sound power in a few bands to increase the source room sound pressure level. In such cases, the bandwidth of the filter applied to the source signal shall extend at least one-third-octave band above and below the frequency band(s) measured in the receiving room.

11.8 *Corrected Receiving room Levels*—If the difference between the background and the combined level in the receiving room due to source and background is more than 10 dB at all frequency bands then no corrections to the receiving room levels are necessary.

11.8.1 If, after increasing the source level, the difference between the background and the receiving room level is between 5 and 10 dB, the adjusted value of the receiving room level shall be calculated as follows:

$$L_s = 10 \log(10^{L_{sb}/10} - 10^{L_b/10}) \quad (6)$$

where:

L_b = the background noise level in each band, dB,

L_{sb} = the combined level of signal and background (the receiving room level), dB, and

L_s = the adjusted signal level, dB.

11.8.2 If the background level is within 5 dB of the receiving room level, then subtract 2 dB from the receiving room level and use the result as the corrected receiving room level. In this case, the measurements shall only be used to provide an estimate of the lower limit of the noise reduction or other derivative result. Identify such measurements in the test report.

11.9 *Room Absorption*—When room absorption or decay rate must be measured in the receiving room to determine the NNR or ATL, they shall be determined in accordance with Test Method E 2235.

12. Calculation of Acoustical Quantities and Associated Metrics

12.1 Where both rooms are less than 150 cubic meters, calculate the noise reduction as the difference between the average sound pressure levels obtained in the source and receiving rooms, using: