Designation: ~~E336 – 20~~ E336 – 23

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

This standard is issued under the fixed designation E336; 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 U.S. 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 E90), the laboratory measurement of impact sound transmission through floors (Test Method E492), the measurement of impact sound transmission in buildings (Test Method E1007), the measurement of sound transmission through building facades and facade elements (Guide E966), the measurement of sound transmission through a common plenum between two rooms (Test Method E1414/E1414M), and measurement of the normalized insertion loss of doors (Test Method E2964).

1. Scope

1.1 The sound isolation between two spaces in a building is influenced most strongly 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, referred to as flanking paths. Fig. 1 illustrates the direct paths (D) and some possible structural flanking paths (F). Additional non-structural flanking paths include transmission through common air ducts between rooms, or doors to the corridor from adjacent rooms. Sound isolation is also influenced by the size of the separating partition between spaces and absorption in the receiving space, and in the case of small spaces by modal behavior of the space and close proximity to surfaces.

1.2 The main part of this test method defines procedures and metrics to assess the sound isolation between two rooms or portions thereof in a building separated by a common partition or the apparent sound insulation of the separating partition, including both direct and flanking transmission paths in all cases. Appropriate measures and their single number ratings are the noise reduction (NR) and noise isolation class (NIC) which indicate the isolation with the receiving room furnished as it is during the test, the normalized noise reduction (NNR) and normalized noise isolation class (NNIC) which indicate the isolation expected if the receiving room was a normally furnished living or office space that is at least 25 m^3 (especially useful when the test must be done with the receiving room unfurnished), and the apparent transmission loss (ATL) and apparent sound transmission class (ASTC) which indicate the apparent sound insulating properties of a separating partition including both the direct transmission and flanking transmission through the support structure. The measurement of ATL is limited to spaces of at least 25 m^3 where modal effects

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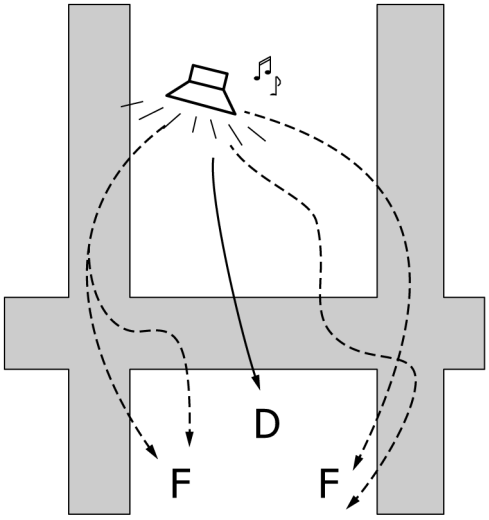


FIG. 1 Direct (D) and Some Indirect or Flanking Paths (F and Dotted) in a Building

create fewer problems. With the exception of the ATL and ASTC under specified conditions, these procedures in the main part of the test method 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 including those that are permanent, operable, or movable.

1.3 The NR and NIC between two locations are always measureable and reportable though conditions present will influence how measurements are performed. With one exception (see 13.5.1), it is required that the NIC always be reported. Restrictions such as minimum room volume or dimensions or maximum room absorption are imposed for all other measures and ratings in this standard. Thus, conditions sometimes exist that will not allow NNR (NNIC) or ATL (ASTC) to be reported. Where a partition between rooms is composed of parts that are constructed differently, or contains an element such as a door, the ATL and ASTC of the individual elements or portions of the partition are not measurable without modifications to the rooms. To evaluate the field performance of a door less than 6 m^2 in area, use Test Method E2964. The various metrics are inherently different quantities, so that NIC cannot be used instead of NNIC or ASTC to evaluate compliance with a specification when the specification is written in terms of one of those metrics that cannot be reported with the conditions present.

1.4 Annex A1 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 test method is intended to evaluate the actual acoustical performance between rooms in buildings. Thus, it forbids temporary modifications that influence performance. The measurement methods are useful in diagnostic situations where modifications are made. In such cases reports of results are required to clearly indicate that such modifications were made.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 The text of this test method references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

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

1.9 *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]

C634 Terminology Relating to Building and Environmental Acoustics
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
E413 Classification for Rating Sound Insulation
E492 Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine
E966 Guide for Field Measurements of Airborne Sound Attenuation of Building Facades and Facade Elements
E1007 Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures
E1414/E1414M Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
E2235 Test Method for Determination of Decay Rates for Use in Sound Insulation Test Methods
E2964 Test Method for Measurement of the Normalized Insertion Loss of Doors
E3091 Specification for Systems to Measure Sound Levels

2.2 *ANSI Standard:*[3]

~~S1.40~~S1.40-2006 ~~Specification~~Specifications and Verification Procedures for Sound Calibrators

2.3 *IEC Standards:*[4]

IEC ~~60942~~60942:2003 Electroacoustics – Sound calibrators
IEC ~~61260-1~~60942:2017 Electroacoustics – ~~Octave-band and fractional-octave-band filters – Part 1: Specifications~~Sound calibrators
IEC 61094-4:1995 Measurement microphones – Part 4: Specifications for working standard microphones
IEC ~~61672-1~~61672-1:2013 Electroacoustics – Sound level meters – Part 1: Specifications
IEC ~~61672-3~~61672-3:2013 Electroacoustics – Sound level meters – Part 3: Periodic tests

NOTE 2—The IEC standards are often adopted by national standards organizations as national standards sometimes with additional unique national standards numbers assigned.

2.4 *ISO Standard:*[5]

ISO 16283-1:2014 Acoustics – Field measurement of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation

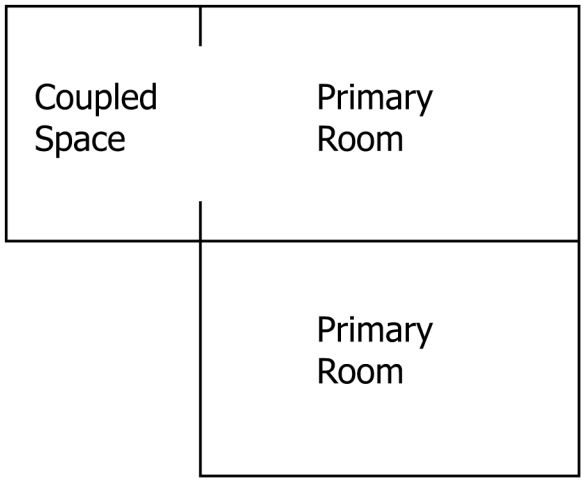


FIG. 2 Coupled Spaces Adjacent to a Primary Space

[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.
[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.
[4] Available from International Electrotechnical Commission (IEC), 3 rue de Varembé, Case postale 131, CH-1211, Geneva 20, Switzerland, http://www.iec.ch.
[5] Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.

3. Terminology

3.1 ~~The following terms~~ Terms used in this ~~test method have specific meanings that are defined~~ standard are defined either in Terminology C634~~:~~ or within this standard. The definition of terms explicitly given within this standard take precedence over definitions given in Terminology C634. The definitions within the Terminology section of Terminology C634 and this standard take precedence over any other definitions found in any other documents, including documents that are referenced in this standard.

3.1.1 The following terms used in this test method have specific meanings that are defined in Terminology C634: airborne sound; background noise; decay rate; decibel; diffuse sound field; flanking transmission; pink noise; receiving room; reverberation; reverberation time; sound absorption; sound attenuation; sound insulation; sound isolation; sound pressure level; sound transmission class, STC; sound transmission loss, TL; source room

~~NOTE 3—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 The following terms are either not defined in the Terminology section of Terminology C634 or have definitions in this document different from those stated in the Terminology section of Terminology C634.

3.2.2 *apparent transmission loss, ATL (dB), 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, m^2
A_2 = the sound absorption in the receiving room, m^2
$\bar{L}_1$ = the source room average sound pressure level, dB and
$\bar{L}_2$ = the receiving room average sound pressure level resulting from the combined effect of direct and flanking transmission, dB.

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

3.2.2.2 *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 (ATL) is equivalent in meaning to apparent sound reduction index (ASRI) used by ISO 16283-1:2014.

3.2.3 *apparent sound transmission class, ASTC, n*—a single number rating obtained by applying the classification procedure of Classification E413 to apparent transmission loss data.

3.2.4 *average sound pressure level, $\bar{L}_p$, (dB), n*—(1) *in a specified frequency band within a defined measurement region*, a continuous time-averaged sound pressure level measured with a moving microphone; (2) *for several related time-averaged sound pressure levels measured at different positions for the same length of time either simultaneously or sequentially*, ten times the base 10 logarithm of the arithmetic mean of the squared ratios of acoustic pressure to reference pressure (20 μPa) from which the individual sound pressure levels were derived."

3.2.4.1 *Discussion—*
For an individual time-average sound pressure level, L_i, the corresponding squared pressure ratio is equal to $10^{(L_i/10)}$. The calculation of average sound pressure level from individual L_i values is expressed in Eq 6.

3.2.5 *coupled space, n*—a secondary space that is adjacent to and partially open to the primary space on the same side of the separating partition and which meets spatial and sound level distribution requirements sufficient to allow the secondary space to be included as part of the measurement space with the primary space.

3.2.5.1 *Discussion—*
Fig. 2 and Fig. 3 illustrate conditions that are candidates for coupled spaces.

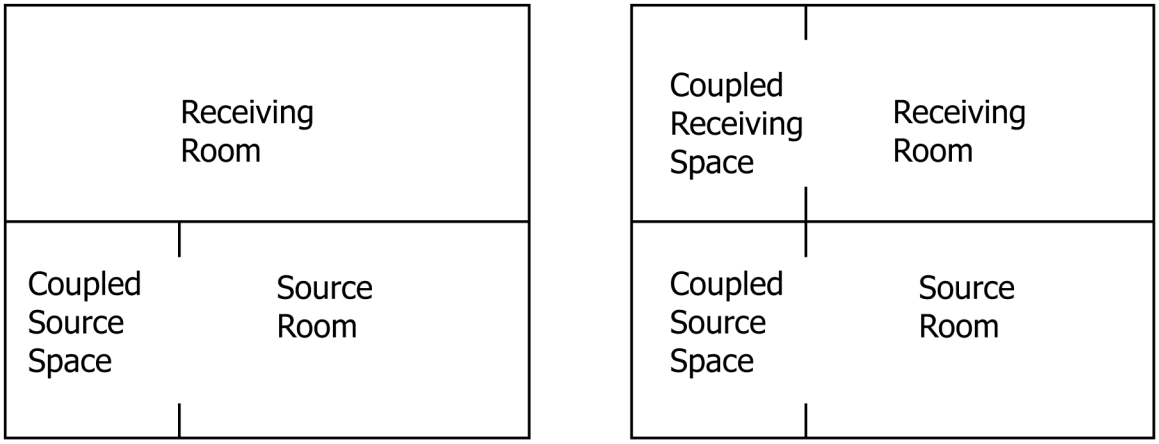


FIG. 3 Receiving Spaces Adjacent to a Coupled Source Space

3.2.5.2 *Discussion—*
To qualify as a coupled space in this standard the space must meet requirements specified in 9.4.1.

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

3.2.7 *noise reduction, NR, (dB), n—in a specified frequency band*, the difference between the sound pressure levels at two well-defined locations.

3.2.8 *noise isolation class, NIC, n*—a single-number rating calculated in accordance with Classification E413 using measured values of noise reduction.

3.2.9 *normalized noise reduction, NNR, (dB), n—between two rooms of less than 150 m^3 where the receiving room is at least 25 m^3, in a specified frequency band*, the value that the noise reduction, NR, in a given field test would have if the reverberation time in the receiving room were 0.5 s. NNR is calculated as follows:

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

where:

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

3.2.9.1 *Discussion—*
The normalized noise reduction is intended to approximate the noise reduction that would exist in an ordinarily furnished receiving room.

3.2.10 *normalized noise isolation class, NNIC (dB), n*—a single-number rating for noise isolation between two rooms both less than 150 ~~cubic~~m^3 ~~meters~~ calculated in accordance with Classification E413 using measured values of normalized noise reduction. (See *normalized noise reduction*.)

3.2.11 *significant digit, n*—any of the figures 0 through 9 that is used with its place value to denote a numerical quantity to some desired approximation, excepting all leading zeros and some trailing zeros in numbers not represented with a decimal point. **E29**

3.2.11.1 *Discussion—*
A measurement value is not always precise to the number of significant digits used to represent it.

3.2.11.2 *Discussion—*
Zeros leading the first nonzero digit of a number are not significant digits. Zeros trailing the last nonzero digit for numbers represented with a decimal point are significant digits. The significance of trailing zeros for numbers represented without use of a decimal point can only be identified from knowledge of the source of the value. A decimal point must not be inserted after a

non-significant zero. The significance or non-significance of a zero can often be clarified by expressing the number in scientific notation or by changing the SI prefix for the units.

3.2.11.3 *Discussion—*

Further discussion and examples are provided in the discussions of this term in Practice E29.

4. Summary of Test Method

4.1 The source and receiving rooms are selected, the measurement spaces and volumes in each room are defined and the metrics to be measured are identified based on information given in Section 5 within the restrictions given in 11.3 and Annex A1.

4.2 The number and location of sound sources are chosen, 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 noise reduction is to be measured between rooms immediately adjacent to a common partition where either is 150 m^3 in volume or greater, the requirements and procedures of Annex A1 must be satisfied.

4.5 If values of NNR are to be reported, the requirements of 9.3 must be satisfied. If values of ATL are to be reported, the requirements of 9.4.1 must be satisfied and if ATL is to be reported for a partition between spaces where either is 150 ~~cubic~~m^3 ~~meters~~ in volume or greater, the requirement of 9.4.1.2 must be satisfied.

4.6 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 sound transmission loss of partitions. These procedures assume that the rooms in which the measurements are performed 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. Experience and controlled studies (**1**)[6] 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~~m^3 ~~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 are measurable between larger spaces that meet a limitation on absorption in the spaces to provide uniform sound distribution.

5.2 Annex A1 was developed for use in spaces that are very large (volume of 150 m^3 or greater). Sound pressure levels during testing vary markedly across large rooms so that the degree of isolation varies 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 Several metrics are available for specific uses. Some evaluate the overall sound isolation between spaces including the effect of absorption in the receiving space and some evaluate the performance or apparent performance of the partition being evaluated. The results obtained are applicable only to the specific location tested.

5.3.1 *Noise Reduction (NR) and Noise Isolation Class (NIC)*—Describe the sound isolation found between two spaces. Noise reduction data are based on the space- and time averaged sound pressure levels meeting the requirements of 11.3 or A1.3 as required depending on the sound absorption, volume, and shape requirements of 9.2. Noise reduction values are influenced by the absorption in the receiving space as well as the apparent performance of the partition. The noise reduction values in unfurnished spaces are typically less than in furnished spaces, and noise reduction values between the spaces depend on the test direction used and the sound absorption in the spaces. However, these effects are lessened when the method of Annex A1 is used.

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

5.3.2 *Normalized Noise Reduction (NNR) and Normalized Noise Isolation Class (NNIC)*—Describe the sound isolation between two residential or office spaces meeting the requirements of 9.3.1 adjusted to standardized room conditions typical of such spaces when normally furnished.

5.3.3 *Apparent Transmission Loss (ATL) and Apparent Sound Transmission Class (ASTC)*—Describe the apparent sound insulation of a partition separating two spaces as influenced by flanking in the supporting structure. All sound transmission, including any flanking transmission, is ascribed to the partition. The apparent transmission loss of the partition will be less than the actual sound transmission loss (Path D in Fig. 1) if flanking (Path F in Fig. 1) is significant **(2,3)**. These results are in theory the same in each direction but differences with direction have been observed in practice. If it is necessary for diagnostic purposes to suppress flanking when doing measurements, the results must be clearly labeled as "flanking suppressed."

5.4 The primary use of this test method is to evaluate the sound isolation and apparent sound insulation performance in buildings based on tests of unmodified structures. If the measurement methods are used for diagnostic or investigative purposes to measure the performance of modified structures in buildings, results must be clearly labeled to indicate such.

NOTE 3—Versions of this standard prior to 2017 included TL and STC metrics with prefixes designated as "Field (F)." The "Field" version of the metrics was intended to exclude the presence of flanking sound transmission altogether; whereas, the "Apparent" version presumes an (unknown) degree of flanking. In addition, the "Field" version of the metrics required more stringent limits on room volume and room absorption. These earlier versions also included guidance on suppression of flanking, useful for diagnostic purposes.

6. Test Equipment, Data Recording, and Rounding in Calculations

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 a continuous distribution of frequencies over each test band. White or pink electronic noise sources satisfy this condition.~~

6.1.1 The input signal to the amplifiers shall be random noise containing a continuous distribution of frequencies over each test band. Measure and check the loudspeaker output on site to ensure it is operating as expected without damage to the system. If the input signal is filtered to a narrow band to increase output level (see 11.7.2), the filter shall be capable of providing signal at least one-third octave above and below the measurement test band.

NOTE 4—A pink noise source is recommended, especially when all frequencies within the test range are being excited simultaneously, but adjustment for exactly equal output level in each band is not required. Directional loudspeakers with multiple driver elements to cover different frequency ranges placed and aimed into trihedral corners of the room or omnidirectional loudspeakers are acceptable.

6.1.2 Select high-power amplifiers and efficient loudspeakers considering the requirements of 11.7.1 and any information available concerning expected test site conditions.

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.~~Preliminary measurements on site can evaluate background sound and identify the need to turn off background sources where possible.

6.1.3 ~~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~~If more than one source is used simultaneously, the sources shall be driven by separate noise generators and amplifier channels, so the outputs are ~~11.8.~~uncorrelated.

6.2 *Sound Measuring Equipment*—~~Microphones, amplifiers,~~Amplifiers, filters, and electronic circuitry to process microphone signals and perform measurements shall satisfy the requirements of ~~IEC 61672-1 for Type 1~~ Section 5 and either Section 6 or Sections 7.1–7.4 of Specification E3091. The system shall also include the ability to measure time-average levels (as required of integrating-averaging sound level ~~meters, except that B and C weighting networks are not required.~~meters) and A-weighting filters, both as specified in IEC 61672-1:2013.

6.2.1 ~~Measurement quality~~"Working standard" microphones 13 mm or smaller in diameter ~~and that are close to omnidirectional below 5000 Hz~~ as described in IEC 61094-4:1995 shall be used.

NOTE 6—If measurements are to be performed 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 measurement system filters or each test band, shall meet or exceed the specifications of IEC 61260-1 for one-third-octave band filter set, class 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.~~

6.3 *Calibrators*—The field calibrator used for sensitivity checks shall be an acoustic or electroacoustic calibrator meeting class 1 requirements of ANSI ~~S1.40~~ S1.40-2006, IEC 60942:2003, or IEC ~~60942.~~60942:2017.

6.4 Devices for measuring linear dimensions shall be capable of determining such to at least ~~two significant figures~~three significant digits for dimensions of 0.1 m or ~~greater and three significant figures for dimensions of 1 m or greater. Include one estimated digit beyond the last certain digit if necessary.~~greater, including one estimated digit beyond the last certain digit if necessary. Count final zeros as significant if they are a verified part of the measurement.

NOTE 7—For non-logarithmic numbers, the significant digits are the first and last non-zero digit, plus all digits between those, plus zero digits at the end if those zeros are verified by measurement and not just added. The significant digits in numbers multiplied or divided control the significant digits in the result of the calculation. A tape marked in decimal divisions of units, or a laser device providing results in decimal divisions, makes it easier to record field dimensions directly for use in calculations with proper significant digits and minimizes the need for additional calculation steps. In decibels, the number of significant digits is equivalent to the number of digits after the decimal point plus one.

6.5 Devices for measuring reverberation time or decay rates shall be capable of determining and reporting the reverberation time to at least hundredths of a second or decay rates to at least three significant ~~figures.~~digits, considering both to be non-logarithmic numbers.

6.6 ~~Where capability exists in the instruments used, record and use sound levels to at least hundredths of a decibel, and linear dimensions,~~ Record observed values to the greatest resolution provided by the instrument for sound levels, reverberation times, and decay ~~rates~~ rates. Record linear dimensions to at least ~~one significant figure greater than specified in~~ 3 significant digits.~~6.5 and 6.6.~~

6.7 Do not round any intermediate results during calculations. Only round reported results as directed ~~herein.~~herein or round as specified in computing single number ratings.

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 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—IEC ~~61672-3~~61672-3:2013 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 Except as discussed in 8.2 and 8.4, the test site shall be a pair of rooms in a building separated by a completed wall or

floor-ceiling that is not modified from the condition expected for future use. Doors shall be installed with the closure hardware and seals (if any) that are to be in place in final construction. Results are intended to indicate conditions to be expected by building occupants.

8.1.1 No building elements that separate and define the source and receiving rooms shall be modified by any temporary means to improve performance. Any permanent modifications made after the beginning of testing shall be reported.

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

8.1.3 Flanking due to doors or other openings into common areas adjacent to the source and receiving rooms shall not be suppressed by any temporary modification.

8.2 *Elimination of Coupled Space*—When determining the apparent transmission ~~lossss~~loss ATL, a coupled space on the receiving side is permitted but not required to be blocked off by solid heavy material such as gypsum board or plywood to create a smaller and more defined measurement volume. The coupled space shall not be so blocked if it is needed to satisfy the minimum volume requirement for the receiving side.

8.3 *Verification of Coupled Spaces*—Any coupled space included in measurements must be verified by dimensional factors and measurement of sound levels. For a space to be a coupled space for purposes of this standard, the following conditions must be met:

8.3.1 The opening between the primary and secondary spaces must be at least 33 % of the total area of the partition separating the primary and secondary spaces.

8.3.2 Unless one or more of the dimensions of a secondary space is less than 1 m (such as spaces A1, A2, and B in Fig. 4), it must be demonstrated by measurement with the sound source operating that the difference between the space-averaged A-weighted overall sound level in the primary and secondary spaces (such as D and F in Fig. 4) is not more than 6 dB.

8.3.3 If either dimension of the secondary space in the plane of the opening between spaces is less than 1 m (such as space B in Fig. 4), that space shall not be considered coupled if the dimension perpendicular to that plane is more than 1 m.

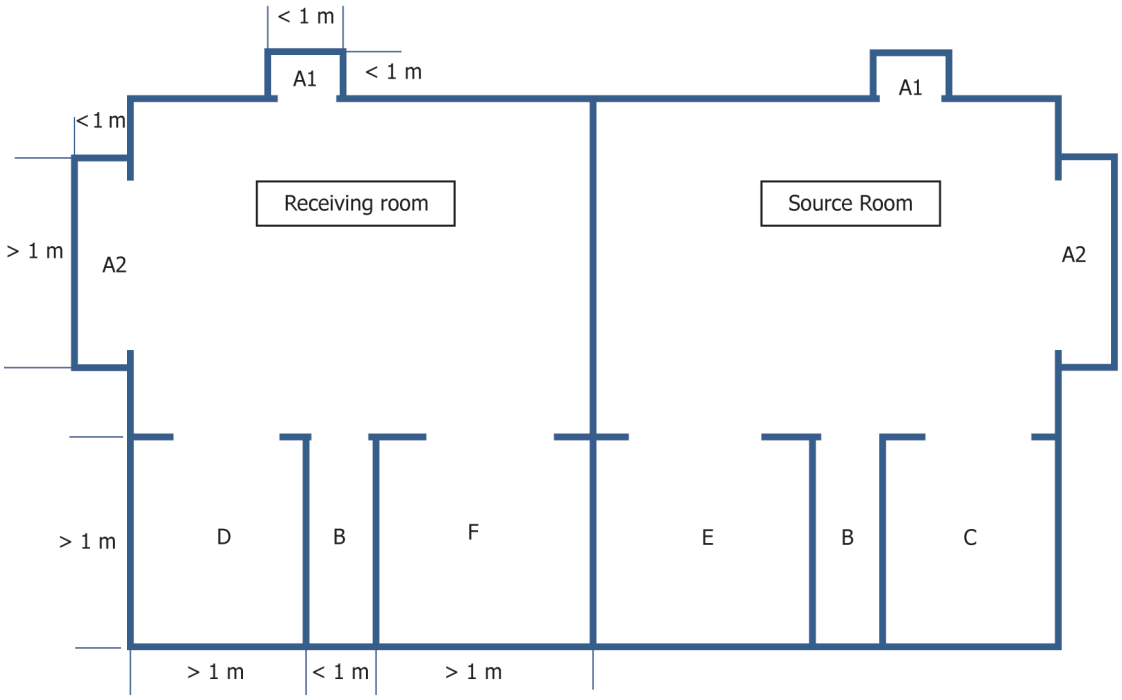
NOTE 9—Coupled spaces sometimes occur where adjacent spaces are partially divided without doors or are created by fully opening doors between adjacent spaces. Such coupled spaces are possible adjacent to a given primary space as shown in Fig. 4. Examples are a bay window, niche, or open shallow closet-like space of less than one meter depth (such as A1 and A2 in Fig. 4). These small coupled spaces are part of the overall room volume. However, sound measurements are not performed within them.

NOTE 10—A corridor less than 1 m wide and extending away from the primary space for more than 1 m (such as space B in Fig. 4) is not coupled and its volume is not included as it is impossible to measure within it.

8.4 *Investigative Measurements*—The measurement methods in this test method are useful and appropriate in situations where structures are modified to isolate specific transmission paths. Examples are *(1)* the investigation of structural flanking with the structural flanking suppressed, *(2)* investigation of structural transmission and structural flanking where it is necessary to eliminate major non-structural flanking through paths such as through doors to a common corridor beside the test rooms, and *(3)* subdividing a room into two spaces by use of heavy solid panels to measure the ATL of parts of a separating partition that are of different construction for the two spaces. Because investigative measurements do not represent the actual expected performance, the reports and results must indicate such. Any ATL results where flanking has been suppressed are required to be marked “flanking suppressed” since by definition ATL does not have flanking suppressed. See 13.1.2.2, 13.1.2.3, and 13.1.4.3.

8.5 *Drying and Curing Period*—The drying and curing period for construction materials shall be considered in the scheduling of testing and reporting of results. The date of construction completion for elements under test shall be reported if within 30 days before testing.

NOTE 11—Results have been found to be influenced by drying or curing time. Some typical drying and curing times for common materials are as follows: masonry 28 days; gypsum concrete 14 days if less than 35 mm thick, 21 days otherwise; plaster 3 days if 3 mm or less thick, 28 days otherwise; wallboard partitions 12 h with typical joint and finishing components, 3 days with non-water-based laminating adhesive, 14 days with water-based laminating adhesive.



A. Always include spaces such as A1 and A2 in volume unless closed off
B. Never include in volume and measurements
C. Do not include in volume and measurements unless needed to meet minimum volume
D. If conditions 8.3.1 and 8.3.2 are met, include in volume and measurements unless closed off
E. Closed off or ensure condition 9.4.9 is met
F. If E is not closed off, include in measurement and volume. If E is closed off, include F in volume and measurements if conditions 8.3.1 and 8.3.2 unless F is closed off also.

FIG. 4 Examples of Potential Coupled Spaces

9. Measurement and Source and Receiving Space Requirements for Specific Measurements

9.1 The areas to be used for measurements and restrictions on the size and absorption present in spaces depend on the type of measurement being performed. These matters are addressed in this section specifically for each type of measurement. These restrictions prohibit some measurements from being performed. The user shall choose to make one or more of the permitted measurements dependent upon the purpose of the measurements and the restrictions imposed in the remainder of Section 9.

9.1.1 With the exception of the volume to be used to calculate the sound absorption in some cases in 11.9, the volumes to be used in this standard are the gross volumes of rooms including coupled spaces without subtracting out the volumes of built-in cabinets, appliances, furniture or other objects in the room.

9.1.2 With one exception (see 9.2.3), all measurements are performed using procedures specified in Section 11. The NIC must always be reported with one exception: when only the ATL is being measured and the gross volume of the source or receiving room is 150 m^3 or more (see 9.4.1.2). If the purpose of the test requires the reporting of both the ATL and the NR when the gross volume of either the source or receiving room is 150 m^3 or greater, then separate measurements must be performed in accordance with Section 11 for ATL and in accordance with Annex A1 for NR.

9.2 *Noise Reduction*—Procedures for the measurement of NR differ depending on circumstances.

9.2.1 When measurements are being performed to determine sound isolation between a particular pair of rooms in only one direction, and the choice of source and receiving room is not specified by the party requesting the test, and the rooms are

significantly different in size and furnishings, the measurements shall be in the direction expected to produce the lowest numerical result unless there is a compelling reason not to do so.

NOTE 12—Since NR and NIC are not normalized to the sound absorption in the receiving room, 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 sound absorption (which is often determined by the type and amount of furnishings).

9.2.2 If the gross volume of the source room (including coupled spaces, if any) and the gross volume of the receiving room (including coupled spaces, if any) are each less than 150 m^3, the procedures of Section 11 shall be used. Noise reduction is also measurable for defined limited areas within such spaces such as a living area or dining area or kitchen area. When doing so, the specific areas included in the measurements must be clearly identified on a drawing in the report.

9.2.3 If the gross volume of the source room (including coupled spaces, if any) or the gross volume of the receiving room (including coupled spaces, if any) are either 150 m^3 or more, the procedures of Annex A1 shall be used. In this case the space shall not be divided into smaller functional spaces such as a living or dining area for measurement using the procedures of Section 11.

9.2.4 When the receiving space for an NR measurement is a corridor, the measurement space in the corridor shall be defined as follows and as illustrated in Fig. 5:

9.2.4.1 When the corridor is perpendicular to the separating partition, take measurements in the region 1 to 2 m from the separating partition.

9.2.4.2 When the corridor is parallel to the separating partition, take measurements in the region between the ends of the separating partition.

9.3 *Normalized Noise Reduction*—NNR shall only be measured between spaces meeting further restrictions beyond those specified above for the noise reduction.

9.3.1 NNR shall be measured only between two spaces meeting the following conditions:

9.3.1.1 The gross volumes of the spaces on each side of the partition must each be less than 150 m^3.

9.3.1.2 The gross volume of the receiving room (including coupled spaces, if any) and any functional areas such as living, dining, or kitchen area where NNR is to be measured, must be at least 25 m^3 and the smallest dimension of the receiving space must be at least 2.3 m.

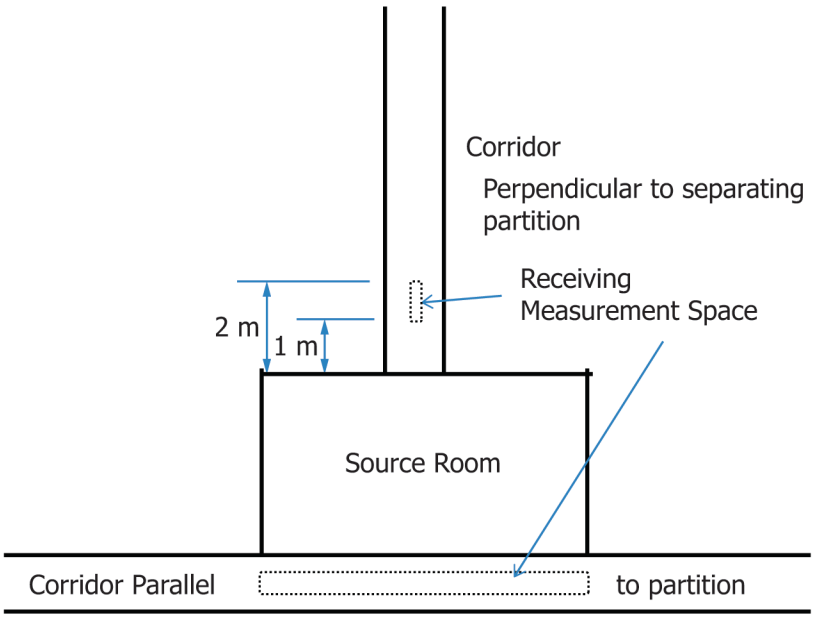


FIG. 5 Receiving Measurement Space in Corridors