



Designation: E2964 – 21

Standard Test Method for Measurement of the Normalized Insertion Loss of Doors¹

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INTRODUCTION

This test method is part of a set of standards for evaluating the sound-insulating properties of building elements and the sound isolation between spaces. It is designed to measure the field sound isolation performance of doors. Others in the set cover the airborne sound transmission loss of an isolated partition element in a controlled laboratory environment (Test Method E90), field measurements of the sound isolation between rooms in buildings (Test Method E336), 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), and the measurement of sound transmission through a common plenum between two rooms (Test Method E1414).

1. Scope

1.1 The sound insulation properties of a door are measured in a laboratory as the sound transmission loss in accordance with Test Method E90. Using those data, the single-number rating sound transmission class (STC) is assigned. In the field, the rooms on one or both sides of a partition containing a door are often either too small or too large and absorptive to allow the apparent transmission loss (ATL) of the partition-door assembly to be measured. Even if that is not the case, the result measured is the composite ATL of the partition including the door, and not that of the door itself. Test Method E336 states that it is impossible to measure the ATL of a portion of a partition such as a door according to the procedures of that standard. This test method provides a method of evaluating doors in the field using a normalized insertion loss with a resulting single-number rating door transmission class, DTC. This method is intended primarily for hinged personnel doors with latching mechanisms and is limited to door openings of area less than 6 m². The flanking effects of surrounding structure are reduced compared to Test Method E336 but not completely eliminated. In a laboratory environment, the DTC is close to or equal to the STC of the door, but in the field results less than the laboratory STC are to be expected due to flanking.

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

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

- C634 Terminology Relating to Building and Environmental Acoustics
- E90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- E336 Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings
- E413 Classification for Rating Sound Insulation
- E492 Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies

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.

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

E3091 Specification for Systems to Measure Sound Levels

2.2 ANSI Standards:³

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

2.3 IEC Standards:⁴

IEC 60942:2013 Electroacoustics—Sound calibrators

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

3. Terminology

3.1 The following terms used in this test method have specific meanings that are defined in Terminology C634:

3.1.1 airborne sound; background noise; decibel; diffuse sound field; flanking transmission; pink noise; receiving room; sound absorption; sound attenuation; sound insulation; sound isolation; sound pressure level; sound transmission loss, TL; source room

NOTE 1—The unqualified term average sound pressure level in this document means that sound pressure levels were averaged 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 average sound pressure level in the source room, and

$\bar{L}_2$ = the average sound pressure level in the receiving room resulting from the combined effect of direct and flanking transmission.

3.2.1.1 *Discussion*—Throughout this test method, log is taken to mean log₁₀, 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 (ATL) is equivalent in meaning to apparent sound reduction index (ASRI) used by ISO 16283-1:2014.

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

3.2.3 *door transmission class, DTC, n*—a single-number rating obtained by applying the classification procedure of Classification E413 to normalized door insertion loss data.

3.2.4 *normalized door insertion loss, NDIL, n*—of a door installed in a building in a specified frequency band is operationally defined as

$$NDIL = (\bar{L}_{(rec\ open)} - \bar{L}_{(rec\ closed)}) + (\bar{L}_{(source\ closed)} - \bar{L}_{(source\ open)}) \quad (2)$$

when a sound source is operated on the source side of the door, where:

$\bar{L}_{(rec\ open)}$ = the average sound pressure level on the receiving side of the door with the door open,

$\bar{L}_{(rec\ closed)}$ = the average sound pressure level due to the source on the receiving side of the door with the door closed (the background-adjusted average level in the receiving room with the door closed),

$\bar{L}_{(source\ closed)}$ = the average sound pressure level on the source side of the door with the door closed, and

$\bar{L}_{(source\ open)}$ = the average sound pressure level on the source side of the door with the door open.

4. Summary of Test Method

4.1 The door and corresponding source and receiving rooms are selected.

4.2 The number and location of sound sources are chosen, sound is produced in the source room, and sound pressure levels are measured on each side of the door with both open and closed door conditions using either a fixed microphone or scanning method.

4.3 The background sound is measured in the receiving room with the source(s) off and the door closed.

4.4 Results and single-number ratings are calculated and reported.

5. Significance and Use

5.1 This standard provides a method for testing the apparent sound insulating properties of doors in the field originally proposed by Morin (1).⁶ This allows doors to be evaluated with a result that has been found to be similar to the transmission loss.

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

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 Varembe, P.O. Box 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>.