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Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors[1]

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~~ε[1] NOTE—Sections 4.2 and 4.3 were editorially revised and section 12.1.3 was editorially added in September 2003.~~
~~ε[2] NOTE—Section 12 was editorially corrected in August 2004.~~

INTRODUCTION

This test method is part of a set for evaluating the sound-insulating properties of building elements. It is designed to measure the reduction in transmission of impact sound due to a floor covering in a laboratory. Others in the set include the measurement of sound isolation in buildings (Test Method E 336), the laboratory methods of measuring airborne sound transmisssion loss of building partitions such as walls, floor-ceiling assemblies, doors, and other space-dividing elements (Test Method E 90); the laboratory measurement of impact sound transmission through floors (Test Method E 492), the measurement of impact sound transmission in buildings (Test Method E 1007), the measurement of sound transmission through building facades and facade elements (Guide E 966), and the measurement of sound transmission through a common plenum between two rooms (Method E 1414).

1. Scope

1.1 This test method describes a method for the laboratory measurement of the effectiveness of floor coverings in reducing impact noise from a standard tapping machine through concrete floors. The test results are not necessarily directly related to the subjective evaluations of the floor coverings.

1.2 This test method applies to all floor coverings, whether single or multi-layered, as installed on a standard concrete floor. Multi-layered coverings may be factory-assembled or assembled at the test laboratory.

1.3 The test method applies only to laboratory measurements. It does not apply to the measurement of the effectiveness of a floor covering in a field situation.

1.4 *Laboratory Accreditation*—A procedure for accrediting a laboratory for performing this test method is given in Method E 492.

1.5 *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 Building and Environmental Acoustics
E 90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
E 336 ~~Test Method for Measurement of Airborne Sound Insulation In Buildings~~ Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings
E 492 Test Method for Laboratory Measurement of Impact Sound Transmission ~~through~~Through Floor-Ceiling Assemblies Using the Tapping Machine
E 966 Guide for Field Measurements of Airborne Sound Insulation of Building Facades and Facade Elements

[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.

E 989 Classification for Determination of Impact Insulation Class (IIC)
E 1007 Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures
E 1414 Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
2.2 *ANSI Standards:*
S1.6 Standard Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements
S1.10 Pressure Calibration of Laboratory Standard Pressure Microphones
S1.11 Specification for Octave-band and Fractional-Octave-Band Analog and Digital Filters
2.3 *ISO Standards:*
ISO 717-2 Rating of Sound Insulation in Buildings and of Building Elements—Part 2: Impact Sound Insulation
ISO 140-6 Acoustics—Measurement of Sound Insulation in Buildings and of Building Elements—Part 6: Laboratory Measurements of Impact Sound Insulation of Floors
ISO 140-8 Acoustics Measurement of Sound Insulation in Buildings and of Building Elements—Part 8: Laboratory Measurements of the Reduction of Transmitted Impact Noise by Floor Coverings on a Heavyweight Floor

3. Terminology

3.1 Definitions of the acoustical terms used in this test method are given in Terminology C 634.
3.2 *Descriptions of Terms Specific to This Standard:*
3.2.1 *floor covering*—any resilient material, combination of resilient materials or combination of resilient material and rigid materials used to provide a finished walking surface on a floor. This includes all materials between the upper walking surface and the base concrete slab.
3.2.2 *reference concrete floor*—a hypothetical concrete floor used to calculate changes in impact insulation class (ΔIIC).
3.2.3 *standard concrete floor*—the actual concrete floor satisfying the provisions of this method used in the measurements.

4. Summary of Test Method

4.1 Two vertically adjacent rooms are used: the upper one being designated the source room and the lower one the receiving room. A standard concrete floor is installed in an opening between them. The rooms and the floor installation are designed so the only significant sound radiation into the receiving room is from the standard concrete floor.
4.2 A standard tapping machine is installed and activated on the standard concrete floor and the normalized impact sound pressure levels are measured in the room below. The floor covering to be evaluated is then installed on the standard concrete floor and the normalized impact sound pressure levels measured again.
4.3 The differences in normalized impact sound pressure level are subtracted from the levels defined for a reference concrete floor and an IIC rating is calculated for the resultant array. This is the IIC that the covering would produce in combination with the reference concrete floor. The second rating, ΔIIC, is obtained by subtracting 28 from the first (28 is the IIC for the reference concrete floor). This gives the improvement in IIC that the covering would produce on the reference concrete floor.

5. Significance and Use

5.1 The impact sound rating for a floor assembly is determined both by the basic floor assembly and the floor covering on the upper surface. The same floor covering in combination with different basic floor assemblies will not always give the same impact insulation class (IIC) ratings. This test method is designed to provide data that characterize the floor covering alone when installed over concrete slab floors.
5.2 The ΔIIC rating calculated in 13.4 is used to compare the effectiveness of different floor coverings on concrete floors.
5.3 The impact insulation class (IIC) calculated for the reference concrete floor with a covering provides an indication of the impact sound insulation that the covering will provide with typical, monolithic concrete floors.
5.4 When the normalized impact sound pressure levels below a bare concrete slab are known, the difference spectrum calculated in 13.1 may be used to estimate the impact sound pressure levels and hence the IIC that would result if the covering were installed on the slab.
5.5 **Warning:** Difference spectra measured using this method shall not be used to estimate impact sound pressure levels for floors comprising only one or two lightweight floor layers such as oriented strandboard or plywood. Such estimated impact sound pressure levels would be very inaccurate.

NOTE 1—The difference spectrum calculated in 13.1 gives unreliable estimates of the reduction in impact sound pressure levels due to the floor covering when it is placed on a joist floor incorporating a concrete topping (about 50 mm thick) poured directly on the plywood subfloor or steel deck. The estimated impact sound pressure levels are too low.[3]

[3] "Impact Sound Measurements on Floors Covered with Small Patches of Resilient Materials or Floating Assemblies," A.C.C. Warnock. Internal Report IRC IR-802. National Research Council Canada. January 2000.

5.6 This test method closely follows that described in ISO 140-8 except that the single number rating used is the impact insulation class (IIC) described in Classification E 989. The description of the standard concrete floor also differs.

NOTE 2—The requirement in Classification E 989 that no deviation above the reference contour may exceed 8 dB means that there is no simple relationship between ISO 140-8 test ratings and those generated by this method.

6. Test Rooms

6.1 The test rooms shall satisfy the requirements given in Method E 492.

7. Standard Concrete Floor

7.1 The standard concrete floor on which the test coverings are to be installed shall consist of a reinforced concrete slab or slab sections with a thickness of 150 ± 50 mm. The slab or slabs shall be homogeneous and of uniform thickness.

NOTE 3—A thickness of 150 mm is preferred for new facilities.

7.2 The surface of the test floor shall be smooth and sufficiently hard to endure the impacts of the tapping machine. Any screed applied to the surface of the test floor shall adhere solidly at all points so the screed does not chip, crack or become pulverized.

7.3 Inspect the surface of the slab frequently to assess surface damage. Repairs shall be made when the surface is no longer smooth.

NOTE 4—Altering the position of the tapping machine slightly for each test will reduce wear on the standard slab and prolong the life of the surface.

8. Test Specimens

8.1 *Classification of Test Specimens*:

8.1.1 *Category I (Small Specimens)*—This category includes flexible coverings (plastics, rubber, cork, matting, carpet or combinations thereof), which are installed loosely or by adhesion to the floor surface.

8.1.1.1 Use three samples, preferably from different production runs but from the same source. Each sample shall measure at least 1 × 0.5 m.

8.1.2 *Category II*—This category includes rigid, homogeneous surface materials or complex floor coverings of which at least one constituent is rigid. When the area of the standard concrete floor is less than 10 m^2, the specimen shall cover the whole surface of the standard concrete floor. When the area of the standard concrete floor is greater than 10 m^2, the specimen area need not exceed 10 m^2 provided that the smallest dimension of the specimen is not less than 3 m.

8.1.3 *Materials of Uncertain Classification*—In the case of uncertainty as to the appropriate category for a material, the testing laboratory shall decide whether small or large specimens will be tested. In any case the specimen shall be described in detail in the test report.

8.2 *Preparation and Installation of Test Specimens*:

8.2.1 *Adhesive Mounting*—Install coverings to be mounted with adhesive with great care, normally with adhesive covering the entire surface of the test specimen. If the adhesive is applied in isolated patches, describe the exact procedure in the report. Follow strictly the manufacturer's instructions for use of the adhesive, especially with regard to the amount and the bonding-time. Report the type of adhesive and the bonding-time.

8.2.2 To avoid damage to the standard concrete slab and ease removal of specimens, it is acceptable to first apply a removable thin layer such as double-faced tape or thin paper using soluble paste. Adhesives for coverings may then be applied to the removable layer. Users shall establish by experiment that such protective coverings have negligible effect on the measurements. The data collected during such experiments shall be kept on file and made available on request.

8.3 *Room Temperature and Humidity*—Measure and report the temperature and the humidity of the air in each room. The temperature shall be in the range 18 to 25°C in the upper room.

8.4 *Aging of Specimens*—Test specimens that incorporate materials for which there is a curing process (for example adhesives, plasters, concrete, mortar, damping compound) shall age for a sufficient interval before testing. Manufacturers may supply information about curing times for their products. Aging periods for certain common materials are given in Test Methods E 492 and E 90.

9. Microphone Requirements

9.1 Microphones shall meet the requirements in Method E 492.

10. Tapping Machine Requirements

10.1 The standard tapping machine used shall meet the requirements in Method E 492.

11. Frequency Range and Bandwidth for Analsis

11.1 *Bandwidth*—For each test band, the overall frequency response of the electrical system, including the filter or filters in the source or microphone systems, shall satisfy the specifications given in ANSI Specification S1.11 for a one-third octave band filter set, Order 3 or higher, Type 1.