Designation: E 1007 – 97

Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures[1]

This standard is issued under the fixed designation E 1007; 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.

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 impact sound insulation of a floor-ceiling assembly and associated supporting structures in field situations using a standard tapping machine. Other in the set cover laboratory measurement of impact sound transmission through floor-ceiling assemblies (Test Method E 492); and the laboratory (Test Method E 90) and field (Test Method E 336) methods of measuring airborne sound transmission loss of building partitions such as walls, floor-ceiling assemblies, doors, and other space-dividing elements; the measurement of sound transmission through building facades and facade elements (Guide E 966); the measurement of sound transmission through a common plenum between two rooms (Test Method E 1414), a quick method for the determination of airborne sound isolation in multiunit buildings (Practice E 597), and the measurement of sound transmission through door panels and systems (Test Method E 1408).

1. Scope

1.1 This test method covers the measurement of the transmission of impact sound generated by a standard tapping machine through floor-ceiling assemblies and associated supporting structures in field situations.

1.2 Measurements may be conducted on all types of floor-ceiling assemblies, including those with floating-floor or suspended ceiling elements, or both, and floor-ceiling assemblies surfaced with any type of floor-surfacing or floor-covering materials.

1.3 This test method further prescribes:

1.3.1 A uniform procedure for reporting test data, that is, the normalized one-third octave band sound pressure levels generated in the receiving room by the operation of the standard tapping machine on the floor-ceiling assembly.

1.3.2 The use of a single-figure classification rating, "Field Impact Insulation Class, FIIC" that can be used by architects, builders, and specification and code authorities for acoustical evaluation purposes in completed buildings. The FIIC is obtained by matching a standard reference contour to the plotted normalized one-third octave band sound pressure levels at each test frequency obtained in accordance with this test method. For details regarding the derivation and significance of the FIIC, see Classification E 989.

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

2. Referenced Documents

2.1 *ASTM Standards:*

C 634 Terminology Relating to Environmental Acoustics[2]
E 90 Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions[2]
E 336 Test Method for Measurement of Airborne Sound Insulation in Buildings[2]
E 492 Test Method of Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine[2]
E 597 Practice for Determining a Single-Number Rating of Airborne Sound Isolation for Use in Multiunit Building Specifications[2]
E 966 Guide for Field Measurement of Airborne Sound Insulation of Building Facades and Facade Elements[2]
E 989 Classification for Determination of Impact Insulation Class (IIC)[2]

[1] This test method is under the jurisdiction of ASTM Committee E-33 on Environmental Acoustics and is the direct responsibility of Subcommittee E33.03 on Sound Transmission.

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

E 1408 Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems[2]

E 1414 Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum[2]

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 *ISO Standard:*

ISO 140—Acoustics—Measurement of Sound Insulation in Buildings and of Building Elements; Part VI—Laboratory Measurement of Impact Sound Insulation of Floors, and Part VII—Field Measurements of Impact Sound Insulation of Floors[3]

2.4 *IEC Standard:*

IEC 804 Specification for Integrating Sound Level Meters

3. Terminology

3.1 *Definitions*—For definitions of terms pertaining to acoustics used in this test method, see Terminology C 634.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *source room*—the room containing the tapping machine.

3.2.2 *receiving room*—a room below or adjacent to the floor specimen under test in which the impact sound pressure levels are measured.

NOTE 1—The receiving room is usually the room below the floor specimen but it may also be on the same level, diagonally below, or, in some cases, it could be above the source room.

3.2.3 *impact sound pressure level*—the average sound pressure level in a specified frequency band produced in the receiving room by the operation of the standard tapping machine on the floor assembly, averaged over each of the specified machine positions.

3.2.4 *normalized impact sound pressure level*—the impact sound pressure level normalized to a reference absorption of 10 m^2(108 sabins).

3.2.5 *field impact insulation class (FIIC)*—a single-number rating derived from measured values of normalized one-third octave band impact sound pressure levels in accordance with Classification E 989.

NOTE 2—FIIC provides an estimate of the sound insulating performance of a floor-ceiling assembly and associated support structures under tapping machine excitation.

4. Summary of Test Method

4.1 A standard tapping machine is placed in operation on a floor specimen. The transmitted impact sound is characterized by the one-third octave band spectrum of the average sound pressure level produced by the tapping machine in the receiving room located beneath or adjacent to the floor specimen under test.

4.2 Since the spectrum and level depend on the absorption of the receiving room, the impact sound pressure levels are normalized to a reference absorption for purposes of comparing results obtained in receiving rooms that differ in absorption.

5. Significance and Use

5.1 The spectrum of the noise produced in the receiving room by the standard tapping machine is determined by (1) the size and the mechanical properties of the floor-ceiling assembly, such as its weight, surface properties, mounting or edge restraints, stiffness, and internal damping; (2) the acoustical response of the receiving room; and (3) the degree of flanking transmission through associated structures.

5.2 The standardized tapping machine specified in 7.1.1 produces a continuous series of uniform impacts at a uniform rate on a test floor assembly and generates in the receiving room broadband sound pressure levels high enough to make accurate and reproducible measurements possible. The tapping machine, however, is not designed to simulate any one type of impact, such as male or female footsteps nor to simulate the weight of a human walker. Thus the subjectively annoying creak or boom generated by human footfalls on a limber floor assembly may not be adequately evaluated by this test method.

5.3 Test Method E 492 calls for the elimination of flanking sound transmission and for highly diffuse sound fields in the receiving room. The problems associated with making acoustical measurements in buildings are much more difficult than those met in the laboratory. In ordinary buildings, a great variety of test room shapes and sizes are encountered. The amount of energy exchange at the nominal boundaries of the test specimen, the manner of construction and factors such as structure-borne flanking paths, for example, transmission in the side walls, varies widely. Highly diffuse fields are seldom found in the field and the special efforts that would be required to simulate laboratory conditions and eliminate flanking sound are impractical.

5.4 This test method accepts these limitations and gives measurement procedures for determining the average impact sound pressure level in nearly all cases that may be encountered in the field. The test procedure evaluates the floor-ceiling assembly and adjacent structures as installed (including structure-borne flanking paths). Results are not meant to be identical to laboratory tests of the floor-ceiling assembly alone. Because of the uncontrollable factors mentioned in 5.1-5.3, caution must be used when using test results to predict the performance of other floors with similar construction. It is preferable to confine the use of test results to the comparison of closely similar floors and supporting structures.

6. Test Specimens

6.1 *Types*—All types of floor-ceiling assemblies surfaced with any type of material may be tested by this test method, including assemblies with floating floors or suspended ceilings.

6.1.1 In all cases the test specimen should be installed in accordance with customary field practice including normal constraint and sealing conditions at the perimeter and at the joints within the specimen.

[3] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

TABLE 1 Recommended Minimum Aging Periods Before Test

Material	Recommended Minimum Aging Period
Masonry	28 days
Plaster:	
Thicker than 3 mm (⅛ in.)	28 days
Thinner than 3 mm (⅛ 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

6.2 *Aging of Specimens*—Test specimens that incorporate materials for which there is a curing process (for example, adhesives, plasters, concrete, mortar, and damping compound) shall age for a sufficient interval before testing. Aging periods for certain common materials are recommended in Test Method E 90 and summarized in Table 1 of this test method.

6.3 *Installation of Floor-Surfacing Materials*:

6.3.1 Since floor-surfacing materials of significant weight, such as carpets and pads, may exert a damping or restraining effect on the flexural motion of lightweight floor structures, it is recommended that the entire area of the floor structure under test be covered with the floor surfacing materials. Any exception to this shall be noted in the test report.

6.3.2 The installation or application of floor-surfacing materials should be in accordance with manufacturer's instruction, especially in regard to cleaning and priming of the subfloor.

6.3.3 Floor-surfacing materials that are intended to be applied with adhesive should not be tested merely laying on the subfloor unless otherwise noted in the report.

6.3.4 Although most floors are ready for immediate use after being installed, it is recommended that measurements on floors with adhesive-applied surfacing materials be deferred for at least 24 h after installation to allow the adhesive to cure.

6.4 *Receiving Room Volume*—Ideally, the receiving room should be large enough so that an approximately diffuse sound field exists in all measurement bands. In the field, sound fields are deemed acceptable down to 100 Hz if the room volume is greater than 60 m^3(2100 ft^3), to 125 Hz if the room volume is greater than 40 m^3(1400 ft^3), and to 160 Hz if the room volume is greater than 25 m^3(880 ft^3).

NOTE 3—The requirement at 125 Hz is obtained by assuming that a minimum of 10 room modes will provide a sufficiently good approximation to a diffuse sound field; those at 100 and 160 Hz are obtained by requiring the same average modal spacing as at 125 Hz.

7. Tapping Machine

7.1 *Tapping Machine Specifications*:

7.1.1 This test method is based on the use of a standardized tapping machine that conforms to the specifications in ISO 140/VI.[4] It shall have five hammers equally spaced in a line with about 400 mm between the two end hammers. The machine shall deliver 10 impacts/s at equal intervals, such that the time between successive impacts is 100 ± 5 ms. The effective mass of each hammer shall be 0.5 ± 0.012 kg. The drop of a hammer on a flat hard floor shall be equivalent to a free drop without friction of 40 ± 1 mm. The part of the hammer that strikes the floor shall be a cylinder of steel, 30 mm in diameter with a spherical steel end having a radius of 500 ± 10 mm. Check both the hammer drop and the radius of curvature of the hammer heads with a gage or template for conformance with the given specifications. Replace hammer heads failing to meet the specifications.

7.1.2 The bottoms of the machine supports shall be at least 100 mm from the nearest hammer and capped with soft sponge rubber pads about 5 mm thick so that the requirements in 7.2.1 are satisfied.

NOTE 4—Investigations **(1)**[5] involving light-frame floating floors have shown that both the resiliency of the tapping machine supports as well as their spacing from the hammers significantly affect the impact sound pressure levels in frequency bands below 400 Hz.

7.1.3 Following adjustment of the hammer drop in accordance with the specifications, the tapping machine is ready for use on any floor, including those surfaced with soft or resilient materials.

7.2 *Operational Noise and Vibration*:

7.2.1 The tapping machine shall be constructed so that the vibratory excitation of the floor structure under test is due primarily to hammers impacting on the floor surface. The one-third octave band noise levels produced in the receiving room by excitation of the floor due to the extraneous mechanical operations of the tapping machine shall be at least 10 dB below those produced by the impacting of the hammers. This requirement can be verified by placing a strip of soft, very resilient material under the impacting hammers. If there is at least a 10-dB reduction in the sound pressure level in the receiving room for each frequency band, extraneous vibrational transmission can be considered negligible.

7.2.2 The presence of airborne sound flanking could cause atypical noise levels to exist in the receiving room. Therefore, the sound pressure levels in the receiving room due to airborne transmission of the noise from the operation of the tapping machine should be at least 10 dB less than those due to hammer impacts transmitted structurally (see also 7.2.1).

NOTE 5—A loudspeaker or other convenient airborne noise source can be used to evaluate the extent of airborne sound transmission between the rooms (see Test Method E 336).

7.3 *Tapping Machine Positions*—The spectrum of the noise in the receiving room may be influenced by the location of the tapping machine on the floor specimen. For purposes of this test method, the tapping machine positions described in 7.3.1-7.3.4 shall be used (see Fig. 1).

7.3.1 *Position 1*—The middle hammer of the tapping machine shall be coincident with the midpoint of the floor area, that is, approximately at the intersection of floor diagonals. In

[4] Suitable tapping machines are available from Scantek Inc., 916 Gist Ave., Silver Spring, MD 20850 and Bruel and Kjaer Instruments, Inc., 185 Forest St., Marlborough, MA 01752.

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

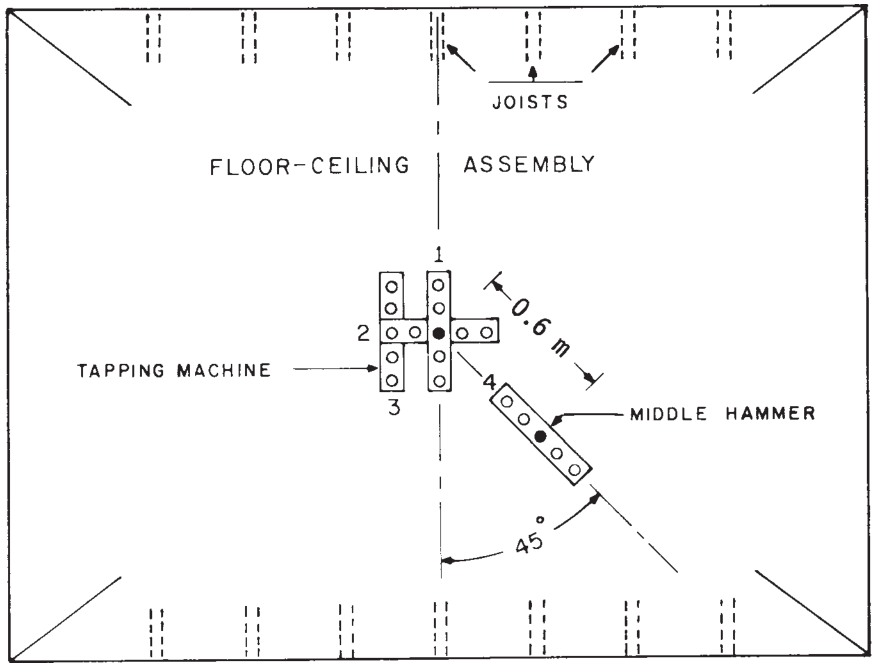

FIG. 1 Tapping Machine Positions

joist construction arrange the tapping machine so that all hammers are parallel with and aligned with the middle joist if possible.

NOTE 6—Joist locations and orientations may not be obvious in field situations. Inspection of building plans and nailing patterns may assist the determination of joist layout.

7.3.2 *Position 2*—Same as Position 1, except rotate the tapping machine 90° around the axis of the middle hammer.

7.3.3 *Position 3*—Displace the tapping machine laterally with respect to Position 1, so that the longitudinal axis of the machine is centered midway between and parallel to the central joists and to Position 1. In the case of homogeneous floors of concrete slab or solid deck construction without joists, the lateral displacement of the tapping machine shall be 0.6 m from that of Position 1.

7.3.4 *Position 4*—Position the tapping machine so that the longitudinal axis of the machine forms an angle of 45° with respect to Position 1. Displace the machine laterally so that the middle hammer is 0.6 m from the midpoint of Position 1.

8. Microphones

8.1 *Microphone Electrical Requirements*—Use microphones that are stable and substantially omnidirectional in the frequency range of measurement. A13 mm (0.5 in.) random-incidence condenser microphone is recommended. Specifically, microphones, amplifiers, and electronic circuitry to process microphone signals must satisfy the requirements of ANSI S1.4 for Type 1 sound level metres, except that A, B, and C weighting networks are not required since one-third octave filters are used.

8.2 *On-site System Calibration*—Calibrate all microphones and associated signal processing systems used in the measurement system. The measurement system is considered to include all amplifiers, cables, and other instrumentation to the point at which the microphone signals are observed and recorded. It is recommended that the calibration of the measurement system be checked before and after each set of measurements to safeguard against small drifts in system sensitivity. Perform such checks with a stable acoustic calibrator that impresses a known sound pressure level directly on the microphone diaphragm at a frequency in the range from 200 to 1250 Hz.

8.3 *Detailed System Calibration*—A system calibration should be performed periodically throughout the entire range of test frequencies to ensure reliable performance. It may be convenient to separate the calibration process into both an electrical and acoustical procedure. For example, check the signal processing system electrically and have the microphone calibrated independently by a qualified laboratory technique (see ANSI S1.10).

9. Frequency Range

9.1 *Test Frequency Bands*—Measure the impact sound pressure levels in the series of 16 contiguous one-third octave bands with mid-band frequencies from 100 to 3150 Hz.

9.1.1 For each test band make sure that the overall frequency response of the third-octave filters used in the microphone and analysis system conforms to the specifications in ANSI S1.11 for a one-third octave band filter set, Order 3 or higher, Type 1 or better.

NOTE 7—It is possible for these measurements to be made in octave bands or with some other type of filtering in the analysis system. Users are always free to do this but such measurements are not covered by this test method.

10. Determination of Impact Sound Pressure Levels

10.1 The impact sound pressure levels are measured in the receiving room adjacent to the floor specimen on which a standard tapping machine operates in the positions described in

7.3. The measurement process must account for variations with microphone position, microphone sensitivity, and possible changes in the spectrum and level of the source, and it must be repeated for each test frequency band. Various spatial sampling arrangements are possible. A single microphone may be moved continuously or placed sequentially at several measurement positions or an array of stationary microphones may be used.

10.2 *Averaging Time*—The average sound pressure level in a given period of time is best obtained using an instrument that provides a direct reading of the required value. Such instruments include integrating sound level metres that meet the requirements of IEC 804 or real-time frequency analyzers. Other methods may also be satisfactory.

10.2.1 *Fixed Microphones*—For each sampling position, the averaging time shall be sufficient to yield an accurate estimate of the time-averaged level. This requires longer averaging times at low frequencies than at high. For 95 % confidence limits of $\pm e$ dB in a one-third octave band with center frequency, *f*, the averaging time, T_a, may be estimated from:

$$T_a = \frac{310}{fe^2} \tag{1}$$

Thus at 125 Hz, the minimum averaging time for confidence limits of$\pm$ 0.5 dB should be 9.9 s. For more information see Ref **(2)**.

10.3 *Moving Microphones*—For mechanically or manually swept microphones, integration times should be long enough that repeat measurements are not significantly different. A typical time for a sweep of the room is 60 s.

10.4 *Microphone Locations*—Locate microphones to adequately sample the sound field in the receiving room, with the following restrictions:

10.4.1 Except as noted below, the shortest distance from any microphone position to any major extended surface shall be not less than 1 m (3.3 ft) if the requirements for microphone separation (see 10.4.2) and number of microphones (see 10.5) can be met with this distance. If these requirements cannot be met then the shortest distance from any microphone position to any major extended surface may be reduced but must never be less than 0.5 m (1.6 ft).

10.4.2 Stationary microphone positions must be at least 1.0 m (3.3 ft) apart. For the measurements of space-average sound pressure levels to be sufficiently precise, the observation points should be spatially separated to provide independent samples of the sound field. In an ideal diffuse field, fixed microphone positions should be at least one-half wavelength apart **(3)**. The 1.0 m separation is deemed to be an acceptable compromise for field measurements.

10.5 *Number of Stationary Microphone Positions*—Use a minimum of four stationary microphone positions in the receiving room for each tapping machine position.

10.6 *Moving Microphones*—Moving microphones may be used in conjunction with sound level metres that give integrated levels in accordance with IEC 804. This procedure has the advantage that it provides average sound pressure levels in the rooms automatically. The same system used to measure the average sound pressure level must be used to measure background noise so that any mechanical or human sounds are present in both cases.

10.6.1 *Mechanically Operated Microphones*—A single microphone continuously moving along a defined traverse, such as a circular path, may be used instead of stationary microphone positions provided that the restrictions given in 10.4 and 10.4.2 are met and that the same scanning technique is used to measure background noise. For the purposes of this test method, it is sufficient if the radius of a circular path is at least 1 m (3.3 ft).

10.6.2 *Manually Swept Microphones*—A manually scanned microphone may also be used provided that the requirement for minimum distance from major surfaces given in 10.4 is met and that the same scanning technique is used to measure background noise. The microphone must be held well away from the operator's body (a boom serves to increase the distance). The operator should slowly turn and move the microphone to sample as much of the central volume of the room as possible, including the central part.

NOTE 8—For a straight line traverse of length *L*, the number of equivalent fixed microphone positions is $2L/\lambda$. For a circular or closed traverse of length *L*, the number of equivalent fixed microphone positions is $2L/\lambda - 1$, where λ is the wavelength of interest **(4)**.

10.7 *Background Noise*—Measure background noise levels to ensure that the observations are not affected by extraneous sound or electrical noise in the receiving system. At each measurement position the background level should be at least 10 dB below the combined level of signal and background. Make corrections if the background level is between 5 and 10 dB below the level due to the combination of the tapping machine signal and the background noise. Corrections to the combined level are given as follows:

$$L_s = 10 \log[10^{L_{sb/10}} - 10^{L_{b/10}}] \tag{2}$$

where:

L_b = background noise level, dB,
L_{sb} = level of signal and background combined, dB, and
L_s = adjusted signal level, dB.

NOTE 9—Throughout this test method log is taken to mean $\log_{10}$, unless otherwise indicated.

NOTE 10—Since acoustical background noise levels can vary due to transportation, construction, or occupancy noises, it is desirable that the operation of the tapping machine be under the control of the operator so that the background noise check can be made immediately after each impact sound pressure level measurement.

10.7.1 When the combined level of signal and background noise is less than 5 dB greater than the level of the background noise alone, then subtract 2 dB from the combined level and use this as the impact sound pressure level in that frequency band. In this case, the measurements can be used only to provide an estimate of the upper limit of the impact noise level; suitably identify such measurements in the test report.

10.8 *Determination of Space-Average Levels*—Following the procedures of 10.2-10.7, obtain an average sound pressure level, corresponding to the sampling in the receiving room. For stationary microphones, the space-average level for the room L_p is given as follows:

$$L_p = 10 \log \left[\frac{1}{N} \sum_{i=1}^{N} 10L_i/10 \right] \quad (3)$$

where L_i is the set of time-average sound pressure levels measured at n microphone locations for the four tapping machine positions and N is $4n$.

11. Determination of Receiving Room Sound Absorption

11.1 Receiving room absorption shall be determined at each frequency by measuring the rate of decay of sound pressure level in the room in the same one-third octave bandwidths that are used to measure sound pressure level differences. The determination of A_2 shall be made with the receiving room in the same condition as for the measurement of impact sound pressure level. Determine the sound absorption of the receiving room, A_2, as follows.

11.2 Activate sound source(s) in the receiving room for a few seconds, then switch them off and record the curves giving the decay of sound pressure level in the room at each one-third octave band frequency. This may be done using a real-time analyzer or sound level meter with built-in algorithms or interfaced to a computer with appropriate software. With such instrumentation, decay rates or reverberation times can be obtained automatically.

11.2.1 Instrument decay rates in each frequency band shall be at least 3 times the room decay rates so measurements of sound decay rate are not biased. The instrument decay rate can be measured by attaching a noise generator directly to the input, switching off the generator and then measuring the decay.

11.3 *Measurement of Decay Rate from Decay Curves*—First select a point on the decay curve as close as practical to 0.1 s after the sound source has been switched off. Select a second point on the decay curve no more than 25 dB lower in sound pressure level than the first point. This second point must be at least 10 dB above the background noise level. Determine the straight line that best approximates the portion of the decay curve between these two points. The slope of the line, *d*, gives the rate of decay of sound pressure level in decibels per second. Fitting may be done to individual decay curves, or to the average of several.

11.4 *Number of Decay Rate Measurements*—Sound decay rates vary from one decay to the next because of the random nature of the sound excitation. They also vary with the position of the microphone in the room. Moving, fixed, or corner microphones may be used to sample the decaying sound field.

NOTE 11—Note that because the quantity entering into the transmission loss calculation is only 10 log A_2, highly precise measurements are not essential. Thus a 10 % uncertainty in measuring A_2 results in only a 0.4-dB error in the calculated transmission loss value.

11.4.1 Obtain the mean room decay rate by averaging the rates for at least three decays measured at each of at least three locations 1 m or more apart in the receiving room. For example, the mean decay rate could be obtained by measuring 4 decays at each of four locations in the receiving room, for a total of 16 decays. A moving microphone may also be used when measuring the decay rate in which case the spatial averaging will be automatic but an average of several decays is still necessary.

11.5 A_2 is given by the Sabine equation:

$$A_2 = 0.921 \frac{Vd}{c} \quad (4)$$

where:

A_2 = equivalent sound absorption area of the room, m2,
c = speed of sound in air, m/s,
V = volume of room, m^3, and
d = rate of decay of sound pressure level in the room, dB/s.

(Note that d = 60/T where T is reverberation time in seconds.)

When V and c are in cubic feet and feet per second respectively, A_2 is in sabins (square feet).

11.5.1 The speed of sound changes with temperature and it shall be calculated for the conditions existing at the time of test from the equation:

$$c = 20.047\sqrt{273.15 + t} \text{ m/s} \quad (5)$$

where t is the receiving room temperature,° C.

11.6 In all test frequency bands the room absorption, A_2, should preferably be less than $V^{2/3}$ where V is the room volume. If V is in cubic metres (cubic feet) then A_2 is in square metres (sabins).

12. Calculation

12.1 Obtain the normalized impact sound pressure level, L_n, in each of the specified frequency bands as follows:

$$L_n = L_p - 10 \log (A_0/A_2) \quad (6)$$

where:

L_p = average one-third octave band sound pressure level, measured in the receiving room, dB, (re 20 μPa),
A_2 = sound absorption of the receiving room, expressed in units of either m^2 or sabins, and
A_0 = reference absorption in the same units as A_1 (either 10 m^2 or 108 sabins, respectively).

13. Report

13.1 Report the following information:

13.1.1 *Statement of Conformance to Standard*—If it is true in every respect, state that the tests were conducted in accordance with the provisions of this test method.

13.1.2 *Description of Test Environment*—Give a general description of the receiving room and furnishings. Give a sketch showing the relationship of the receiving room to the source room. State the volume of the receiving room.

13.1.3 *Description of Test Specimen*—If the information is available and relevant to the purpose of the test, give a complete description of the test specimen, including the dimensions, thickness, and all of the constructional elements, along with an estimate of the average weight per unit area of the specimen. The description should as far as practicable be based upon measurement and examination of the specimen itself, rather than upon the building plans or information received from the builder or others. If the construction or installation of the test specimen is, for some reason, such that the results do not represent normal performance of the specimen, state this explicitly.

NOTE 12—If there are no access panels, outlet boxes, etc., that would permit a direct measurement, one can often deduce the floor thickness by measurement between windows separated by the specimen.

13.1.3.1 Include a description of any floor-covering material and underlayment such as carpets, pads, and mats that may have been placed on top of the finished floor.

13.1.4 *Statement of Test Results*:

13.1.4.1 State the normalized impact sound pressure levels rounded to the nearest 1 dB at the specified frequencies in tabular form and in graphical form if so desired. State the measured absorption in the receiving space at each of the test frequencies. Identify those values of room absorption that do not meet the recommendations in 11.6. Identify those values of impact sound pressure level that are contaminated by background noise (see 10.7.1).

NOTE 13—When the results are presented in graphical form, it is recommended that the ordinate scale be 2 mm/dB and the abscissa scale be 50 mm/decade. If it is necessary to use a larger or smaller scale, the same aspect ratio as above should be used. Whenever practicable, the ordinate scale should start at 0 dB.

13.1.4.2 If the room volume does not meet the criteria given in 6.4 for measurement in the low frequency bands, the normalized impact sound pressure levels in such bands shall be marked to indicate this, and the report shall include a statement explaining the marking.

13.1.5 The normalized one-third octave impact sound pressure levels may be used to obtain a single number rating (FIIC) in accordance with Classification E 989.

14. Precision and Bias

14.1 *Precision*—The precision of this test method has not been established.

14.2 *Bias*—There is no known bias in this test method.

15. Keywords

15.1 field impact insulation class; impact sound insulation; impact sound pressure level; tapping machine

REFERENCES

(**1**) Bruel, P. V., "Tapping Machines for Measuring Impact Sound Transmission," *Bruel and Kjaer Technical Review*, No. 2, 1967.

(**2**) *Noise and Vibration Control*, L. L. Beranek, Ed., McGraw-Hill, 1971, p. 115.

(**3**) Lubman, D., "Spatial Averaging in Sound Power Measurements," *Journal of Sound and Vibration*, Vol 16, 1971, p. 43.

(**4**) Waterhouse, R., and Lubman, D., "Discrete Versus Continuous Space Averaging in a Reverberant Sound Field," *Journal of the Acoustical Society of America*, Vol 48, 1970, pp. 1–5.