



Designation: E3207 – 21

Standard Classification for Determination of Low-Frequency Impact Noise Ratings¹

This standard is issued under the fixed designation E3207; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This classification provides methods for calculating single-number ratings of low-frequency impact noise transmission, based on one-third-octave-band impact noise levels as described in Test Methods E492 and E1007.

1.2 This classification defines ratings that are not defined in other standards. Other standards may define additional ratings based on the methods of this classification.

1.3 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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

1.5 *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

E492 Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine

E989 Classification for Determination of Single-Number Metrics for Impact Noise

E1007 Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-

Ceiling Assemblies and Associated Support Structures

3. Terminology

3.1 *Definitions*—The following terms used in this classification have specific meaning that are defined in Terminology C634: average sound pressure level; decibel; flanking transmission; impact insulation class; level; octave band; sound insulation; sound isolation; sound pressure; sound pressure level.

3.2 *Definitions*—The following terms used in this classification have specific meaning that are defined in Test Method E492: normalized sound pressure level, L_n .

3.3 *Definitions*—The following terms used in this classification have specific meaning that are defined in Test Method E1007: impact sound pressure level, *ISPL*.

3.4 Definitions of Terms Specific to This Standard:

3.4.1 *low-frequency impact insulation class, LIIC, n*—of a floor ceiling assembly installed in a laboratory, the single-number rating calculated in accordance with this classification using the normalized sound pressure levels (L_n) measured as described in Test Method E492.

3.4.1.1 *Discussion*—This classification method uses the L_n in the 50, 63, and 80 Hz one-third-octave bands. Measurement of these bands is described as desirable but not required in Test Method E492. Measurement in these bands is required in order to calculate LIIC.

3.4.1.2 *Discussion*—Except for the frequency range, no change in Test Method E492 is required to measure LIIC.

3.4.2 *low-frequency impact rating, LIR, n*—the single number rating calculated in accordance with this classification using the impact sound pressure levels (*ISPL*) measured in a building, as described in Test Method E1007.

3.4.2.1 *Discussion*—This classification method uses the *ISPL* in the 50, 63, and 80 Hz one-third-octave bands. Measurement of these bands is described as desirable but not required in Test Method E1007. Measurement in these bands is required in order to calculate LIR.

3.4.2.2 *Discussion*—Except for the frequency range, no change in Test Method E1007 is required to measure LIR.

4. Significance and Use

4.1 The purpose of the LIR rating is to describe the low-frequency impact noise, often referred to as “thudding,”

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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.

primarily generated by footfall on lightweight structures. The rating increases as the impact sound attenuation of the floor-ceiling structure increases. This rating has been shown to correlate with subjective reaction^{3,4} and can be used to evaluate and compare the low-frequency impact noise performance of assemblies.

4.2 The LIIC rating can be used for relative comparison and to rank-order the low-frequency performance of assemblies within a given test laboratory.⁵ The reproducibility of LIIC between laboratories has not been measured, and the relationship between laboratory and field ratings (LIIC and LIR) is not assumed or established.

NOTE 1—The tendency for measurement uncertainty to increase at low frequencies should be considered when utilizing metrics of classification standard.

NOTE 2—This classification does not replace Classification E989 (Impact Insulation Class) and is not interchangeable with it. For example, the LIIC rating of an assembly does not determine its IIC rating and cannot be used to show compliance with an IIC requirement. The expectation is that the low-frequency ratings would be reported alongside the existing ratings.

4.3 This classification shall only be used with one-third-octave-band data.

³ LoVerde, J. and Dong, W., “A dual-rating method for evaluating impact noise isolation of floor-ceiling assemblies,” *J. Acoust. Soc. Am.*, 141, 2017, pp. 428–440.

⁴ LoVerde, J. and Dong, W., “The low-frequency limit of proposed ratings for quantifying low-frequency impact insulation,” *Proc. Mtgs. Acoust.*, 35, 2018.

⁵ LoVerde, J. and Dong, W., “Laboratory measurement of low-frequency impact sound,” *Proc. 25th Int. Congress on Sound and Vib.*, 2018.

5. Procedure for Low-frequency Rating

5.1 The rating is calculated from the one-third-octave-band impact sound pressure levels in the 50, 63 and 80 Hz bands.

5.2 LIIC is calculated from the normalized sound pressure levels measured in the laboratory as shown in Eq 1.

$$LIIC = 190 - 2 \cdot 10 \log \left(\sum_{f=50}^{f=80} 10^{\frac{L_n(f)}{10}} \right) \quad (1)$$

where:

$L_n(f)$ = the normalized sound pressure level L_n at frequency band f .

5.3 LIR is calculated from the non-normalized impact sound pressure levels measured in the field as shown in Eq 2.

$$LIR = 190 - 2 \cdot 10 \log \left(\sum_{f=50}^{f=80} 10^{\frac{ISPL(f)}{10}} \right) \quad (2)$$

where:

$ISPL(f)$ = the non-normalized impact sound pressure level at frequency band f .

5.4 The rating is rounded to the nearest integer after the calculation.

NOTE 3—Test Method E492 and Test Method E1007 require that L_n and $ISPL$ be rounded to the nearest integer when reported. For the purposes of this classification, L_n and $ISPL$ in Eq 1 and Eq 2 should be given to one decimal place to avoid rounding errors. If only integer values of L_n and $ISPL$ are available, the calculation method is unchanged.

6. Keywords

6.1 floors; impact noise; LIIC; LIR; low-frequency impact insulation class; low-frequency impact rating; tapping machine

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