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Designation: ~~E989 – 18~~ E989 – 21

Standard Classification for Determination of Single-Number Metrics for Impact Noise[1]

This standard is issued under the fixed designation E989; 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.

1. Scope

1.1 This classification provides a method for determining a rating that can be used to compare the levels of impact noise generated by a standard tapping machine and transmitted through different floor-ceiling assemblies.

1.2 The name given to the rating is assigned by the test method that invokes this classification.

1.3 This classification is applicable only to one third octave band impact noise data obtained using the standard tapping machine described in Test Methods E492 and E1007.

1.4 Test methods that invoke this classification include:

1.4.1 *Test Method E492* – the single-number rating is called impact insulation class (IIC).

1.4.2 *Test Method E1007* – the single-number ratings are called apparent impact insulation class (AIIC), impact sound rating (ISR), and normalized impact sound rating (NISR).

1.4.3 *Test Method E2179* – the single-number rating is called the change in impact insulation class (ΔIIC).

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

1.6 *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

E1007 Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures

[1] This classification is under the jurisdiction of ASTM Committee E33 on Building and Environmental Acoustics and is the direct responsibility of Subcommittee E33.10 on Structural Acoustics and Vibration.

Current edition approved ~~Nov. 1, 2018~~May 1, 2021. Published ~~December 2018~~May 2021. Originally approved in 1984. Last previous edition approved in ~~2012~~2018 as ~~E989 – 06 (2012).~~E989 – 18. DOI: ~~10.1520/E0989-18.~~10.1520/E0989-21.

[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.

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E2179 Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors

3. Terminology

3.1 The following terms used in this classification are defined in Terminology C634.

decibel sound
impact insulation class
level
octave band
sound insulation
sound pressure
sound pressure level

4. Significance and Use

4.1 The rating increases as the impact sound attenuation of the floor ceiling structure increases. The rating can be used by architects, builders, and specification and code authorities for acoustical design purposes in building constructions.

4.2 The rating strictly only applies to excitation by the standard tapping machine defined in Test Methods E492 and E1007. It does not deal with low frequency sounds below 100 Hz that are typically generated below lightweight joist floors when they are walked on. Nor does it deal with the squeaking, crunching or rattling sounds that can occur in joist construction when elements in the construction are loose and occupants walk on the floor.

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

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5. Basis of Classification

5.1 Table 1 lists the sound pressure levels defining the shape of the reference contour, ~~*C(f),*~~*C(n),* for the sixteen one-third octave bands from 100 to 3150 Hz.

5.2 To determine the impact insulation rating of a floor ceiling assembly, the impact sound pressure levels, ~~*L(f),*~~*L(n),* must first be rounded to the nearest decibel (dB).

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5.3 The reference contour, ~~*C(f),*~~*C(n),* is then fitted to the impact sound pressure levels for the specimen by adding ~~a constant~~an integer *T* to all values of ~~*C(f)*~~*C(n)* until the sum of positive differences between the data and the fitted contour for all frequencies is less than or equal to 32 dB. Stating this criterion as a formula, gives:

TABLE 1 Reference Impact Rating Contour Values

~~Frequency, Hz~~	~~Contour value, dB~~	~~Frequency, Hz~~	~~Contour value,dB~~
~~100~~	~~2~~	~~630~~	~~-1~~
~~125~~	~~2~~	~~800~~	~~-2~~
~~160~~	~~2~~	~~1000~~	~~-3~~
~~200~~	~~2~~	~~1250~~	~~-6~~
~~250~~	~~2~~	~~1600~~	~~-9~~
~~315~~	~~2~~	~~2000~~	~~-12~~
~~400~~	~~1~~	~~2500~~	~~-15~~
~~500~~	~~0~~	~~3150~~	~~-18~~

TABLE 1 Reference Impact Rating Contour Values

Band Number (n)[A]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Frequency, Hz	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Contour value (C(n)), dB	2	2	2	2	2	2	1	0	–1	–2	–3	–6	–9	–12	–15	–18

[A] The band numbers presented here are shown for the purposes of this standard only. They may not be consistent with band numbers defined in other standards.

$$D = \sum_{f=100}^{f=3150} ifpos[L_n(f) - \{C(f) + T\}] \quad (1)$$

$$D = \sum_{n=1}^{16} ifpos[L(n) - \{C(n) + T\}] \quad (1)$$

where the function *ifpos* returns the value of the expression inside the square brackets if the value is positive. If the value is zero or negative, *ifpos* returns zero. T is the ~~greatest~~smallest integer for which D is less than or equal to 32.

5.4 The second criterion that must be satisfied is that no value of the differences ~~$L(f) - \{C(f)$~~$L(n) - \{C(n) + T\}$ can be greater than 8. T must be increased until the difference in each frequency band is less than or equal to 8.

5.5 When both criteria have been satisfied, the fitted contour is given by the array ~~$C(f)$~~$C(n) + T$ and the rating is given by 110 – T.

6. Presentation of Results

6.1 It is recommended that the test data be plotted in a graph together with the corresponding IIC contour obtained as described in Section 5. In this way attention is drawn to the frequency regions that limit the impact insulation performance of the test specimen. Fig. X1.1 shows an example of spectrum having an IIC 49.

7. Keywords

7.1 floors; IIC; impact noise; impact rating; tapping machine

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APPENDIX

(Nonmandatory Information)

X1. REFERENCE CONTOUR FITTED TO A MEASUREMENT

Fig. X1.1 shows an example of the reference contour fitted to a measurement.

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