



Designation: E413 – 22

Classification for Rating Sound Insulation¹

This standard is issued under the fixed designation E413; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This classification covers methods of calculating single-number acoustical ratings for laboratory and field measurements of sound attenuation obtained in one-third octave bands.

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

1.3 Test methods that invoke this classification include:

1.3.1 *Test Method E90*—The single-number rating is called sound transmission class (STC).

1.3.2 *Test Method E336*—Single number ratings are noise isolation class (NIC), normalized noise isolation class (NNIC), and apparent sound transmission class (ASTC).

1.3.3 *Test Method E596*—The single-number rating is called noise isolation class (NIC).

1.3.4 *Test Method E1414*—The single-number rating is called ceiling attenuation class (CAC).

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

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](#)

[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](#)

[E596 Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures](#)

[E1332 Classification for Rating Outdoor-Indoor Sound Attenuation](#)

[E1414 Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum](#)

2.2 *ISO Standard*:³

[ISO 717-1:2020 Acoustics — Rating of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation](#)

3. Terminology

3.1 The following terms used in this classification are defined in Terminology [C634](#):

airborne sound,
field sound transmission class,
level,
noise isolation class,
noise reduction,
normalized noise isolation class,
one-third octave band,
sound insulation,
sound isolation, and
sound transmission loss.

4. Significance and Use

4.1 These single-number ratings correlate in a general way with subjective impressions of sound transmission for speech, radio, television, and similar sources of noise in offices and buildings. This classification method is not appropriate for sound sources with spectra significantly different from those sources listed above. Such sources include machinery, industrial processes, bowling allies, power transformers, musical instruments, many music systems, and transportation noises such as motor vehicles, aircraft and trains. For these sources,

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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.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

accurate assessment of sound transmission requires a detailed analysis in frequency bands. A single-number sound transmission rating for building façade elements is given in Classification [E1332](#).

4.2 The single-number ratings obtained can be used to compare the potential sound insulation of partitions or floors tested in laboratory conditions (STC) or the actual sound isolation between different suites in buildings (NNIC, NIC). The rating for a partition built and tested in a building may be lower than that obtained for a partition tested in a laboratory because of flanking transmission or construction errors.

NOTE 1—A similar rating procedure, described in ISO 717-1:2020, provides single figure sound insulation ratings with a frequency range that extends from 100 to 3150 Hz with no maximum deficiency specified at individual frequencies. For most partitions, the two ratings differ by only one or two points.

5. Procedure

5.1 The reference contour is defined by the array of values given in [Table 1](#).

5.2 Round the data to which the contour is to be fitted to the nearest integer.

NOTE 2—The contour in [Table 1](#) has a rating of zero. Other contours may be derived by adding the same integer to all values in the table.

TABLE 1 Reference Sound Insulation Contour for Calculation of Single-Number Ratings

Frequency, Hz	125	160	200	250	315	400	500	630
Value, dB	-16	-13	-10	-7	-4	-1	0	1
Frequency, Hz	800	1000	1250	1600	2000	2500	3150	4000
Value, dB	2	3	4	4	4	4	4	4

5.3 Fit the reference contour to the data by increasing simultaneously all the values in [Table 1](#) in 1-dB increments until some of the data are less than the shifted reference contour.

5.4 At each frequency calculate the difference between the shifted reference value and the data. If a measured data point is less than the reference contour this is a deficiency; only deficiencies are counted in the fitting procedure. Continue to increase the reference contour values to the highest level that will satisfy the following conditions:

5.4.1 The sum of the deficiencies is less than or equal to 32 dB; and

5.4.2 The maximum deficiency at any one frequency does not exceed 8 dB.

5.5 The single-number rating is given by the value of the shifted reference contour at 500 Hz.

6. Presentation of Results

6.1 It is recommended that the data be plotted to the scale sizes recommended in [Note 3](#), along with the shifted reference contour (see [Figs. X1.1 and X1.2](#)). This type of presentation draws attention to the frequency regions of the data that limit the single-number rating.

NOTE 3—Recommended graph scale sizes are 2 mm/dB for the ordinate and 50 mm per 10 to 1 frequency ratio for the logarithmic abscissa. It is recommended that the ordinate scale start at 0 dB. If larger or smaller scale sizes are unavoidable, it is recommended that the same aspect ratio of 25 dB per 10 to 1 frequency ratio be retained.

7. Keywords

7.1 architectural acoustics; building design; ceiling attenuation class (CAC); noise isolation class (NIC); normalized noise isolation class (NNIC); partitions (buildings); sound insulation rating; sound transmission class (STC)

APPENDIX

(Nonmandatory Information)

X1. EXAMPLES OF FITTED CONTOURS

X1.1 [Figs. X1.1 and X1.2](#) show examples of transmission loss data fitted to the reference contour. In [Fig. X1.1](#), the STC is 24 and the 8-dB limitation in [5.4.2](#) is not invoked. In [Fig.](#)

[X1.2](#) the STC is 30 and the 8-dB limitation is invoked at 2500 Hz.