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Designation: E 413 – 04

Classification for Rating Sound Insulation[1]

This standard is issued under the fixed designation E 413; 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 Department of Defense.

[1] This classification is under the jurisdiction of ASTM Committee E33 on Environmental Acoustics and is the direct responsibility of Subcommittee E33.03 on Sound Transmission.

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1. Scope

1.1 This classification provides covers methods of calculating single-number acoustical ratings for laboratory and field measurements of sound transmission attenuation obtained in one-third octave bands. The method may be applied bands.

1.2 The name given to laboratory or field measurements of the sound transmission loss of a partition in which case 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 E 90*—The single-number ratings are rating is called sound transmission class (STC).

1.3.2 *Test Method E 336*—Single-number ratings are field sound transmission class (FSTC), respectively. The method may also be applied to laboratory and field measurements of the sound isolation between two spaces, in which case the single-number ratings are called the noise isolation class (NIC) or (NIC), and normalized noise isolation class (NNIC).

1.3.3 *Test Method E 596*—The single-number rating is called noise isolation class (NIC).

1.3.4 *Test Method E 1414*—The single-number rating is called ceiling attenuation class (CAC).

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 634 Terminology Relating to 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

E 596 Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures

E 1332 Classification for Determination of Outdoor-Indoor Transmission Class

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

2.2 *ISO Standard:*[3]

ISO 717 Rating of Sound Insulation for Dwellings

3. Terminology

3.1 For definitions of

3.1 The following terms used in this classification, s are defined in Terminology C 634:

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

[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*, Vol 04.06. volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 11 25 W. 42nd 43rd St., 13th 4th Floor, New York, NY 10036.

sound transmission loss.

4. Significance and Use

4.1 The procedure may be applied to one-third octave band sound transmission losses of test specimens measured in accordance with Test Method E 90 to derive sound transmission class (STC). It can also be applied to (*1*) similar quantities measured in accordance with Test Method E 336, to derive field sound transmission class (FSTC), noise isolation class (NIC), and normalized noise isolation class (NNIC) and to (*2*) noise reductions measured in accordance with Method E 596 to derive noise isolation class.

4.2 These

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, accurate assessment of sound transmission requires a detailed analysis in frequency bands.

4.3 The bands. A single-number sound transmission rating for building façade elements is given in Classification E 1332.

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, provides single figure sound insulation ratings with a frequency range that extends from 100 to 3150 Hz and 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 levels values given in Table 1 and shown in Fig. 1.

5.2 Round the data to which the contour is to be fitted to the nearest integer if this is not already specified in the measurement standard.

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 measured data are less than the shifted reference contour.

5.4 At each frequency calculate the difference between the shifted reference value and the measured data. Only deficiencies, that is, where the measured data are less than the reference contour, are counted in the fitting procedure. Continue to increase the reference contour values until the most stringent of the following conditions is satisfied:

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

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

5.5 The STC, FSTC, NIC, or NNIC rating is given by the value of the shifted reference contour at 500 Hz. integer.

NOTE 2—This fitting procedure can be done numerically or graphically. One graphical technique involves placing 2—The contour in Table 1 has a transparent overlay rating of zero. Other contours may be derived by adding the same integer to all values in the table.

5.3 Fit the reference contour over a graph 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 same scale, adjusting initially by trial and error, then making finer adjustments until 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 criteria are satisfied. value of the shifted reference contour at 500 Hz.

TABLE 1 Reference Sound Insulation Contour for Calculation of Single-Number Ratings Note 1—Reference sound insulation contour for calculation of single-number ratings. This contour has a rating of zero. Other contours may be derived by adding the same integer simultaneously to all values in the table.

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

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 measured 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. The ordinate scale should start at 0 dB. If larger or smaller scale sizes are unavoidable, the same aspect ratio of 25 dB per 10 to 1 frequency ratio should be retained.

7. Keywords

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

(STC)

APPENDIX

(Nonmandatory Information)

X1. METHODS

X1. EXAMPLES OF CALCULATING STC FITTED CONTOURS

X1.1 *Calculating STC Using a Worksheet:*

NOTE X1.1—Although Figs. X1.1 and X1.2 describe calculation show examples of sound transmission class from sound transmission loss data; fitted to the method is equally suitable for calculating reference contour. In Fig. X1.1, the other single-number ratings mentioned in the standard.

X1.1.1 The STC may be calculated numerically using the worksheet at the end of this section. The procedure is as follows:

X1.1.2 Write the transmission loss for each one-third octave center frequency from 125 through 4000 Hz in the column labelled "TL" on the worksheet.

X1.1.3 For each frequency add the number in the "Adjustment" column algebraically to the TL 24 and write the result 8-dB limitation in the "Adjusted TL" column.

X1.1.4 Draw a circle around the lowest adjusted TL. Add eight to the circled number to get the first trial STC. Write this trial STC at the top of the first column under "Trial STCs and deficiencies."

X1.1.5 For each frequency subtract the adjusted TL from the current trial STC. If this number 5.4.2 is positive, write it under not invoked. In Fig. X1.2 the trial STC opposite the frequency; otherwise leave a blank.

X1.1.6 Add the deficiencies for the trial STC. Write the sum at the bottom of the column.

X1.1.7 If the sum of the deficiencies is 32 or less, the trial STC is the true STC, 30 and the calculation 8-dB limitation is complete.

X1.1.8 If the sum of the deficiencies is greater than 32, subtract one from the current trial STC to get a new trial STC. Write the new trial STC invoked at the top of the next column. (This can be done after each subtraction in X1.1.5.)

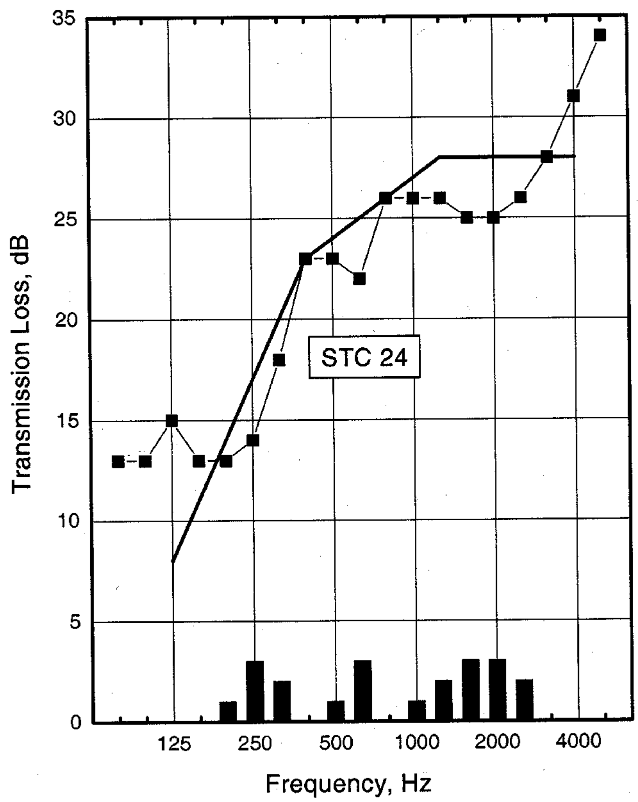
X1.1.9 Repeat X1.1.5-X1.1.8 until the correct STC is found.

X1.2 2500 Hz.

Calculating STC Using a Computer Program:

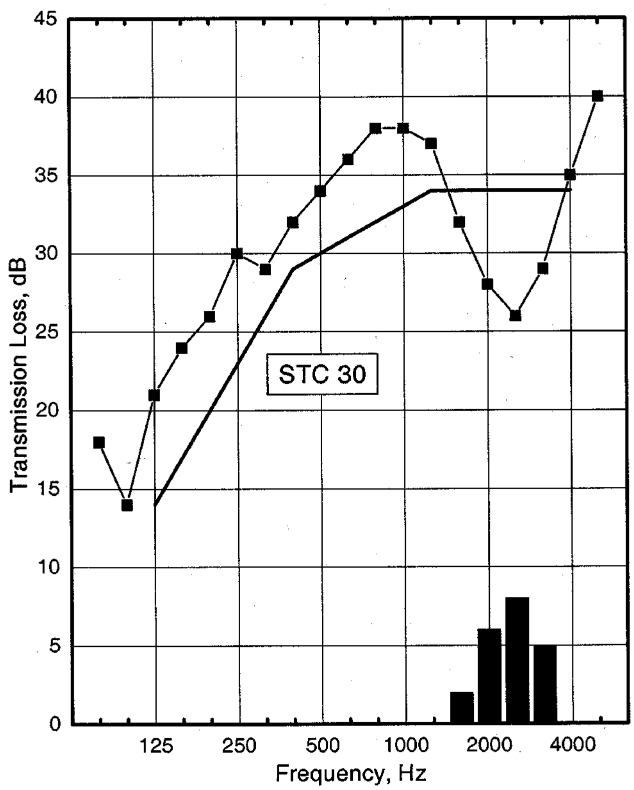
X1.2.1 The BASIC program shown in Fig. X1.1 can be used as a subroutine in other programs and altered as necessary to calculate single-number ratings based on the reference contour.

NOTE X1.2—See Note X1.1.



NOMPUTE—The deficiencies ar Pre shogwn as bars amt the bo Calttom of the culhart. The Single 8-NudB limber Ritationg is not invoked.

FIG. X1.1 Reference Contour (Solid Line) Fitted to Transmission Loss Data (Symbols + Line)



NOTE—The deficiencies are shown as bars at the bottom of the chart. The 8-dB limitation is invoked at 2500 Hz.

FIG. X1.2 Reference Contour (Solid Line) Fitted To Transmission Loss Data (Symbols + Line)