Acoustical Performance Standards For Schools

Updated Standards Provide Recommendations For Acoustic Criteria For Background Noise, Reverberation, And Sound Isolation For Schools.

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Before 2000, there was relatively little emphasis on the acoustical performance of schools and school classrooms. If architects and engineers were aware of the importance of good acoustical design in school classrooms and other learning spaces, these features were often discarded during “value engineering” or simply removed from the project entirely to meet a predetermined budget that was based on previous school designs.

This resulted in a perpetuation of substandard acoustical performance. As a result, many students and teachers suffered with classrooms and other learning spaces that were either too noisy or so reverberant that speech was nearly unintelligible when the separation between the speaker and listener exceeded a nominal distance.

In the early 1990s, a group of acoustical consultants within the Acoustical Society of Americarecognized this problem and started a working group charged with the task of creating acoustical performance standards for school classrooms. The result of this task group’s work was ANSI S12.60-2002, *Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools*. The standard provides specific recommendations for acoustic criteria for background noise, reverberation, and sound isolation for enclosed school classrooms and ancillary learning spaces.

The standard has recently been updated and is now published in two parts: one for permanent school buildings (ANSI S12.60-2010/Part 1), and another for portable or relocatable classroom buildings (ANSI S12.60-2009/Part 2). Both standards are available online at no cost.

The acoustical performance standards recommended in ANSI S12.60 are briefly summarized in Tables 1 and 2. The requirements for portable classrooms are phased in over an eight-year period ending in 2017.

Table 1. Summary of Acoustical Performance Criteria for Permanent Schools (ANSI S12.60/Part 1)

Room type	Room volume	Background noise	Reverberation time
Core learning space	< 10,000 cu ft	35 dBA, 55 dBC	0.6 sec
Core learning space	10,000 to 20,000 cu ft	35 dBA, 55 dBC	0.7 sec
Ancillary learning space	> 20,000 cu ft	40 dBA, 60 dBC	See Annex C

Table 2. Summary of Acoustical Performance Criteria for Relocatable Classrooms (2009-2013) (ANSI S12.60 Part 2)

Room type	Room volume	Background noise*	Reverberation time
Core learning space	< 10,000 cu ft	41 dBA, 61 dBC	0.5 sec
Core learning space	10,000 to 20,000 cu ft	41 dBA, 61 dBC	0.6 sec
Ancillary learning space	All	40 dBA, 60 dBC	Non

**Background noise criteria will reduce to 38 dBA and 58 dBC in 2013 and to 35 dBA and 55 dBC in 2017.*

In addition to the background noise and reverberation criteria, ANSI S12.60 also provides specific guidelines for controlling sound transmission between adjacent interior rooms and corridors as well as limiting the transmission of exterior noise into classrooms and other learning spaces. These guidelines are much too complicated and extensive to reproduce here.

Although ANSI S12.60 represents a consensus of a large group of acoustic and education experts throughout the country, it is only a guideline. Since the adoption of ANSI S12.60, a few states and many school districts have

adopted this standard as a requirement for all new school construction. Hopefully, many more will do so in the near future.

A few years ago, the U.S. Green Building Council (USGBC) decided to include acoustical performance standards in its LEED rating system for new school construction and major renovations. Although the LEED rating systems are all voluntary and market driven, there is great pressure to certify new public and private buildings with this and other similar programs.

The acoustical performance standards specified in LEED 2009 for Schools are much less detailed than those found in ANSI S12.60. First, there are minimum performance standards that must be satisfied before any level of LEED certification can be achieved. The minimum acoustical performance standards are presented in Indoor Environmental Quality (IEQ) Prerequisite 3: Minimum Acoustical Performance as shown in Table

Table 3. LEED 2009 for Schools (IEQ Prerequisite 3)

Room type	Room volume	Background noise	Reverberation time
Core learning space	< 20,000 cu ft	45 dBA	NRC 0.70 ceiling
Core learning space	> 20,000 cu ft	45 dBA	1.5 sec

Note that the maximum allowable classroom background noise level associated with the LEED*minimum* acoustical performance standards is 10 dBA higher (perceived as twice as loud) than the background noise level recommended in ANSI S12.60. Also note that a reverberation time calculation is not required for learning spaces less than 20,000 cu ft in volume, as long as there is sufficient sound-absorbing material in the room that is equivalent in sound absorption to a fully treated ceiling that has a noise reduction coefficient (NRC) rating of 0.70 or higher. Guidelines for achieving the background noise level requirements can be found in Annex B of ANSI S12.60 and in the 2007 ASHRAE Applications Handbook.

Table 3 identifies the *minimum* acoustical performance requirements to achieve any level of LEED certification in schools. In order to achieve the higher LEED certifications, additional points are typically required. An additional point is now available for *enhanced* acoustical performance as identified in IEQ Credit 9 and as shown in Table 4.

Table 4. LEED 2009 for Schools (IEQ Credit 9, 1 Point)

Room type	Room volume	Background noise	Sound transmission
Core learning space	All sizes	40 dBA	STC from ANSI S12.60-2002

Note that the enhanced acoustical performance requires not only a lower background noise level, but also that the walls, floor/ceiling assemblies, roof assemblies, and doors meet the minimum STC ratings for sound transmission control as specified in ANSI S12.60-2002. In addition, the STC rating for all exterior windows must be at least 35 to achieve the extra point available with LEED IEQ Credit 9. It should be noted that the background noise level requirement for LEED enhanced acoustical performance (IEQ Credit 9) does not meet the 35 dBA background noise level specified in ANSI S12.60.

The timeline for the next revision of LEED for Schools is not yet known; however, LEED rating systems have historically undergone updates every few years to respond to the needs of the industry. The process includes public comment periods during which time anyone can submit feedback on proposed changes.

Although ANSI S12.60 provides optional testing procedures for verifying acoustical performance after construction, LEED for Schools does not currently make verification testing a *requirement*—the performance criteria are to be met "on paper" only. Recognizing the importance and benefits of benchmarking building performance as well as the economic realities that may prevent testing with specialized instrumentation on certain projects, ASHRAE, the USGBC, and the Chartered Institute of Building Service Engineers (CIBSE) recently released the *Performance Measurement Protocols for Commercial Buildings*. This standard, which includes basic, intermediate, and advanced acoustical testing procedures, provides an excellent means of verifying classroom acoustical performance during building commissioning.

So, how can you go about achieving these acoustical performance standards in your next school project? There are certainly excellent guidelines presented in the annexes of ANSI S12.60 to help get you started, but you probably will be best served by retaining the services of a qualified acoustical consultant who can perform the necessary calculations and keep you on track during the entire design process to ensure that you meet the acoustical performance criteria that are specific to your project. You can find qualified and reputable acoustical consultants at the National Council of Acoustical Consultants and the Institute of Noise Control Engineers.

Glossary

Acoustic frequency: Number of acoustic pressure oscillations per second, expressed in Hertz (Hz). The human ear is most sensitive at frequencies near 2,000 Hz, but most people with good hearing can hear sounds as low as 20 Hz and as high as 16,000 Hz.

Decibel (dB): A number representing the level or loudness of a sound. Typical values range from 0 dB (threshold of hearing) to 120 dB (threshold of pain).

dBA: Sound pressure level weighted in frequency to approximate the sensitivity of the human ear. Higher values represent higher sound levels. A 10 dBA increase represents a doubling of the loudness.

dBC: Sound pressure level with a flat frequency response (no frequency weighting) from 63 Hz to 6,300 Hz.

Noise: Unwanted sound. Noise is usually distributed (though not uniformly) over a wide range of acoustic frequencies. Excessive noise can cause annoyance and reduced speech intelligibility.

Reverberation time: The time (in seconds) it takes for the sound level to drop 60 dB in a room. Reverberation time increases with room volume and decreases with the total area of sound-absorbing surfaces in the room. Excess reverberation can severely reduce speech intelligibility.

Sound pressure level: A measure of the intensity or loudness of a sound, expressed in dB. In general, the sound pressure level decreases with distance from the source because the acoustic energy is distributed over a broader area.

NRC: Noise reduction coefficient. A measure of the sound absorptive property of a material. Values range from 0.0 (no sound absorption) to 1.0 (100% sound absorption).

STC: Sound transmission class. A single number rating used to characterize the ability of a material or construction assembly to block sound transmission. Higher values represent better sound control (i.e., less sound transmission through the product).

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