

Market Point

Sound Ratings and Spray Polyurethane Foam

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We've heard how well spray polyurethane foam (SPF) works to control sound in our homes and buildings, but we rarely talk about how it works or how we can best use foam to quiet a room.

There are two commonly reported sound metrics: Noise Reduction Coefficient (NRC) and Sound Transition Class (STC). NRC is a scalar representation of the amount of sound energy absorbed upon striking a particular surface. An NRC of 0 indicates perfect reflection (lots of echo), while an NRC of 1 indicates perfect absorption.

STC is an integer rating of how well a building partition reduces airborne sound. STC is roughly the decibel (dB) reduction in noise a partition can provide. The dB scale is a logarithmic one. The human ear perceives a 10 dB reduction in sound as roughly halving the volume (meaning a 40 dB noise seems half as loud as a 50 dB one). If an 80 dB sound on one side of a wall, floor, or ceiling is reduced to 50 dB on the other side, that partition is said to have an STC of 30. (This number does not evenly apply across the range of frequencies, since the STC value is based on a curve representing audible frequencies.)

Any partition will have less sound attenuation at lower frequencies. For example, a wall with an STC of 30 may provide over 40 dB of attenuation at 3000 Hz (high pitch or treble sound) but only 10 dB of attenuation at 125 Hz (low pitch or bass sound.). The range that STC is tested and reported is essentially the human voice range plus a little higher and a little lower.

Sound transmission tests are strictly for assemblies and do not represent the properties of a particular material such as SPF. Furthermore, these tests (like R-value tests) are not



fully representative of typical construction and therefore are somewhat biased against SPF. This means, for example, that a wall assembly insulated with fiberglass is likely to test as well as a wall insulated with SPF because both assemblies are built specifically for the test and not the "real world." In addition, construction practices would be meticulous in the test case, whereas with field-built assemblies, the fiberglass wall is likely to leak more air than the SPF wall, which means the fiberglass wall will tend to transmit more noise. Unfortunately, testing will never show this.

Architects generally design partition walls between apartments, hotel rooms, and condominiums for an STC of 50. This will reduce the sound of loud music on one side of the wall to a whisper on the other side. If a higher degree of privacy is

required, the STC could be specified at 60, which would halve the sound transfer of an STC 50 wall. Building assemblies achieve high STC ratings through a creative combination of decoupled sound paths (i.e., double walls, disconnected studs, multiple layers, sound absorbing membranes, channels, etc.) and absorption (i.e., mass walls, SPF, fiberglass, etc.).

STC	What can be heard
25	Normal speech can be understood quite easily and distinctly through a wall.
30	Loud speech can be understood fairly well, normal speech heard but not understood.
35	Loud speech audible but not intelligible.
40	Onset of "privacy."
42	Loud speech audible as a murmur.
45	Loud speech not audible; 90% of statistical population not annoyed.
50	Very loud sounds such as musical instruments or a stereo can be faintly heard; 99% of population not annoyed.
60+	Superior soundproofing; most sounds inaudible.

"When I observed a sound test for a low-density (open-celled) SPF wall, the structure, test equipment, and process seemed both fascinating and surprisingly simple. In that particular test, the room itself was made of cast concrete with an odd number of walls and no two exactly in the same plane. This is done so that the sound will not be reflected around the room in a predictable pattern.

Anechoic foam – highly sound absorptive, which produces little echo – covered most of the walls. In the center was a concrete dividing wall with an opening for the test sample.

A speaker was set up on one side of the room and a microphone on the other to produce sounds at a known dB level and measure how much sound came through the test wall. The



roughly eight-foot-square (0.74 m²) sample wall was placed in the opening and the edges were sealed using... you guessed it... single-component spray foam.

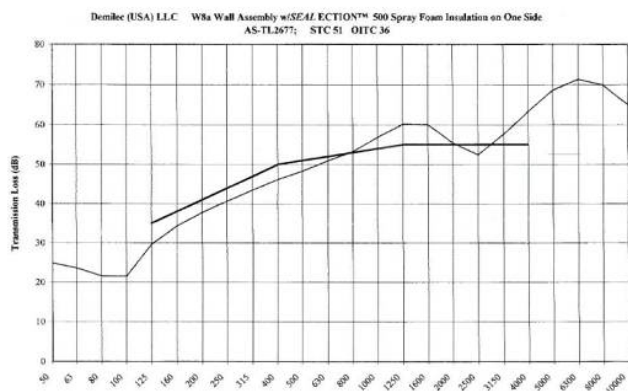
The test's engineers were meticulous about sealing all air leaks around the edges of the sample wall. Because the STC test is mainly measuring airborne sound transfer, the seal is critical. Even the size of the opening in the test makes a big difference. If an opening the size of an index finger is put in the test wall, the sound transfer would likely double!

That test made it obvious why spray foam works so incredibly well at reducing noise through walls: it's an air barrier material and, when properly applied, it creates air barrier wall assemblies. Just as SPF has superior control over convective currents that carry heat and moisture through building enclosures, it also controls airborne sound."

The Noise Reduction Coefficient is also worth noting here because it describes how sound is absorbed in a material as opposed to being reflected from it. Low-density foam will absorb much more sound than medium-density foam. Everyone who walks around in a house freshly sprayed with low-density foam marvels at the sound absorption. It's almost eerie how quiet it is.

The NRC, though, is reported by only a few foam manufacturers, and only for low-density foam. The ratings are 0.70 to 0.75, which tells us that 70 to 75 percent of sound is absorbed by the low-density foam. Since the NRC is a measurement of the sound absorption of the foam itself, and since foam plastics are always separated from the living space by a thermal barrier, this metric has questionable value to the finished wall or ceiling assembly.

In the "real world," there are several things that we can do to enhance sound control in our buildings. The first and most important is to air-seal the structure. Every crack and crevice needs to be foamed, but the best wall for sound is not filled with foam. It's advantageous to leave about an inch (2.5 cm) air gap on one side of the sound wall so the foam touches the gypsum board on only one side. (The more layers of different and decoupled materials that sound must pass through, the better for sound reduction.) A two-by-six-inch (5.1-by-15.2 cm) top and bottom plate with offset two-by-four-inch (5.1-by-10.2 cm) studs assembly has better sound control than a conventional wall, and double walls that have an inch (2.5 cm) space between the plates and studs are better yet. Multiple sheets of gypsum

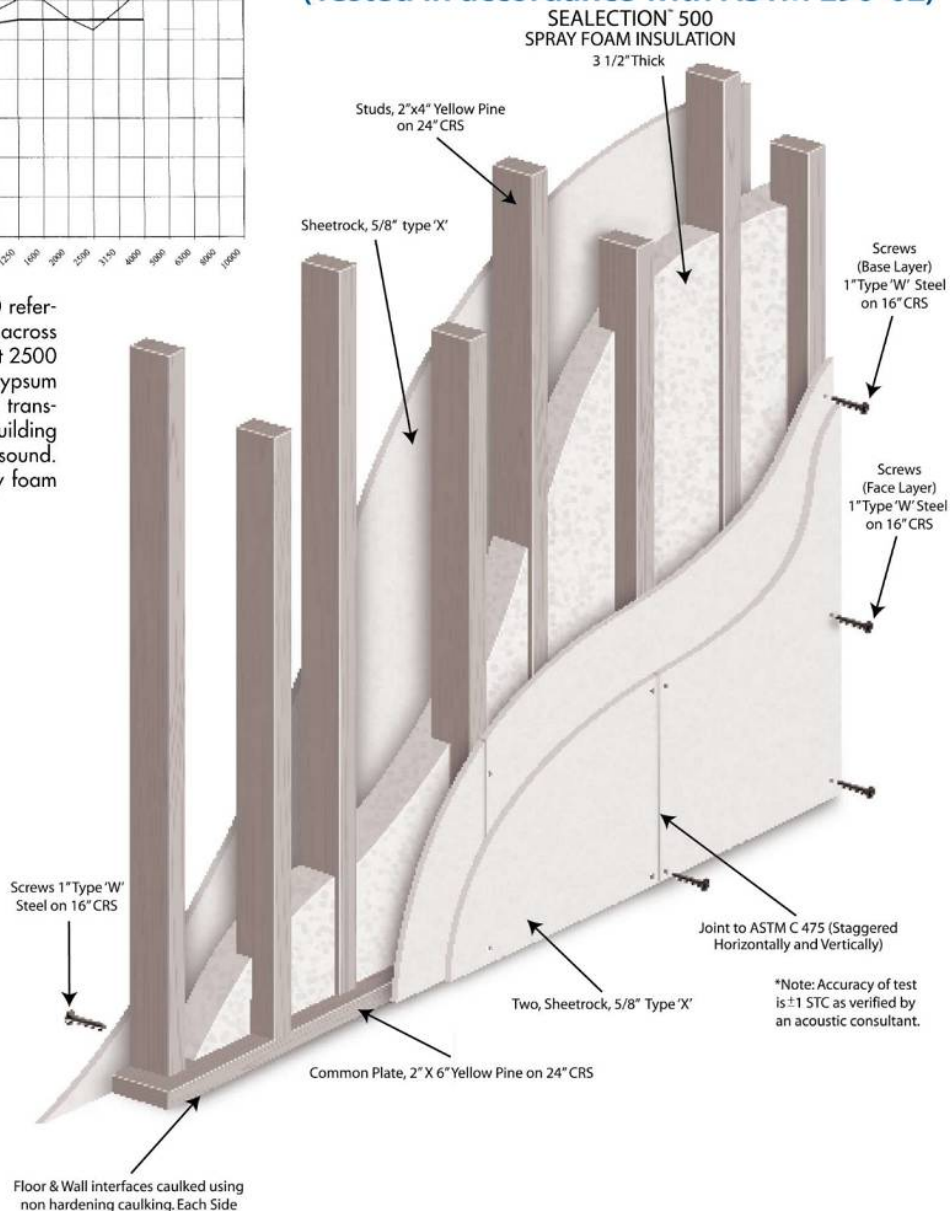


A typical STC curve shows the STC-50 reference in bold and the measured data across the sound spectrum. The sharp drop at 2500 Hz is due to the natural resonance of gypsum board. Foam does not control sound transfer due to the conductance of the building materials as efficiently as airborne sound. This assembly using low-density spray foam tested at STC 51.

WALL ASSEMBLY REF W8 A

Result: STC-50*

(Tested in accordance with ASTM E90-02)



Note: The STC rating specified above is only valid for Sealection™ 500 spray foam insulation manufactured by Demilec® USA and applied by an Authorized Contractor.

Spray Foam Insulation Properties	
0.47 - 0.5	LBS/FT ³
5.6	LBS/IN ²
4%	Closed Cell Content
8600	BTU/LB Maximum

*Note: Accuracy of test is ±1 STC as verified by an acoustic consultant.

board add mass to the wall and help reduce sound transmission across the sound spectrum, especially on the lower end. The way to truly control that deep, pounding bass from a subwoofer is lots of mass.

We teach our spray foam contractors not to declare that we “sound-proof” a wall or room. It’s best to say, “We’ll air-seal the structure, which will attenuate the airborne sound” or, “we’ll add some sound control.” If your customer is building a home theater, encourage multiple layers of gypsum board and isolating channels to further reduce sound transfer. The major effect of SPF on sound reduction is to eliminate air passages in leaky building assemblies. However, this does nothing for, say, noise transmitted through duct work (which bypasses the assembly) or

noise generated from impacts (such as foot traffic noise transmitted through floor framing).

For great sound control between hotel rooms, apartments, office walls, condominiums, and the like, a wall assembly incorporating SPF will outperform any fibrous insulation as we air seal the assembly. Once again, spray polyurethane foam proves its worth. **SF**

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