

Acoustics

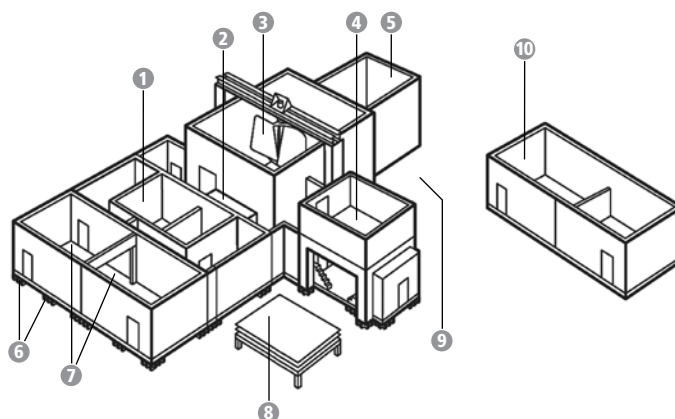


The NGC Testing Services acoustical laboratory features nine full-scale, fully isolated independent test chambers complete with a sophisticated control room so multiple tests can be completed concurrently. NGC Testing Services has 50-plus prebuilt, movable, floor-ceiling test assemblies and is continuously adding more custom assemblies.

Acoustical Laboratory Testing Complex

Our acoustical laboratory has been engineered to complete full-scale tests on a wide range of products.

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| 1. Ceiling Attenuation Chambers | 6. Springs |
| 2. Sound Console | 7. Transmission Loss Chambers |
| 3. Reverberation Chamber | 8. Test Floor Assemblies |
| 4. Floor-Ceiling Facility | 9. Test Floor Construction Area |
| 5. Pipe and Automotive Barrier Testing | 10. Hemi-Anechoic Interzone Attenuation Chamber |



THE ACOUSTICAL LAB ALSO FEATURES:

- **Partition Sound Transmission Loss Chambers:** Sound Transmission Class (STC)
- **Ceiling Attenuation Chambers:** Ceiling Attenuation Class (CAC)
- **Sound Absorption Chamber:** Noise Reduction Coefficient (NRC)
- **Sound Transmission Chamber:** Evaluating pipe-lagging systems, smaller-scale sound transmission tests and automotive barriers
- **Floor-Ceiling Chambers:** Sound Transmission Class (STC), Impact Insulation Class (IIC) and Reduction in Impact Sound Transmission (Delta IIC), with multiple test frames and overhead crane capabilities
- **Hemi-Anechoic Test Chamber:** Articulation Class (AC) and Interzone Attenuation (IA)
- **Miscellaneous:** Additional facilities for developing custom test programs to evaluate acoustical performance of a wide range of products

Test Capabilities

- ASTM E90:** Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements (ISO 140, Part 3)
- ASTM E413:** Classification of Rating Sound Insulation (STC)
- ASTM E1111:** Measurement of the Interzone Attenuation of Open Office Components
- ASTM E1332:** Standard Classification for Determination of Outdoor Indoor Sound Attenuation (OITC)
- ASTM E1408:** Measures the Sound Transmission Loss of Door Panels and Door Systems
- ASTM E1414:** Standard test for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum (ISO 140, Part 9)
- ASTM C423:** Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method (ISO 354)
- ASTM E1222:** Test for the Insertion Loss of Pipe-Lagging Systems
- ASTM E492:** Test for Impact Sound Transmission through Floor-Ceiling Assemblies using the Tapping Machine
- ASTM E2179:** Test for the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors
- ASTM E989:** For Determination of Impact Transmission Class (IIC)
- ASTM E1110:** For Determination of Articulation Class (AC)
- SAE J1400:** Automotive Barriers
- ANSI S12.31/ISO 3741:** To Determine Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms
- ASTM E795:** Standard Practices for Mounting Test Specimens During Sound Absorption Tests

Designers and contractors have come under increasing pressure to reduce sound transmission between adjacent spaces in commercial and multi-family residential buildings. The demand for quiet comes from various sources. They include apartment dwellers who do not want to hear their neighbors' music or the noise from the building's community rooms; the business that wants a quiet workspace despite being next to the elevator shaft; and federal laws that mandate patient privacy in medical facilities. The solutions are the same whether it is a condominium, an office building or a hospital.

Sound waves can pass through the materials used in building assemblies and through flanking paths, as well as through hidden air passages. You can reduce sound transmission by acoustically decoupling the spaces, sealing air holes, adding mass and using sound-damping materials. It may require more than one approach.

Traditional sound attenuation strategies have proven themselves over decades of use, but the quest for quiet has also led manufacturers to develop new materials, such as sound-damping gypsum board, that make those strategies more effective than ever.

Definitions

HERTZ

Sound frequency is measured in hertz (Hz), or cycles per second – the number of sound pressure fluctuations that occur at a fixed point within a second. The human ear can hear frequencies between 20 Hz and 20,000 Hz, though the ability to hear higher frequencies degrades with age. People are most sensitive to sound in the 100 to 5,000 Hz range. (The lowest and highest notes on a piano are 27.5 and 4,186 Hz.)

DECIBELS

Sound intensity, or loudness, is measured in decibels (dB). A quiet whisper might register at 20 dB, normal conversation at 60 dB, and loud singing at 75 dB. The scale is logarithmic, which means that sound intensity doubles with every 10 dB increase.

Best Practices To Reduce Flanking Sound

- Stagger electrical boxes
- Stagger board joints
- Use putty pads on electrical boxes



Recommended



Not Recommended

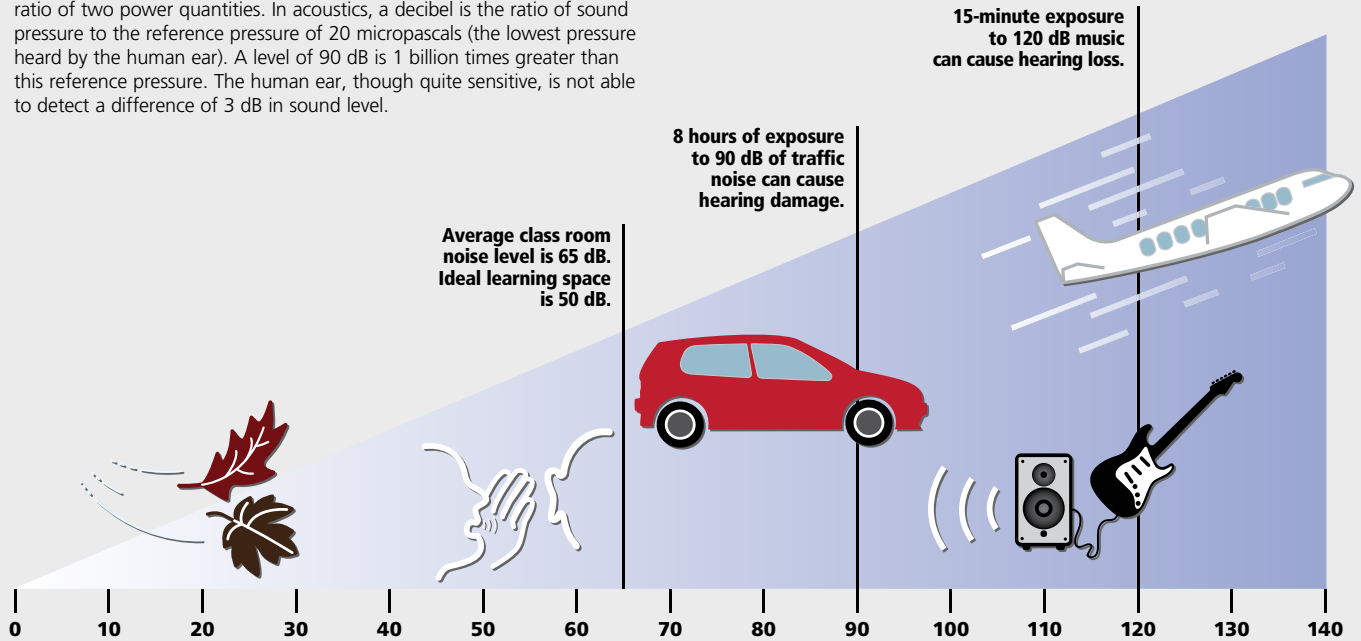
FLANKING SOUND

This is transmission of sound around building assemblies or through holes in the assembly. Flanking paths include the space above partition walls in office buildings, as well as holes in the floor and around electrical boxes. Failure to address these can derail an otherwise solid attenuation strategy.

DECIBELS (dB) OF COMMON SOUNDS

Did you Know:

"Decibel" describes how loud a sound is and it is defined as a logarithmic ratio of two power quantities. In acoustics, a decibel is the ratio of sound pressure to the reference pressure of 20 micropascals (the lowest pressure heard by the human ear). A level of 90 dB is 1 billion times greater than this reference pressure. The human ear, though quite sensitive, is not able to detect a difference of 3 dB in sound level.



Acoustical Terms

STC

Sound Transmission Class, or STC, measures how well a building material or assembly blocks airborne sound. The Sound Transmission Class is a single number rating of the effectiveness of a material or construction assembly to attenuate the transmission of airborne sound. The sound transmission loss between the source and receiving rooms are plotted on a graph by frequency and sound level in decibels. The STC curve is a sliding contour that is fitted to the performance data plotted in a manner that will allow no more than 32-decibel deficiencies below the appropriate contour. The maximum deficiency at any given frequency should not exceed 8 decibels.

Once the laboratory selects the appropriate contour, the STC is determined by the decibel value of the vertical scale at 500 Hz. The STC is expressed as a single STC number (for example, STC 38). The lab measures sound transmission loss values using ASTM E90, *Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*, to calculate the STC ratings in accordance with ASTM E413, *Classification for Rating Sound Insulation*.

There is usually an optimum STC for a given wall assembly and budget. A wood stud wall with fiberglass batt insulation and 1/2 in. (12.7 mm) gypsum board on each face will get an STC of about 38, which is fine for most interior partition walls. Party walls between apartments usually require a minimum STC of 50. Area separation walls with STC's of 60 rarely get complaints from residents. For some applications, it may be worth spending more on the assembly to achieve a higher STC rating.

Note that STC is tested at one-third octave frequencies, from 125 to 4,000 Hz. This range includes normal conversation as well as everyday sounds, such as people using pots and pans. Sound-Damping gypsum board panels, such as 5/8 in. Gold Bond® BRAND SoundBreak® XP® Gypsum Board, are extremely effective at blocking this range of sound.

Sound-Damping gypsum board will somewhat attenuate extremely low frequency sound, such as that generated by stereo subwoofers or MRI machines. These sounds can be as low as 40 Hz. Higher frequencies in the human voice and speech range are where dampened gypsum board performs best. Resilient channels may work better for those lower frequencies.

IIC

The Impact Insulation Class, or IIC, refers to the impact sound transmission performance of floor/ceiling structures. It measures how well the assembly attenuates sounds, such as footsteps and impacts. The higher the rating, the better the IIC.

NRC

Noise Reduction Coefficient, or NRC, measures sound absorption within a room by materials such as carpet, furnishings, sound isolation mats and drop-in ceiling panels. It is expressed as a value between 0 and 1. An NRC of 0.8 is considered very quiet.

CAC

Ceiling Attenuation Class, or CAC, is a single-number measure of how well ceiling tiles block sound from traveling between rooms through the ceiling plenum above a partition wall. A CAC of more than 35 is considered good, and usually requires the placement of insulation above the ceiling tiles to about 4 ft. (1,219 mm) from the wall. There is a direct relationship between STC and CAC. It is important to design a high CAC ceiling assembly to compliment a high STC wall assembly.

Sound Attenuation

When sound hits the face of a wall, the wall will vibrate like a drumhead or speaker cone, transmitting sound waves from one side to another. As mentioned above, sound can also move through airspaces or flanking paths, from one side of the wall to the other.

Ways to attenuate airborne sound include sealing the flanking paths, adding mass to the wall, decoupling the two faces, using Sound-Damping gypsum board, and adding insulation for cavity absorption.

AIR SEALING

This is an essential part of any sound attenuation approach, regardless of the frequencies being targeted. It consists of plugging the holes and gaps that create sound-flanking paths. These include gaps around electrical outlets, recessed lights, fire sprinkler heads, and doors or windows. Sealing is done with gasketing and acoustical sealant.

Not sealing the perimeter of a wall can lower its STC by as much as 10 to 15 points.

ADDING MASS

The more massive a wall, the less it will vibrate, and the less sound it will transmit. A common way to add mass is to use thicker gypsum board and/or to add more layers (5/8 in. [15.9 mm] gypsum board will transmit less sound than 1/2 in. [12.7 mm]). However, there is a law of diminishing returns when it comes to adding mass.

Remember also that a heavy, solid door will transmit less sound than a light, hollow-core door. Thermal, energy-efficient windows will also improve the STC of an exterior wall partition.

DECOUPLING

Decoupling adjacent spaces is absolutely necessary when trying to muffle with low-frequency sounds.

There are two ways to decouple a wall.

One way is to frame the wall so that each side only contacts one of the gypsum board surfaces. To do this, build two independent walls separated by airspace, or use top and bottom plates that are wider than the studs (2 ft. [610 mm] x 6 ft. [1,829 mm] plates and 2 ft. [610 mm] x 4 ft. [1,219 mm] studs, for example). Stagger the studs so that adjacent studs line up with different sides of the plate. Although staggered studs are not as effective as a double wall, they require less floor space.

Another way is to use resilient channels to separate the gypsum board from the studs. This method was originally developed to decouple the gypsum board from high-density wood studs to improve transmission loss through the wall cavity. Fasten these channels horizontally across the studs to damp the vibrations from the gypsum board. Install them over sound clips that separate the channel from the stud. The drywall screws should penetrate the channels but should not be long enough to reach the studs.

For decades, resilient channels have facilitated low-frequency sound attenuation. They work well when done right, but require near-perfect installation. They can be short-circuited by screws that penetrate the studs during construction or after completion by a tenant attaching something to the wall – a flat screen TV bracket attached to the studs, for example. Even one or two screws that penetrate the stud can undo the intended acoustical performance of the resilient channel.

REDUCING STIFFNESS

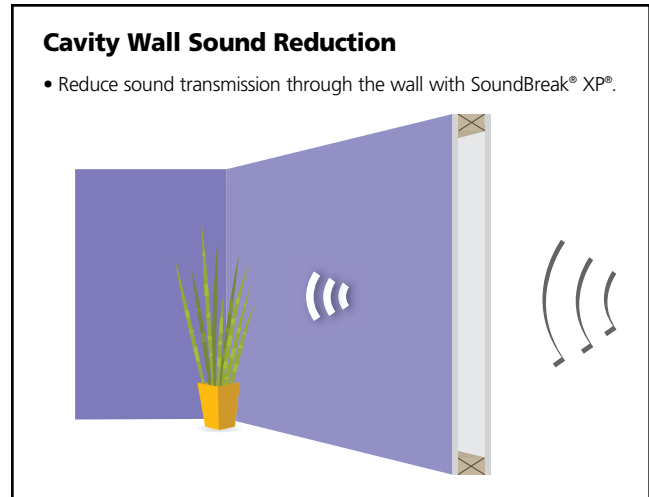
The stiffer the wall, the more it will vibrate. (Think of a drum-head: the tighter the tension, the louder the sound when you hit it.) Metal studs work better in a sound assembly than wood studs because they are less stiff. 25-gauge metal studs perform better than 20-gauge studs, and 24 in. (610 mm) o.c. framing performs better than 16 in. (406 mm) o.c. framing. Typically, there is a 3 STC reduction when moving to thicker studs and when reducing the framing spacing.

Some structural details, like seismic panels, can make walls more rigid and more likely to transmit sound. Some wood species also transmit more sound than others. For instance, Douglas Fir and Hem Fir transmit more sound than spruce or pine.

CAREFUL DETAILING OF INSULATION

The secret with insulation is not to leave gaps that can create flanking paths. Research has found that leaving just 6 percent of the wall uninsulated will reduce the insulation's sound attenuation effectiveness by 35 percent. When designing fire-rated partitions, it is important to follow the insulation guidelines of the rated assembly.

Although it is common to use R-11 fiberglass batts in sound-rated assemblies, mineral wool or sound attenuation batts may offer better performance. Spray foam does a good job at sealing air gaps, but otherwise may not provide good acoustical performance.

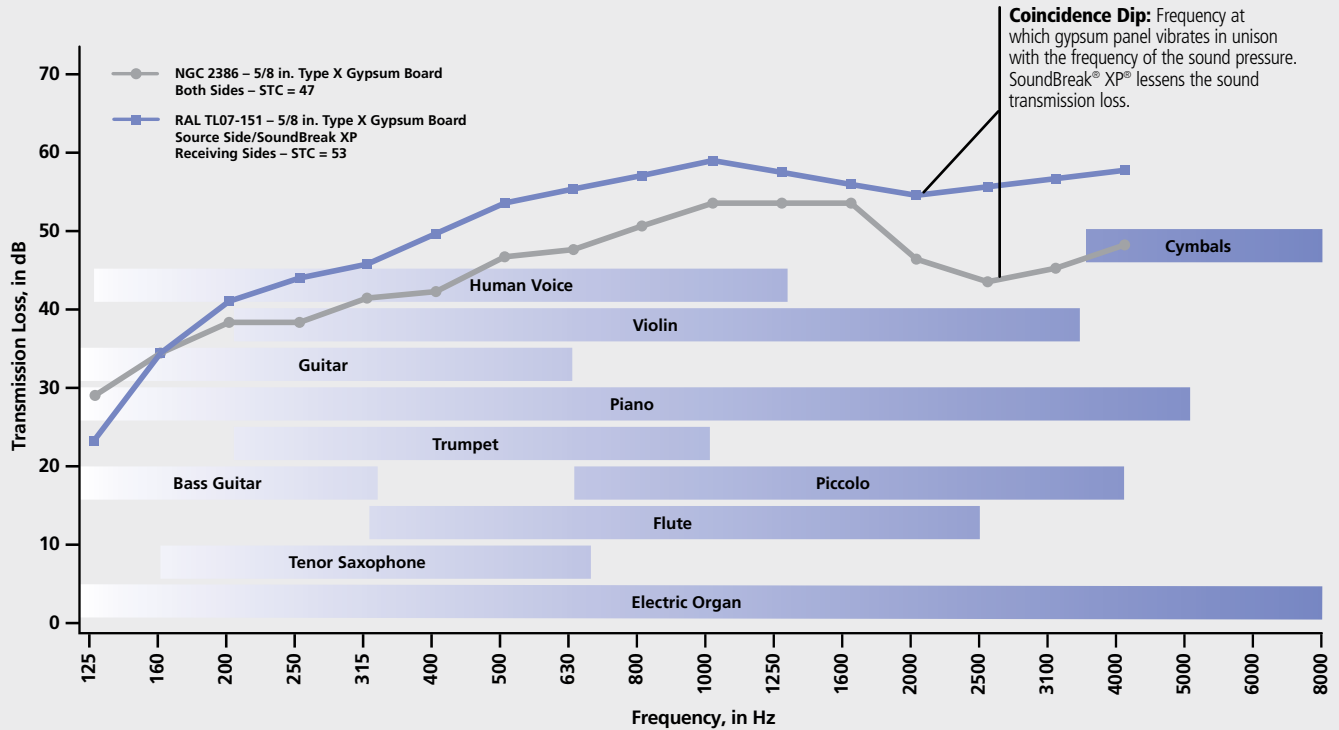


USING SOUND-DAMPING GYPSUM BOARD

Sound-Damping gypsum board uses Constrained Layer Damping. Constrained Layer Damping is like a shock absorber for sound, with a viscoelastic polymer layer at the center of the panel that absorbs and dissipates sound waves. It can reduce sound transmission by 4 decibels or more. Sound-Damping gypsum board handles, installs and finishes just like conventional gypsum board.

5/8 in. Gold Bond® BRAND SoundBreak® XP® Gypsum Board features a fire-resistant Type X core. It also resists mold growth when tested in accordance with ASTM D3273, earning a score of 10, the best possible score. Heavy, abrasion-resistant paper and a denser core provide greater resistance to surface abuse and indentation than conventional panels, when tested in accordance with ASTM C1629.

3-5/8" STEEL STUDS 24" O.C. INSULATED



Acoustics

With SoundBreak® XP®, a contractor who has been using double-stud walls with conventional gypsum board can now use standard framing with no loss in acoustical performance. Achieve a STC of 60 with either double-stud walls or a single-stud wall utilizing 5/8 in. (15.9 mm) SoundBreak XP. Standard, single steel-stud wall framing with 5/8 in. (15.9 mm) gypsum board on both faces will have an STC of around 47; using 5/8 in. (15.9 mm) SoundBreak will increase that STC to 54. Eliminating the second stud wall also adds several inches of floor area to the living space.

The designer or builder can also substitute two layers of 5/8 in. (15.9 mm) gypsum board with one layer of SoundBreak XP with no loss of performance. This can translate to big savings in areas with high labor rates.

Also use SoundBreak XP as an additional layer in UL fire-rated assemblies, adding margins to the STC rating without compromising the fire rating.

Interior Partitions

Interior partitions in office buildings usually extend from the floor to just above the ceiling tiles. While this creates an uninterrupted mechanical plenum, it also serves as a flanking path for sound to travel from one side of the partition to the other.

Drop-in ceiling panels raise the CAC number rather than block sound transmission. In addition, the ceiling grid usually includes a sizable path for airborne sound.

To solve this challenge, install 4 in. (102 mm) thick insulation batts above the ceiling next to the partition. The batts need only extend 4 ft. (1,219 mm) from the partition. Additional insulation adds only nominal sound attenuation, according to laboratory tests performed by National Gypsum.

