Designing for Acoustics with KnollTextiles

KnollTextiles

SOUND IS GOOD; NOISE IS BAD.

Acoustics shape our environment and our experience.

Sound is an important and sometimes neglected aspect of comfort. Noise affects our stress and productivity levels, our ability to learn and retain information, our perception of a space and our overall well-being.

A well-designed interior controls for acoustics in order to contribute to a welcoming and comfortable environment. If reverberation levels interfere with the intended use, then the space becomes uncomfortable.

The way a space *sounds* gives meaning as to what that space *is*.

Spaces have distinct acoustic needs based on their purpose

OPEN OFFICES need to encourage concentration, productivity and a sense of wellness. The inability to have a comfortable conversation is the biggest frustration for people working in an open office. In a recent survey, 75% of workers cited "workplace acoustics" as the worst aspect of their office environment.[1]

HOTELS have multiple acoustic needs depending on the space and its purpose: while a lobby should be warm and buzzing (but not cacophonous), a hotel room must be peaceful and quiet. Noise is the most common complaint at hotels.

RESTAURANTS require a delicate balance between a sense of liveliness and overwhelming noise. Diners need to be able to hear one another without competing with everyone else's conversations.

SCHOOLS need 100% speech intelligibility in their classrooms so that students and teachers can hear everything that is being said. Most schools in the U.S. only have 75% speech intelligibility, which means every fourth word that is spoken is not understood.[2] Noise from reverberation makes it difficult to focus on the teacher and leads to a poor learning environment.

[1] "The Workplace Experience Revolution," October 2018, Leesman Index. https://www.leesmanindex.com/wp-content/uploads/2018/10/Leesman-EwX-Book.pdf

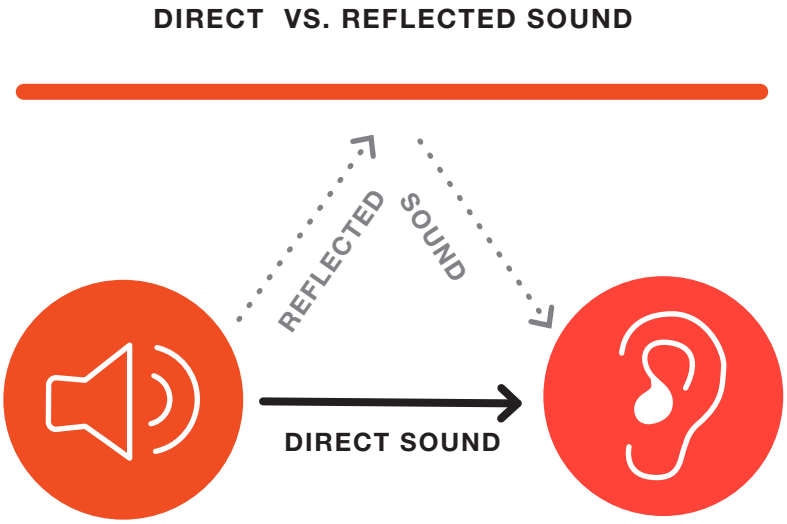
[2] "Acoustics in Schools," Cisca. http://www.cisca.org/files/public/Acoustics in Schools_CISCA.pdf

How does sound move in a space?

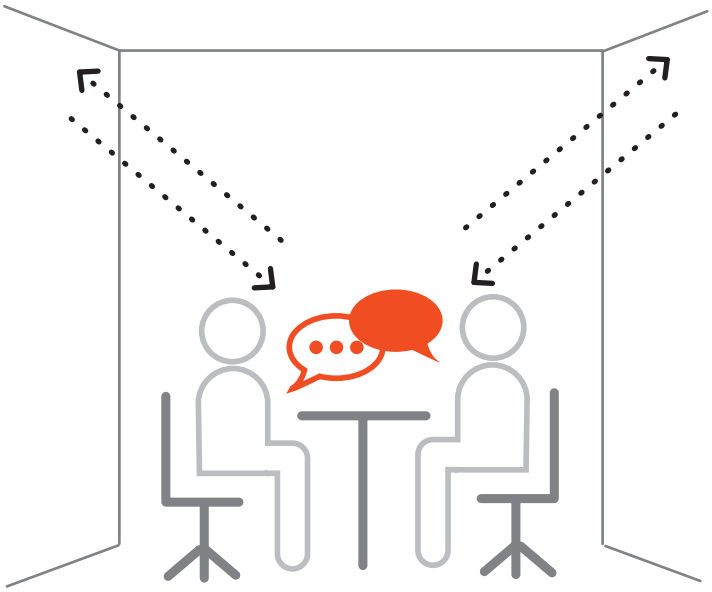
There are two types of sound: Direct and Reflected.

Direct Sound reaches your ears directly from the source.

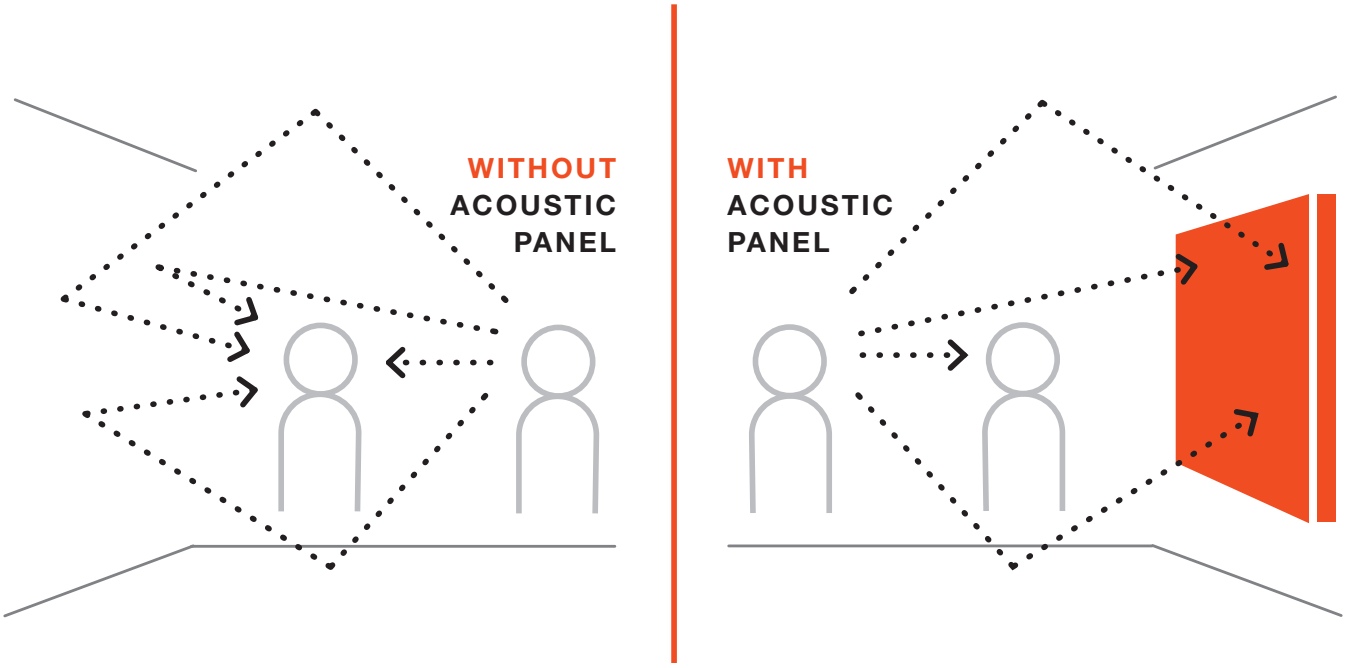
Reflected Sound bounces off of objects and surfaces before reaching your ears. The amount of time it takes for this type of sound to dissipate in a space is called *reverberation time*.



Comfort and clarity can be increased by controlling reverberation time with sound absorbing materials.



What factors affect the acoustics of an interior?



Reverberation is a major factor affecting the acoustics in an interior space.

All the surfaces and contents within a room, including the furnishings, flooring, window treatments and even people, affect the amount of time it takes for sound to dissipate. Ceiling height and angles also have an effect on reverberation time.

To best mitigate reverberation, a significant portion of reflective surfaces should be made absorptive.

Materials play an important role in minimizing or sustaining sound. Hard surfaces allow sounds to bounce around the room multiple times before they become inaudible, whereas textiles can help absorb sound.

Not every fabric has acoustic properties. Specially designed acoustic textiles are either **sound absorbing** or **acoustically neutral** (allowing sound to pass through them).

Improving acoustic comfort with textiles

A strategy of A-B-C—Absorb, Block, Cover—can achieve an acoustically balanced environment. This can be achieved by installing interior products with acoustic properties and employing sound-masking technology when needed. The combination of sound absorption, sound blocking and sound covering is the 1-2-3 punch that can make a measurable difference in the acoustic comfort of any interior.

PRO TIP: *The total absorption added to a space is the product of NRC and the area of application, so low and mid-NRC products are often excellent solutions as long as more total area is applied.*

Here are a few examples of how KnollTextiles can be a beautiful and effective part of the A-B-C strategy:

Sound-Absorbing Drapery

Sound-absorbing drapery, like the acoustic sheers offered by KnollTextiles, absorb up to 75% of the sound waves that come into contact with the fabric.

PRO TIP: *A recent trend is to install sound-absorbing drapery to create a softer, more flexible subdivision of space.*

Acoustic Tiles

Innovative, wall-mounted acoustic tiles like our *Impressions* line offer a turn key acoustic management solution with an NRC of 0.55. The tiles are created by "impressing" classic KnollTextiles patterns onto an acoustic substrate and turn walls into sculptural, sound-absorbing surfaces.

Acoustically Neutral Textiles for Wrapped Panels

Sound-absorbing panels can be wrapped with an acoustically neutral fabric so that the sound can travel through the fabric and be absorbed by the acoustic substrate. These panels can be installed on walls or ceilings in order to reduce reverberation and improve speech intelligibility.

PRO TIP: *Avoid using fabrics with high percentages of natural fibers, rayon or nylon; instead look for fabrics made out of polyester (or other hydrophobic synthetics) to prevent sagging.*

Architectural Products

Freestanding acoustic partitions that block sound are a good way to break up space, add a novel touch and address the "football field" feel of overly large spaces. Most of the options on the market can accommodate a wide variety of fabrics and wallcoverings, like the dozens of acoustically neutral fabrics offered by KnollTextiles.

Although the best and most cost-effective acoustic solutions are planned during the space design phase, it's often not until after occupancy that noise is determined to be an issue. For this reason, KnollTextiles offers acoustic solutions for both pre- and post-occupancy.

Sound absorbing and acoustically neutral products

Acoustic textiles are designed to have the primary benefit of being either sound absorbing or acoustically neutral.

Sound absorbing products perform on their own within an environment.

Acoustically neutral products are paired with a sound absorbing substrate.

Occasionally, a textile may perform both functions. For example, KnollTextiles *Tranquil* absorbs some sound on its own and is acoustically neutral when paired with a sound absorbing substrate.

Testing for Sound Absorption

Sound absorption is measured with an NRC rating.

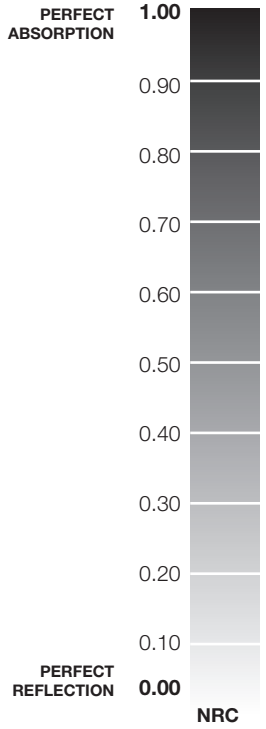
Noise Reduction Coefficient (NRC) refers to the amount of sound absorbed when a sound wave strikes a surface. It is calculated from the absorption data of four frequencies. An NRC of "0" indicates perfect *reflection* while an NRC of "1" indicates perfect *absorption*.

Some materials *can* have an NRC rating *greater* than 1.00. How is this possible? The data used in the NRC calculation only accounts for 2-dimensional measurements of the material being tested—length x width. In reality, materials and objects also have depth, which increases a material's actual surface area available for sound to encounter.

Example: An NRC rating of .65 means that 65% of the sound energy that comes into contact with the fabric is absorbed rather than reflected. The greater the number, the more absorbent the fabric is.

Industry best practice is to use fabrics that have been evaluated by a reputable third party with the industry recognized ASTM C423 test and are NRC rated.

NOISE REDUCTION COEFFICIENT (NRC)



Another method of measuring sound absorption is the Sound Absorption Average (SAA). The SAA is identical to NRC, except that twelve one-third octave measurements, from 200 Hz to 2500 Hz, are averaged instead of the four used to ascertain an NRC rating. The other difference is that NRC results are rounded to the nearest 0.05 and SAA results are not.

Testing for Acoustic Neutrality

ASTM C423 is used to test for sound absorption and acoustic neutrality. Testing for acoustic neutrality means determining the NRC difference between an acoustic substrate alone and then a fabric wrapped acoustic substrate.

In order to find the NRC difference, the ASTM C423 test is conducted twice—once with the panel alone and secondly with a fabric covered panel. The difference is found by subtracting the NRC result of the fabric covered panel from the NRC result of the panel alone. The closer this number is to "0", the less interference the fabric caused in the panel's ability to absorb. Depending on the level of noise control that the acoustician is looking to attain, it may be necessary to review the full report showing the absorption at all frequencies tested.

KnollTextiles tests all panel fabrics in our line, as well as several wallcoverings and upholstery fabrics for acoustic neutrality. The products that have an NRC difference between -0.25 and 0.25 are deemed acoustically neutral and are suitable to be paired with an acoustic substrate.

ASTM C423, "Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method," is the industry recognized test for evaluating the sound absorption of a building material. The test uses a reverberation chamber and measures the rate of decay of sound waves.

The "blow through test" is a primitive way to evaluate the acoustic neutrality of a textile.

In this 'test' a person blows through a fabric and if they are able to feel their breath on the other side, the fabric is considered acoustically neutral and suitable for wrapped acoustical panel use. The reality is that this methodology has no scientific backing. It can be misleading and may not align with actual outcomes of a true acoustical test.

A listing of all KnollTextiles acoustic textiles and products are available as a resource document at knolltextiles.com.

What makes KnollTextiles acoustic sheers effective?

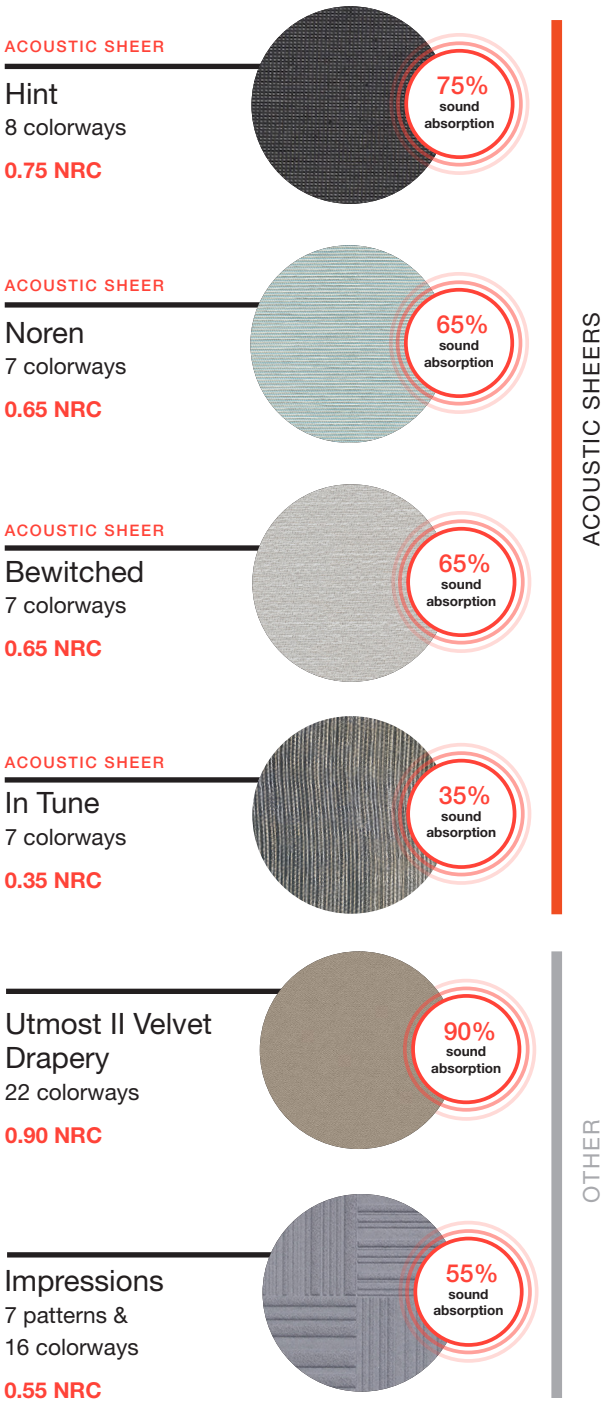
All KnollTextiles acoustic sheers are made primarily with a proprietary Trevira CS polyester yarn that is lightweight, durable and offers visual transparency.

This yarn is fibrous, which creates tiny air pockets for absorbing sound when it's spun together. The weave structure of the sheer textile also has an ideal air permeability. As the air molecules of sound waves vibrate back and forth through the fabric, the weave and yarn resist and convert the sound energy to minuscule amounts of heat.

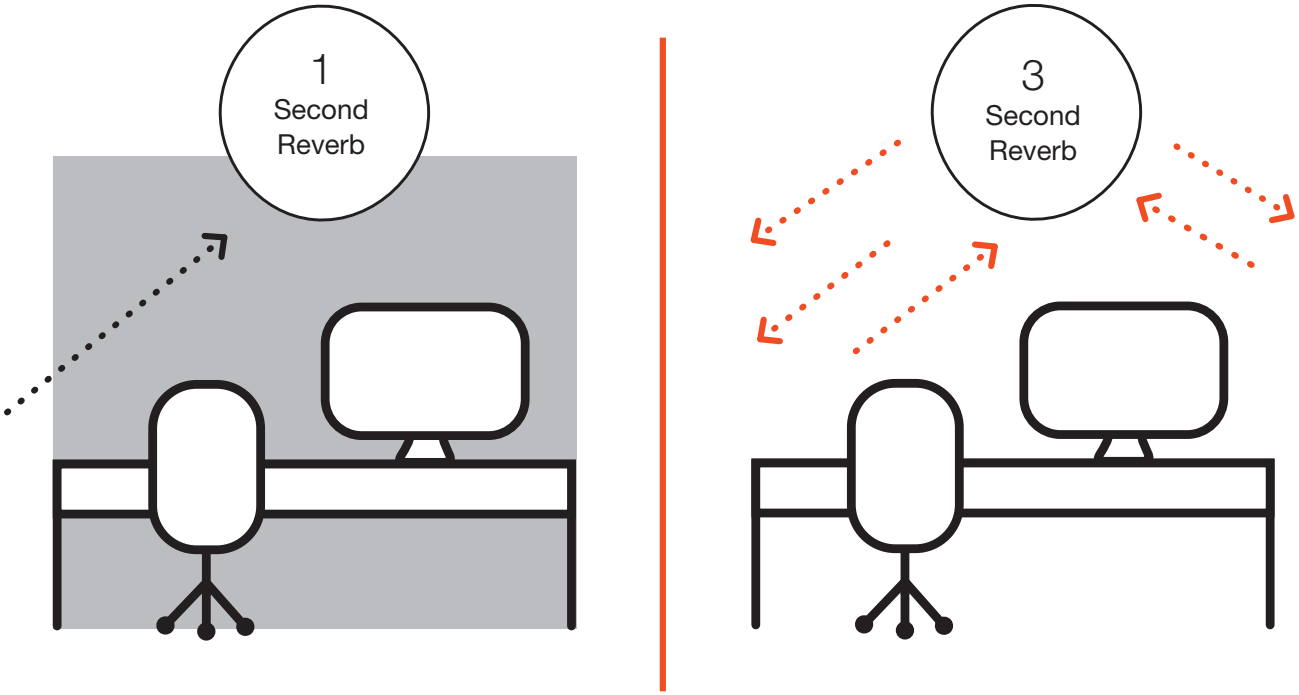
PRO TIPS

Acoustic sheers should be hung at a minimum of 2" from the (curtain) wall for superior sound absorption. Greater sound absorption is achieved by allowing more space between the sheer and the wall.

The more fullness the textile has, the more absorbent it will be. (KnollTextiles tests the draperies for sound absorption at 100% fullness).



Reducing reverberation time with Impressions acoustic tiles



KnollTextiles *Impressions* acoustic tiles have an overall NRC of 0.55 while providing almost perfect absorption (0.77 -0.93) at the frequencies where the human voice registers (1,000-2,000 Hz). This means the tiles are highly effective at absorbing the sound of voices and reducing the reverberation time (the amount of time it takes for sound to dissipate) in an interior space.

The illustration above shows the difference between an ideal acoustic environment, where the reverberation time is 1 second or less, and a noisy environment, where the reverberation time is 3 seconds.

KnollTextiles has solutions to help you accomplish a balanced acoustic environment.

Visit knolltextiles.com to learn more about the acoustic offerings.

KnollTextiles

Contact your local sales representative for full product information.