

Sound Transmission and Sound Control

Updated: 03.2021

STC is a rating of how well a building partition attenuates airborne sound. In the USA, it is widely used to rate interior partitions, ceilings/floors, doors, windows and exterior wall configurations. The STC rating figures reflect the decibel reduction in noise that a partition can provide.

Ref: (see ASTM International Classification E413 and E90). Sound Reduction Index (SRI) ISO index or its related indices are used. These are currently defined in the ISO - 140 series of standards.

Sound Transmission Basics

Single Glazed

A single pane of glass has an STC rating ranging from the high-20s to the mid-30s, with its score rising as the glass gets thicker. For reference, standard house walls are 33 STC, while studio-level soundproofing requires a rating of at least 45. With this in mind, a score in the mid-30s might seem low, but it's fine for the majority of office spaces.

Laminated Glass

Laminating glass is a popular way to increase an STC rating. Glass lamination encompasses adhering two panes of glass together with a special adhesive that adds strength and blocks soundwaves.

Laminated panes' STC ratings typically provide an STC rating reaching high 30s depending on the thickness of the glass and adhesive.

Double-Glazed

Double-glazed, or double-pane glass features two panes in a frame with a layer of air between them. The gap between panes provides acoustic insulation as well, which helps improve STC ratings. The larger the gap the better it is for soundproofing. The farther soundwaves have to travel, the better.

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Double-glazed glass provides an STC rating in the 40s depending on the thickness of the glass, adhesive, and cavity width.

Using dissimilar glass thicknesses in double glazing is generally a good idea for improved acoustical performances. When both layers of glass have equal thickness, the resonance effects of each pane will match causing increased transmission at certain frequencies.

Moreover, air cavities of less than ½" should be avoided. A wall with two panes of 1/8" and an air gap of ¼" of air space will in fact have a lower STC rating than a single layer of 1/8" glass! While glaziers generally do not offer systems with cavities larger than ½", Muraflex's glass wall systems offer cavities ranging 1" to 2-3/4" for double glazed solutions.

Triple glazing is not generally recommended because it is much more expensive than double glazing, and its acoustical performance at low frequencies is generally poorer than double glazing of the same total thickness.

Lamination and Double-Glaze Combinations

Laminated and double-glazed glass both hold STC ratings of up to of 40, but anything higher typically calls for a combination of the two. Maximum noise insulation is achieved by laminating one or more panes in a double-pane piece.

The vast majority of glass advertised as "sound-proof" consists of this combo, for maximum noise cancellation, with STCs of 45 to 50, or higher. This type of glass is likely overkill unless you're building a professional recording studio.

Flanking Transmission

If you want to achieve higher STC ratings, you want to make sure to fill all gaps during construction.

STC ratings are based on laboratory tests conducted under ideal construction conditions. STC ratings are obtained in a controlled environment. These ideal conditions can unfortunately never be replicated in the field, on the construction site.

Much like water, sound will always find any existing hole and seep through it. Even with a high STC rating, any penetration, air-gap, or "flanking" path can seriously degrade the isolation quality of a wall. Flanking paths are the means for sound to transfer from one space to another other than through the wall. Sound can flank over, under, or around a wall. Sound can also travel through common ductwork, plumbing or corridors. Noise will travel between spaces at the weakest points. Therefore, it is crucial for the construction team and the design team to take this into account for higher STC ratings.

STC Standards

For reference, most building codes throughout the US require an exterior wall to have an STC rating of 50, standard house walls and wooden doors have an STC rating of 33, windows range from 18 to 38, while studio-level soundproofing requires a rating of at least 45.

The following table shows the standard STC rating for various types of walls and what can be heard:

What can be heard	STC	Partition type
Normal speech can be heard and understood	27	Single pane glass window (typical value)
Loud speech can be heard and understood	32	Dual pane glass window (typical value)
Loud speech heard, but not understood	33	Single layer of 1/2" drywall on each side, wood studs (typical interior wall) (private office)
Loud speech now only a murmur	45	Double layer of 1/2" drywall on each side, wood studs, batt insulation in wall
Loud speech not heard, music systems / heavy traffic noise can potentially be heard	50	10" Hollow CMU (Concrete Masonry Unit) (bedroom)
Very loud sounds such as musical instruments or a stereo can be faintly heard	54	8" Hollow CMU (Concrete Masonry Unit) with 1 1/2" Wood Furring, 1 1/2" Fiberglass Insulation and 1/2" Drywall on each side
Excellent soundproofing	55	Double layer of 1/2" drywall on each side, on staggered wood stud wall, batt insulation in wall (recording studio)

https://en.wikipedia.org/wiki/Sound_transmission_class

Changes in Apparent Loudness STC Testing

The following table shows the changes in apparent loudness in STC ratings:

Changes in STC Ratings	Changes in Apparent Loudness
+/- 1 STC points	Almost imperceptible
+/- 3 STC points	Just perceptible
+/- 5 STC points	Clearly noticeable
+/- 10 STC points	Twice (or half) as loud

Single Glazed solid wall STC Standards

Industry standard STC ratings of single glazed solid fixed wall:

Solid Glazed Wall	Standard STC Rating
3/8" Clear Tempered Glass	34
1/2" Clear Tempered Glass	36

Solid Glazed Wall	Standard STC Rating
3/8" Clear Laminated Glass	36
1/2" Clear Laminated Glass	38

Double Glazed solid wall STC Standards

Industry standard STC ratings of double glazed solid fixed wall:

Solid Double-Glazed Wall	Standard STC Rating
3/8" Tempered Glass - 1" air space - 1/2" Laminated Glass	43
3/8" Tempered Glass - 2" air space - 1/2" Laminated Glass	46

All Muraflex standard single or double glazed solid fixed wall would meet industry standards.

Muraflex STC Testing

Any wall's sound blocking qualities are only as good as those of the material of the wall. A 1/2" glass pane from one manufacturer will have the same acoustical ratings from another. The challenge, and what sets glass wall manufacturers apart, is their ability to design full wall assemblies with acoustical properties that equate the acoustical rating of the raw material: the glass pane.

Muraflex is dedicated to offer high performing products and providing glass walls with superior STC ratings is a priority. STC testing, as other performance tests, are performed periodically as product lines evolve and grow.

Glazed Assemblies STC Ratings

The opening of an assembly is the weakest point for sound transmission. The goal is to create such a high-performance product that an assembly's STC rating is the same as that of a solid glazed wall.

Single Glazed Assembly STC Ratings

System	Single Glazed Door	Wall Glass Type & Thickness	STC Rating
Mimo	Pivot Door	1/2" Clear Tempered Glass	35-38
Fino	Sliding Door	1/2" Clear Tempered Glass	32-35
Fino	Pivot Door	1/2" Clear Tempered Glass	35-38
Quadro	Sliding Door	1/2" Clear Tempered Glass	32-35
Quadro	Pivot Door	1/2" Clear Tempered Glass	35-38

Double Glazed Assembly STC Ratings

System	Double Glazed Door	Wall Glass Type & Thickness	STC Rating
Mimo	Pivot Door	3/8" Tempered Glass & 1/2" Laminated Glass	43-46
Fino	Sliding Door	3/8" Tempered Glass & 1/2" Laminated Glass	40-43
Fino	Pivot Door	3/8" Tempered Glass & 1/2" Laminated Glass	42-45
Quadro	Sliding Door	3/8" Tempered Glass & 1/2" Laminated Glass	45-48
Quadro	Pivot Door	3/8" Tempered Glass & 1/2" Laminated Glass	45-48

We guarantee that these ASTM E90 results were obtained by testing in a certified lab.

Testing Details and Procedures

All tests were performed by accredited and reputable assurance, inspection, product testing and certification company. The test method conforms explicitly with the American Society for Testing and Materials Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements / Rating Outdoor-Indoor Sound Attenuation. The specimens were evaluated in accordance with the following designations:

- **ASTM E90-09 (2016)** Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- **ASTM E413-16** Classification for Rating Sound System

- **ASTM E1332-16** Standard Classification for Rating Outdoor-Indoor Sound Attenuation
- **ASTM E2235-04 (2012)** Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Test Methods

Glossary

ACOUSTICS:

The scientific study of sound, its production, transmission, and effects.

ARTICULATION CLASS (AC):

A measure of rating building elements such as acoustical ceilings and acoustical screens for speech privacy purposes. AC values increase with increasing privacy. AC has replaced Noise Isolation Class (NIC) as the accepted industry standard performance value. NIC is based on hearing sensitivity rather than discernment of actual speech, which is the primary concern in open office layouts prevalent in acoustical design work.

ASTM:

Acronym for American Society of Testing and Materials

BACKGROUND NOISE:

The sum total of all unwanted residual noise generated from all direct and reflected sound sources in a space that can represent an

interface to, or interfere with good listening and speech intelligibility. (Hearing impaired persons are especially victimized by background noise).

BAFFLE:

An acoustical sound absorbing unit. Normally suspended vertically in a variety of patterns to introduce absorption into a space to reduce reverberation and noise levels.

BARRIER:

Anything physical or an environment that interferes with communication or listening.

DECIBEL (dB):

A logarithmic unit used to express the difference or magnitude of the level or power of sound intensity. It is equal to ten times the common logarithm of the ratio of the two levels. [DECI + BEL] A whisper is about 20 dB, typical conversation is between 60 - 70 dB, and the threshold of pain for the human ear is around 120 dB. Decibels are not directly related to human ear

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sensitivity and doubling dB does not equate to a doubling in perceived loudness since it works as a curve. 10 dB is a typical doubling or halving of perceived volume. Note that being logarithmic values, they cannot be added.

FLANKING:

An indirect path of sound transmission traveling around a partition or barrier within a building reducing the STC significantly. Some examples of flanking paths are noise under doors, electrical conduit penetrations in the partition, window mullions, back to back electrical boxes, ductwork and ceiling plenums, as well as shared walls, floors, and ceilings

FREQUENCY:

The number of cycles per second of a given tone. Acoustical frequency is normally measured in units called Hertz (Hz). One Hz is 1 cycle per second, two Hz is 2 cycles per second, and so on.

HERTZ (Hz):

The unit of frequency, equal to one cycle per second.

MASKING:

The ability or process in which one sound makes the ear incapable of hearing another sound. Most commonly used in open office environments to help speech privacy and are more commonly and less accurately known as "white noise" or "pink noise".

NOISE:

In acoustics Noise is described as any sound in the acoustic domain both wanted and unwanted. While music and birds chirping are examples of wanted sounds, noise is more commonly used in reference to unwanted sounds such as traffic, airplane, industrial, and other annoying sounds. Noise does not have to be excessively loud to be annoying or cause interference.

NOISE ISOLATION CLASS (NIC):

A single-number rating of building elements such as acoustical ceilings and acoustical screens for speech privacy purposes derived from the measured values of noise reduction between two enclosed spaces that are connected between one

or more paths that can not be isolated such as open office environments. NIC has been replaced by Articulation Class (AC).

NOISE REDUCTION COEFFICIENT (NRC):

An arithmetic average of an acoustic material to the nearest multiple of .05 of four sound absorption coefficients at frequencies of 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz. An NRC of 0 = perfect reflection and an NRC of 1 = perfect absorption. NRC is based on human speech frequencies therefore providing a simple scale of how well a surface material will absorb the human voice.

OITC:

Acronym for Outdoor Indoor Transmission Class and covers a range from 80 Hz to 4000 Hz. Though similar to STC, this method is used to rate the amount of Transmission Loss (TL) of a partition or wall from outside to inside such as determining how much traffic noise an exterior wall can stop. OITC is an A-Weighted number and is expressed in dB as opposed to STC which uses points.

PINK NOISE:

A random signal of every frequency in which each higher octave drops off 3 dB. The lower octaves have more power, and the higher octaves have less power. Pink noise is used to test loudspeakers and "tune" a room for optimum audio reproduction or masking systems.

SOUND ABSORPTION:

The property of materials such as air, walls or acoustic panels that changes sound wave energy into heat energy. When a sound wave hits a surface, that which is not reflected is absorbed.

SOUND ABSORPTION COEFFICIENT:

This defines the amount of sound energy absorbed by a given material. As an example, if a material being tested reflects 75% of the sound energy striking that material, the Sound Absorption Coefficient would be 0.25.

SOUND BARRIER:

In acoustics, a sound barrier is any material or structure that is placed around a sound source to

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impede the transmission of the noise beyond the barrier. A poor acoustical environment, such as a room with a long reverberation time, can be a "barrier" to speech intelligibility or good hearing.

SOUNDPROOFING:

Building materials, elements in construction, and design features that make structures more impervious to sound transmission from room to room or from the outside to inside of buildings.

SOUND ATTENUATION - INVERSE SQUARE LAW:

In acoustics, the law in which sound levels falls inversely proportional to the square of the distance from the source. For every doubling of distance from the source, the sound falls 6 dB in air.

SOUND TRANSMISSION CLASS - STC:

A method for a single number ranking of walls, doors, windows, noise barriers, partitions, and other acoustic products measured over 16 different frequencies ranging from 125 Hz - 4000 Hz, assuming that the noise source in generally even across the frequency spectrum. STC involves measuring transmission loss (TL) at various frequency bands of a generated sound source from one room to another separated by the median that is being tested. STC is not a very good rating system for most real world situations which generate sound in frequencies lower than

125 Hz such as traffic noise, machinery noise, and many music systems like those found in today's home theaters. Again, STC does not consider low frequencies in its calculation, so a "high STC" wall could very well perform poorly in the problematic lower frequencies.

SPEECH PRIVACY:

The extent that speech becomes unintelligible between rooms or spaces like offices and conference rooms usually found in an open office plan, The three ratings used are: Confidential (Very Private), Normal (Non Obtrusive), and Minimal (Poor or Low Privacy).

TIME WEIGHTED AVERAGE (TWA):

The guideline used by the Occupational Safety and Health Administration to measure noise levels in the workplace. Exposure to loud noise over a long time can cause hearing damage. If the TWA noise level, which is the average sound level over 8 hours, is exceeding 85 dB(A), a hearing conservation pro

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