

Soundproofing Home Theaters & Media Rooms

**Recording studios, rehearsal spaces, jam rooms,
professional production, editing & postproduction
suites**



Theater design & rendering: Keith Yates Design Group www.keithyates.com

The Goal

"I want a home theater that is my own private world – I don't want to disturb other people at home (or neighbors), and I don't want outside noise to disturb my movie-viewing pleasure."

The Problems

- Your family members or neighbors complain when you listen to movies and music at what you consider to be "normal theatrical levels" (outbound noise)
- You can hear street noise, or the upstairs/next door neighbors, etc) while in your home theater (inbound noise)
- You want all inside noise to disappear acoustically – the TV in the next room, family members talking, laughing, shouting, the garage door opener, the doorbell, Junior's boom box, high heels walking on hardwood floor, toilet flushing.
- You want all outside noises to disappear acoustically - road traffic, jack hammers, airplanes, barking dogs, arguing neighbors, cars with oversize boom boxes, city buses, freight trains, and garbage trucks.
- You want your audio systems to sound like it cost you 2x as much as it really did.
- You don't want to field any more complaints from the neighbors upstairs, downstairs or next door.
- You want to use standard construction techniques to keep cost and risk to a minimum.



This paper is organized to help you get a handle on these common problems and complaints. In five steps, you'll learn:

1. *What STC Rating Do I Want to Achieve?*
2. *Old Approaches & New Solutions*
3. *The Quiet Solution Home Theater System*
4. *Methods to achieve the STC Rating You Want*
5. *How to Apply Quiet Solution Products*

1. What STC Rating Do I Want To Achieve?

The fundamental question you'll answer for yourself is "what STC rating do I want for my home theater, and how do I get it?" The decision begins with an understanding of STC Ratings.

Sound Transmission Class (STC) is the single number rating that describes the sound reduction of a wall or ceiling. It is almost universally used by architects, designers, manufacturers, contractors and distributors of acoustic building products. The higher the STC rating, the greater the sound reduction of the acoustical barrier.

STC is essentially the weighted noise reduction (in decibels) through a barrier over a range of frequencies (from about 125Hz to 4000 Hz). An STC rating loosely corresponds to the average noise reduction, measured in dB, achieved by an isolating partition, separating the sound in one area and a listener in an adjacent area. For example here are some common noises:

Subjective Impression	Typical Sounds	dB	STC needed to produce quiet
Very quiet	Breathing	10	
	Whispering	20	
Pleasantly quiet	Quiet library	30	
	Quiet home	40	0
Normal noise level	General office building interior	50	10
	Normal Conversation at 3'-5'	60	20
Loud noise level	Vacuum cleaner Bus idling	70	30
	Noisy office; typical factory interior Rail car Home theater, normal operation	80	40
	Male Scream at 6' Diesel locomotive Home theater, loud sequences	90	50
	Near a jackhammer Car going around curve squeal Locomotive horn Typical Home theaters	100	60
	Rock concert speakers	110	70
	Near a jet engine THX Home Theater peaks	120	80
Pain threshold	Cannon explosion	140	100

Source: Charles M. Salter & Associates, ACOUSTICS, 1976

A quality home theater can produce sounds as loud as 100dB to 120dB. A typical “quiet room” is around 30dB. So to have a quiet room at 30dB adjacent to a loud home theater with a noise level of 110dB, a wall would have to be rated with an STC of 70 or more ($110 - 30 = 70$).

Typical existing wall construction (the most common method is stud construction with drywall on either side) has an STC rating of 32 to 34. A room built with standard construction walls adjacent to the home theater would have sound levels at 76dB ($110 - 34 = 76$). This level is typical of a factory and is far too loud for conversation or relaxation. However, with a wall built to an STC of 70, the adjacent room would have sound levels of 40dB, about as quiet as a library.

Based on a scenario of a your home theater producing peaks of 100 to 120dB, the table below shows the Sound Transmission Class (STC) target values of partitions needed between the home theater and the adjoining rooms to keep everyone happy. Conversely, you can read the table as the STC needed to keep the Home Theater occupants from being distracted by outside noises like traffic, or neighbors.

The three levels shown below are achievable targets. Each one dictates a different construction method, and hence construction budget. It’s perfectly reasonable to shoot for intermediate target STCs, such as 60. Achieving an STC of 70-80 is world-class, but required for top rated home theaters.

Home theater subjective evaluation	Target STC for home theater wall/ceiling/floor (in dB)	This noise level in adjacent Rooms (in dB)
Benchmark - no special soundproofing	34	66-86
Three Levels		
“Minimal” soundproofing	50	50-70
“Good” soundproofing	60	40-60
“Superb” soundproofing	70+	30-50

**Assumes home theater produces peaks of 100-120dB and the adjacent room target is 30-40dB*

Low Frequency Considerations

STC is a basic method of determining wall transmission loss performance. However, when considering walls for home theaters, loss factors at very low frequencies (below 125Hz) is a major consideration. The STC measurement method does not include such low frequencies in the final calculation. To see these, one must obtain the "TL" (or total loss) measurements at 1/3rd octave bands down to 50Hz. A typical interior wall has a loss of 10dB to 20dB at 50Hz to 125Hz. The THX target is at least 40dB to maintain a quiet environment outside the room. The following chart shows the lab tested performance of various assemblies at low frequencies.

Construction Method	Loss at 50Hz (dB)	Loss at 125Hz (dB)
Standard interior wall (single stud)	20	9
Mass Loaded Vinyl in wall (single stud)	16	19
Single stud wall with RC Channels	19	24
Double gypsum both sides single stud	26	16
Double Stud Wall	14	34
QuietRock QR530 Retrofit wall (single stud)	23	36
QuietRock QR545 1-side (single stud)	24	38
QuietRock QR545 both sides (double stud)	42	54
2X QuietRock QR545 both sides (double stud)	45	60



In the next section, you'll learn about conventional, "old school" soundproofing approaches and about the new method (viscoelastic damping).

2. Old Approaches & New Solutions

There are two basic approaches to reducing noise: sound barriers and sound absorbers.

Sound barriers reduce sound transmission from one space to another. Traditional sound barriers follow Mass Law, which states that the heavier an object is, the more energy it takes to vibrate it. Eight inches of solid concrete is considered an excellent sound barrier. Other sound barriers include walls constructed using non-standard methods (staggered and double stud walls, or the incorporation of resilient channels) that are expensive and prone to being ruined by faulty construction.

Surprisingly many people hold serious misconceptions about how to create a proper sound barrier. Some of the common misconceptions are given below.

Approach	Common misconception	Test results show...
Fill the wall with egg cartons	Will reduce noise by 10dB	No measurable effect
Put insulation in wall	Will fix everything	2-4dB reduction
Put mass loaded vinyl beneath drywall	Will reduce noise by 27dB	3-9dB reduction (at 1 lb/ft ²)
Add another layer of drywall	Will stop the bass sounds	2-3dB reduction per layer
Use foam as a barrier	Regarded as a great barrier	Ineffective - less than 3dB reduction
Use Soundboard (or SoundBarrier) under gypsum	Recognized as an effective method	3-6dB of reduction

Sound absorbers reduce the noise due to reflections (echoes or reverberation) within a space. Sound absorbers are usually some kind of foam, fiberglass, fabric or other “fuzzy” material. Foam panels and fabrics, placed on walls and ceilings, are popular examples. A sound absorber reduces echo or reverberation in a room by absorbing a portion of energy each time a sound wave hits it. Therefore, they are effective for reducing sound *within* a home theater. However, they rarely offer much sound reduction *through* the theater walls, so they do not make good barriers. When used alone, sound absorbers in your home theater will continue to allow sound to be transmitted outside your room to adjacent rooms or even to your neighbors’ homes.

Quiet Solution Technology

There are a variety of techniques to reduce noise and vibration in a home theater or media rooms. Most approaches rely on one of two principals: mass or viscoelasticity. Both methods can be effective, depending on how much material you are willing to use. The more the source can be treated, or isolated with airtight barriers treated with viscoelastic or mass-loaded techniques, the opportunity to meet your needs for quiet are enhanced.

Quiet Solution has developed a series of advanced technology drywalls and woods designed for superior noise reduction. They use a patent pending viscoelastic polymer with “constrained layer damping” to fundamentally change the way sound moves through walls, ceilings and floors. Basically, damping built into these enhanced panels isolates the face of the wall from the studs. It is as if you built a room-within-a-room, only at a microscopic level. This new sound isolation technology exploits the viscoelastic properties of polymeric materials. Quiet Solution has formulated special compounds that are highly viscoelastic (both viscous and elastic or resilient). When deformed by a sound wave – kinetic energy – the compound’s internal resistance lengthens the time before the material returns to its normal shape. Within a range of temperatures and frequencies, viscoelastic polymers can reduce noise and vibration by 10–20dB per layer or more. Every 10dB of reduction is perceived as a reduction in sound volume of approximately 50%. If your home theater gets to peaks around 100dB (which is quite loud) then a 20dB reduction through a sound barrier becomes as loud as a telephone dial tone on the other side.

There are two types of viscoelastic materials. **Unconstrained layer damping** is the simplest way of introducing damping into a structure. The treatment consists of a layer of damping material bonded to the surface of the sound-generating source. The coating goes through extension/compression deformation, tracking the bending of the base structure. This forced, simultaneous motion results in dissipation of energy. The material is low cost, typically 1mm thick, and low weight.

Constrained layer damping is among the most efficient ways of introducing damping into a home theater. This requires the viscoelastic material to be incorporated into a laminated structure (such as plywood or drywall) and designed for such a purpose.

Materials such as concrete or gypsum board have a certain amount of sound barrier capability because of their heavy weight (mass). With additional layers, there’s more weight, and slightly improved performance. But what about applications where it would be impractical to use layer upon layer of high mass materials? In these situations, using constrained-layer damping rather than mass can yield excellent results. As you’ll see below, a damped drywall or wood panel can achieve even higher STC Ratings than a mass-loaded wall – with less material, less weight and less bulk.



In the next section, you’ll learn about the most modern and effective method on the market to build a soundproof room – the Quiet Solution Home Theater System.

3. The Quiet Solution Home Theater System

Quiet Solution has assembled a line of products, which work in concert with each other to give you an unparalleled home theater experience, while preserving the level of quiet in spaces adjacent to the home theater. The four products in the Home Theater System are designed to perform far better than traditional approaches, while remaining low cost, low weight, low bulk, and easy to install.



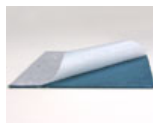
QuietRock® - soundproof engineered panels for walls & ceilings



QuietWood® - soundproof panels for sub-floors, exterior walls & booths



QuietSeal® - soundproof acoustical sealant for joints & outlets



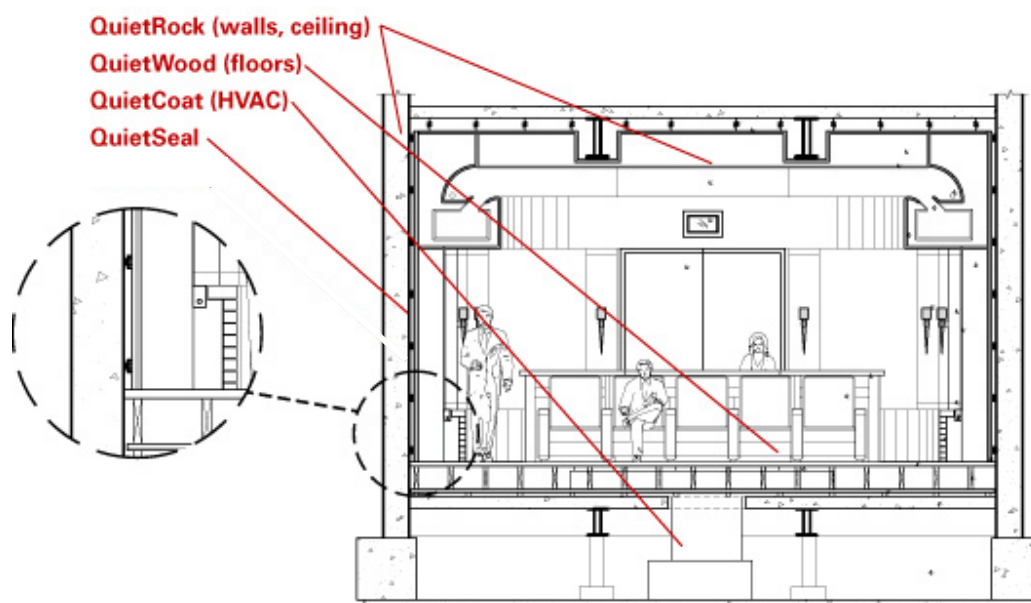
QuietPutty™ - soundproof putty pads for junction boxes and electrical outlets



QuietCoat® 118 soundproof coating for HVAC ducts & steel studs

These five elements are used throughout a home theater in conjunction with one another to make up the Quiet Solution Home Theater System.

Using Quiet Solution Home Theater System Elements



A typical home theater installation using all four of the Quiet Solution Home Theater elements.

A. QuietRock for walls & ceilings

With the highest STC rating of any drywall product, the QuietRock product line significantly reduces noise and sound entering or exiting a room, as part of standard new construction or over existing walls. QuietRock is a multi-layer acoustic isolation drywall product. It is ideal for designs requiring high acoustical performance using very little floor space.

QuietRock QR-520 Relief is an entry-level internally damped panel and is available in a standard 4' x 8' panel (4' x 10' or 4' x 12' special order). It is ready to use and can replace standard drywall or be installed over existing drywall. Walls and ceilings can be easily constructed with STC ratings of 45–50+ using QuietRock QR-520 Relief.

QuietRock QR-530 Serenity is a higher performance internally damped panel with a standard 5/8 inch thickness. This product is regularly stocked throughout North America at hundreds of dealer locations. It is also one of the most tested architectural transmission loss systems available, and has been used in thousands of projects. Using QuietRock QR-530 Serenity, walls and ceilings can be constructed with finished STC ratings from 52–74, depending on construction techniques.

QuietRock QR-545 THX has all the features of QuietRock QR-530 Serenity but is a much higher performance Ceramic-Polymer-Gypsum composite internally damped panel. The result is the most complete isolation design available, with more damping than QR-530. It is the only soundproofing product certified by THX and designed specifically for high-end applications. Using QuietRock QR-545 THX, walls and ceilings can also be constructed with finished STC ratings from 53–80, and featuring the highest low frequency performance ever measured in an interior wall system.

B. QuietWood for floors & exterior walls

With the highest STC rating of any wood product, the QuietWood product line significantly reduces unwanted noise and sounds entering or exiting from the home's

floors, exterior walls or from adjacent rooms. QuietWood is a multi-layer product, and is ideal for use in either existing or new construction.

QuietWood QW-620 Relief is an entry level internally damped wood panel, and is available in standard 4' x 8' panels. It is ready-to-use, and can replace standard plywood above ceilings, below floors or behind walls.

QuietWood QW-630 Serenity is a higher performance panel with a minimal 5/8 inch thickness.

QuietWood QW-631 is a structural subfloor product that is 1-1/8" thick.

QuietWood QW-640 Solitude is a high performance internally damped wood product featuring outstanding low frequency performance.

C. QuietSeal for seams

Sound, like water, will travel through any available opening. We have developed QuietSeal acoustical sealant to combat this common flaw in sound barriers. QuietSeal helps your home theater maintain high STC values when used in conjunction with QuietWood and QuietRock.

Use QuietSeal between panels, and to seal perimeter joints where the panels meet the floor and ceiling. QuietSeal is highly resilient and can therefore withstand movement normally encountered by partitions.

D. QuietPutty for junction boxes

Use QuietPutty around electrical, cable, telephone and speaker outlet boxes. Typical steel and plastic enclosures are thin and have many penetrations resulting in a poor barrier to noise. A backing layer of QuietPutty will ensure that a high-performance wall is not flanked by necessary penetrations such as junction boxes or outlets.

QuietPutty is easy to apply at normal working temperatures, and will adhere well to all clean surfaces without priming.

E. QuietCoat 118 for HVAC, steel studs & recessed lighting

Your sound system isn't the only source of noise in your home theater. QuietCoat is an unconstrained-layer damping product, meaning it can be applied to the exterior of nearly anything to minimize noise and vibration.

QuietCoat has a broad functional temperature range, which makes it perfect for use on HVAC ducts and lighting fixtures, where temperatures can reach extreme highs and lows. This product is designed to minimize the interference from these necessary building systems, while allowing you to enjoy the full, true sounds produced by your home theater system. QuietCoat is less expensive, easier to apply, more effective, thinner, and lighter than older sound and vibration damping technologies.

In new construction, using metal studs improves the acoustic damping provided by the wall frame itself. However, low frequency exterior noise can actually vibrate an entire wall. By applying QuietCoat to the steel studs, a few additional STC rating points can be achieved.



In the next section, you'll learn about various construction methods to help you achieve the STC rating you want. This decision is the most important one you, your architect, designer or builder needs to make.

4. Methods to Achieve the STC Rating You Want

Wood Stud Summary

The table below summarizes the results you can expect from using the different construction techniques outlined above with wood studs. Select the one that most closely matches your goals and budget.

Summary of dB Loss Using Various Techniques Using Wood Studs

Construction Technique	STC	% Noise Reduction versus standard wall (perceived volume)
Over Existing Wall		
Standard Interior Wall with 5/8" drywall both sides with insulation (baseline)	34	0
Add QuietRock QR-520 to 1-side	48	62%
Add QuietRock QR-530 to 1-side	53	73%
Add QuietRock QR-545 THX to 1-side	56	78%
New Construction (standard 2x4 16"-24" OC wood frame with acoustic sealant and R13 insulation)		
Drywall + Frame + QuietRock QR-520	47	59%
Drywall + Frame + QuietRock QR-530	52	71%
Drywall + Frame + QuietRock QR-545 THX	53	73%
New Construction (staggered stud wood frame with R-13 insulation and acoustic sealant)		
Drywall + Frame + QuietRock QR-520	51	68%
Drywall + Frame + QuietRock QR-530	58	80%
Drywall + Frame + QuietRock QR-545 THX	62	85%
New Construction (double stud wood frame with R-30 insulation and acoustic sealant)		
Drywall + Frame + QuietRock QR-520	60	82%
Drywall + Frame + QuietRock QR-530	63	87%
Drywall + Frame + QuietRock QR-545 THX	67	89%
Extreme Construction (double stud wood frame, R-30 insulation, acoustic sealant)		
Double QuietRock QR-520 + Frame + Double QuietRock QR-520	72	91%
Double QuietRock QR-530 + Frame + Double QuietRock QR-530	74	93%
Double QuietRock QR-545 THX + Frame + Double QuietRock QR-545 THX	80	97%

Source: Quiet Solution conducts continuous rigorous testing of its products using high-quality independent test labs that use industry-standard testing procedures and techniques. Many of the above combinations have been verified by National Research Council of Canada (Ottawa, Ontario), and/or Western Electro-Acoustical Labs (Santa Clarita, CA) using ASTM E-90 and E-413 specifications for transmission loss testing. Copies of test reports are available separately online.

Competitive Comparisons

In the past, older technologies utilizing fiberboard (such as Homasote®*) or vinyl barriers have been used to gain marginal improvement in STC values. It is important to note that STC values of materials do not add up. In other words, adding a 27-STC-vinyl barrier to a wall that has an STC of 34 does *not* result in an STC of 61 (actually, it only raises the STC of the final assembly by 3-9dB). The table below summarizes the results you can expect from using various techniques.

STC Comparison

Construction Method - 2x4 single wood studs, 16" – 24" OC, R13 insulation with:	STC	
5/8" Drywall both sides	34	Note 4
Double 1/2" Drywall on both sides	38	Note 4
1lb Vinyl under 5/8" drywall both sides	43	Note 3
Resilient Channel 24" OC, ½" drywall	43	Note 4
Homasote®* under 5/8" drywall and under both sides	45	Note 1
QuietRock QR-530 on one side	52	Note 5
QuietRock QR-545 THX both sides	60	Note 6
Construction Method - 8" Cinder Block Wall	43	Note 2

Note 1: STC data provided by Homasote®, Note 2: STC data provided by Schundler Corp., Note 3: STC data provided by Western Electro-Acoustic Labs, Note 4: STC data provided by National Research Council of Canada IRC-IR-761, Note 5: STC data provided by independent lab testing at National Research Council of Canada, Note 6: STC data provided by interpolation from tests at National Research Council of Canada*



In the next section, you'll learn about various construction methods to help you achieve the STC rating you want. This decision is the most important one you need to make with your architect, designer or builder.

* Homasote® is a registered trademark of Homasote Company.

5. How to Apply Quiet Solution Products

A. QuietRock Panels

Using QuietRock in New Wall Construction

QuietRock hangs and finishes just like standard drywall. Any drywall subcontractor can install, and no special skills are required.

1. Choose your preferred construction method, such as single, staggered, or double frame. QuietRock works with wood and steel framing.
2. Cut panels with a saw, and attach QuietRock to the studs using appropriate drywall screws. Use coarse thread for wood studs and fine thread for steel studs. Hold the panel in place until at least four screws are set.
3. Seal each seam between panels (and before an adjacent panel is placed), at floor and ceiling, and around electrical boxes with QuietSeal. Be sure that the QuietSeal is set deep into the seams to enable normal applications of tape and texture. QuietSeal will remain viscoelastic, i.e. not dry.
4. Tape, texture, paint or wallpaper as normal.

SEE QUIETROCK INSTALLATION NOTE FOR COMPLETE INSTRUCTIONS

Using QuietRock in Existing Wall Construction

1. QuietRock can be used directly over existing drywall construction without removing the original drywall. Hang as described above.

D. QuietCoat 118

You can apply QuietCoat using brush, roller or spray typically to metal (such as HVAC ducts). Damping ability of the material is un-affected by application method. The goal is to apply one or more coats that accumulate to 1-3mm.

Drying & Curing Time: Being water based, QuietCoat needs to dry by evaporation during the cure cycle. QuietCoat that has been thinned excessively will take longer to dry. Water will evaporate more readily when the following conditions exist: higher temperature, increased air circulation, lowered relative humidity. These conditions along with layer thickness contribute to drying time. Thicker layers require longer drying times.

Application of second or successive coats require the previous one to be dry, therefore the goal normally will be to apply as much QuietCoat as possible in each coat keeping in mind the effect on drying time.

Typically, apply the first coat and wait four hours for it to become tack-free. Then, apply a second coat if you wish, and wait four hours for it to become tack-free. Then, if you wish, you may apply a third coat. *Thicker coverage and more coverage greatly enhance the noise and vibration absorption properties.*

Development Time: After QuietCoat is applied, it will take up to one week to develop fully and obtain its maximum noise absorption properties. While you can use the treated surface a few hours after the last coat, the vibration absorbing properties will continue to get better for up to one week after the final coat is applied.

QuietCoat is water based and can be treated the same as any water-based latex paint. Keep a bucket of warm soapy water handy. If you mistakenly brush, roller or spray

material where you don't want it, just wipe it off. It takes QuietCoat at least 20 minutes to get tacky, but the quicker you wipe it off the better.

Acoustical & Architectural Technical Support

If you have any questions during installation, Quiet Solution's staff of professional consultants will be happy to offer guidance. Contact our architectural consultants or our acoustical engineers at 800-797-8438. Complete architectural binders are available to qualified architects and engineers.

Resources

Building a home theater involves some important decisions. A great place to start your search for a home theater contractor is with industry organizations:

HTSA - Home Theater Specialists of America: www.htsa.com

CEDIA - Custom Electronic Design & Installation Association: www.cedia.org

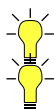
Various specialist home contractors can help you construct an appropriate quiet environment for your home theater. They design acoustically optimized home theaters, media rooms and precision listening environments and are familiar with the Quiet Solution Home Theater System:

Audio One www.audio-one.com

Performance Media Industries www.pmilt.com

Mody & Mody www.hometheaterstore.com

Design Cinema Privee www.designcinema.com



*Our architectural and acoustical consultants are available to help you.
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