KNAUF INSULATION
FOR THE WORLD WE LIVE IN.

Sound Solutions

Silence is golden.

More architects and builders are adding home offices and theatres to their list of custom design features in homes, creating a demand for better sound control. A study in RSI magazine showed that 60% of new home owners are interested in increasing levels of soundproofing. Homes that can provide a quiet, peaceful refuge offer a valuable benefit to the average home buyer.

People prize their privacy. The value of a home office is undermined if the noise of children playing in the next room makes it impossible to concentrate. Proper acoustical insulation is essential to enjoying the sound effects of a home theatre while small children are sleeping in nearby rooms. Even low-level bathroom noises may disturb a light sleeper and make a home less comfortable. These noise problems of single family homes multiply with common walls in multi-family dwellings.

Intensity of Common Sounds

Source	dB	Sensory Response
Threshold of good hearing	10	Very faint
Whispering conversation at 6 ft.	30	Faint
Conversational speech at 3 ft.	60	Moderate
Computer printout room	80	Loud
Loud rock band	110	Threshold of dis-comfort
Passenger ramp at airliner	120	Threshold of pain
Military jet takeoff at 100 ft.	140	Extreme danger

Frequency and Intensity

Sound is measured in two ways. Frequency (pitch) is expressed in cycles per second or hertz (Hz). The human ear, which senses sound by responding to vibrations or pressure waves traveling through the air, can hear between 20 and 20,000 hertz. Intensity, or volume, is measured in decibels (dB). Since the ear is more sensitive to the middle range frequencies, intensity is measured at 1000 Hz.

Controlling Sound

Sound waves or vibrations travel from room to room through the air or through walls and floor/ceiling assemblies. There are two types of waves: airborne penetration sound (e.g., conversation) and impact sound (e.g. footsteps). The intensity or volume of these sounds is reduced through either absorption or isolation.

Airborne penetration sounds are typically reduced by absorption. As sound passes through a wall or floor/ceiling assembly, part of the sound energy is absorbed by the structure. The ability to absorb airborne noise is rated by sound transmission class (STC), measured in decibel reduction. The higher the STC, the better a partition performs. For example, an STC rating of 15 is considered very poor, inadequate even to muffle a normal conversation. An STC rating of 50 is required for walls that separate offices or rooms to provide privacy — a 50+ rating would render even loud speech inaudible. The charts below indicate the sound level changes that correspond to decibel reductions and STC ratings

Perceptions of Decibel Reductions

Sound Power Level Change	Perception
0-3 dB	Barely perceivable
4-5 dB	Perceivable and significant
6 dB	Resultant sound level ¼ of initial level
7-9 dB	Major perceived reduction
10 dB	Resultant sound level ½ of initial level

Reduction in Room-to-Room Speech Transmission

STC	Speech Transmission Through Wall Assembly
30	Loud speech can be understood fairly well
35	Loud speech audible, but not intelligible
42	Loud speech audible as a murmur
45	Some loud speech barely audible
48	Hearing strained to detect loud speech
50	Loud speech not audible

Impact noises, such as footsteps, are normally controlled most effectively by a combination of absorption and sound isolation. An assembly's ability to reduce sound through isolation is rated on the basis of an Impact Isolation Class (IIC). IIC categories are defined by decibel reductions and are equivalent to STC categories. The ability of a floor/ceiling assembly to isolate impact sounds and their reverberation is due to the density and thickness of the floor/ceiling materials. In apartments with concrete floors, noise from footsteps is not a problem. In wood frame construction, impact sounds can be muffled by carpeting wood floors.

Sound Control Basics

There are many design elements that must be incorporated as part of an overall sound control strategy. For example, placing electrical outlets or switch boxes on opposite sides of a wall at least two studs away from one another will avoid the creation of a sound transmission path.

There are three basic ways to reduce sound transmission in a home or office using internal partitions.

- **Increase partition mass**
  Increasing the thickness of a partition is an effective way to improve the STC rating. Unfortunately, the increased weight may present design problems in lightweight construction and may not be pleasing, aesthetically.

- **Break the vibration path**
  By using discontinuous construction (i.e. cavity walls), sound transmission can be reduced by as much as 6 to 10 dB. Double wall construction with a 1-inch separation can improve performance by 18 STC points or more.

- **Cavity absorption**
  Discontinuous construction strategy can be improved by cavity absorption, or filling the space in wall and ceiling constructions with acoustical insulation.

Other methods that home designers use to maintain a quieter atmosphere are using absorbent building materials (porous finishes absorb sound rather than reflect it), creating sound barriers and strategic placement of closets, halls and stairways, strategically placing mechanical equipment far away from quiet areas and using acoustical masking or background noise (although this may be expensive and not attractive to home owners).

Using Acoustical Insulation to Improve STC Ratings

- **Acoustical blanket insulation**
  Adding fiberglass insulation to the framing cavity in a residential or light commercial assembly can improve the STC rating from 3 to 11 points (decibels), depending on the configuration. Placing insulation in the sound path absorbs the energy and dampens the noise. Improvement in this range is discernible and significant.

- **Acoustical channel**
  Metal acoustical or resilient channel interrupts the sound path through the assembly. The channel is attached perpendicular to the framing, between the framing and drywall. The improvement in acoustical performance can be as much as 12 STC points.

- **Air sealing**
  Unsealed seams and penetrations can cause poor overall performance. Recessed ceiling light fixtures and junction boxes can effectively break the seal, opening up the assembly to sound transmission paths. Pay special attention to sealing around piping and other through penetrations.

- **Duct work**
  Even a room that is completely sound-isolated can transmit noise via metal ductwork. “Cross talk” between rooms and mechanical noise (from an air handler’s blower motor) are the most common complaints associated with duct sound transmission. These noise problems can be nearly eliminated with the use of fiberglass duct board, such as Knauf Insulation Atmosphere Air Duct Board. The fiberglass not only absorbs the sound, it also provides thermal insulation, offering tremendous efficiency gains over uninsulated metal duct systems.

  The absorptive quality of the fiberglass duct board can also be used to balance supply and return air of a sound-isolated room. For example, designing walls with high STC values, caulking and sealing air leakage sites and installing tight-fitting solid wood doors effectively seal off a room from the rest of the house. If the room is supplied with forced-air heating or cooling without providing for a separate return air duct for the room, a negative pressure results in the rest of the house.

- A building under negative pressure can cause back drafting of naturally vented combustion appliances and increase air infiltration of the building. Installing an equalizing duct within one of the cavity bays of an interior wall adjacent to a common area can eliminate this problem. A vent placed high on one side of the wall and low on the other takes advantage of the full height of the cavity. Fiberglass duct is used to absorb any noise through the vent, retaining the room’s isolated quality and not affecting the air pressure within the house.

- **Framing**
  Using double wall construction or staggered stud strategies can increase the performance of the wall by breaking the transmission path. Staggering 2 x 4 studs on a 6" plate can improve performance 10 to 12 STC points. Double wall construction with a 1" separation can improve performance up to 18 STC points or more.

- **Gypsum board**
  Adding of a second layer of wall board can improve performance 2 to 7 STC points.

- **Window and door selection**
  Operable windows should seal tightly when closed. Double-pane glazing is significantly better than single-pane in acoustical performance and energy efficiency. The thickness of the glass and air spacing also effect performance. The amount of window area should be minimized on the side of the building that faces the noise source. Proper caulking and sealing of the window or door will ensure the best sound performance of the wall assembly. The principal considerations in door selection include solid construction (preferably wood) and a snug fit.

- **Using acoustical insulation to overcome zoning challenges**
  Building closer to highways and airports offer greater challenges to builders, not only in obtaining permits but also in designing homes with buyer appeal. One strategy to ease zoning restrictions is to present proffers that allay concerns over objectable noise in residential buildings. Using sound control construction methods to shield home owners from surrounding noise is one way builders are building in restricted and unpleasant environments.

Effects of Thickness and Density on STC Ratings

As stated previously, the higher the STC rating of a wall assembly, the greater the transmission loss and the quieter the room. Comparative testing from nationally-recognized acoustical laboratories have shown that insulation thickness has the most significant effect on transmission loss and STC rating. Conversely, density variations have minimal effect on the STC rating.

Maximum STC ratings were found to occur when low density insulating materials were slightly compressed in the stud cavity; installed compressed densities greater than 2.0 PCF caused a reduction in STC ratings. Data from one test showing minimal STC dependence on density is shown below.

STC Values of Equal Thickness of Mineral Fibers*

3⅝" steel studs; single layer ½"gypsum board each side

Material	Thickness	Density	STC
Fiberglass	2"	0.75 PCF	46
		1.3 PCF	46
		3.9 PCF	46
Rock Wool		2.0 PCF	45
		2.4 PCF	46

*Loney, W., "Effect of Cavity Absorption and Multiple Layers of Wallboard on the Sound Transmission Loss of Steel Stud Gypsum Wallboard Partitions." The Journal of Acoustical Society of America, Vol.53, No. 6, 1973.

Thermal and Acoustical Blanket Insulation

EcoBatt insulation is compression packed in durable, poly bags and shipped in units sized for easy, convenient handling and stacking.

This table is meant as a quick reference guide as product availability varies by region. Please check with your Territory Manager for a full product offering in your region.

Specification Compliance

- ASTM C665 (facing)
  - Type I, Class A, (Unfaced)
  - Type II, Class C, Category 1 (Kraft)
  - Type III, Class A, Category 1 (FSK-25 foil)
  - Type III, Class B, Category 1 (Foil)

Forms Available

Wood Frame Construction						
R-Value	**Thickness**	**Unfaced**	**Kraft**	**FSK-25**	**Standard Foil**	**Staple-Free**
R-11	3½"	11", 15¼", 19", 23¼"	15", 23"	–	–	–
R-13	3½"	11", 15", 23"	11", 15", 23"	–	–	15¼"
R-15 HD	3½"	15", 23"	15", 23"	–	–	15¼"
R-19	6¼"	12", 15", 15¼", 19", 23¼"	11", 15", 19", 23"	–	–	15¼"
R-20	5½"	15"	15"	–	–	–
R-21 HD	5½"	15", 23"	15", 23"	–	–	15¼"
R-22	6½"	23"	15"	–	–	–
R-23 HD	5½"	15"	–	–	–	–
R-25	8"	16", 24"	15", 23"	–	–	–
R-30	10"	16", 19¼", 24"	12", 16", 19", 24"	–	–	–
R-30 HD	8¼"	15", 23"	15", 23"	–	–	–
R-38	12"	16", 19", 24"	16", 19", 24"	–	–	–
R-38 HD	10¼"	15", 23"	15", 23"	–	–	–
R-49	13¾"	16", 24"	16", 19", 24"	–	–	–
Metal Frame Construction						
R-8	2½"	16", 24"	–	–	–	–
R-11	3½"	16", 24"	16", 24"	16"	16"	–
R-13	3½"	16", 24"	16", 24"	16"	16"	–
R-15 HD	3½"	16"	16", 24"	–	–	–
R-19	6¼"	16", 24"	16", 24"	16", 24"	16", 24"	–
R-21 HD	5½"	16", 24"	16"	16"	–	–
R-22	6½"	16"	–	–	–	–
R-30	10"	–	–	24", 24" E.F.	24"	–
R-38	12"	–	–	16", 24"	–	
Manufactured Housing Rolls						
R-5	1½"	15"	–	–	–	–
R-7	2¼"	15", 16" 42", 48", 90", 96"	–	–	–	–
R-11	3½"	15", 48", 72", 84", 90", 96"	15"	–	–	–
R-13	3½"	15"	15"	–	–	–
R-14	3½"	72"	–	–	–	–
R-19	6¼"	15", 48", 91½"	15", 23"	–	–	–
R-22	7"	84"	–	–	–	–

HD = High Density, E.F. = Extended Flange

Short Form Specification

All fiberglass insulation on drawings or specified herein shall be fiberglass insulation as manufactured by Knauf Insulation, Shelbyville, IN. Thermal resistance shall be R-_____ in ceilings, R-_____ in floors over unheated spaces. Insulation shall be installed as recommended by manufacturer.

Technical Data

Property (Unit)	Test	Performance
Corrosion	ASTM C1617	Pass
Thermal Value	ASTM C518	See Forms Available chart
Water Vapor Permeance	ASTM E96	Kraft Faced: 1.0 perms or less; FSK-25 and Foil Faced: 0.05 perms
Water Vapor Sorption (by weight)	ASTM C1104	Less than 5%
Combustibility	ASTM E136	Non-combustible (unfaced only)
Mold Growth	ASTM C1338	Pass
Surface Burning Characteristics (flame spread/smoke developed)	ASTM E84	Unfaced awnd flamed-rated FSK facings: 25/50; Kraft facing will burn and should not be left exposed.

Acoustical Performance

EcoBatt insulation provides excellent acoustical properties and will reduce sound transmission when properly installed in partition walls and acoustical ceiling and floor systems. Knauf acoustical/thermal insulation can improve STC ratings in wood stud construction by 3 to 5 points and metal stud construction by 8 to 10 points depending upon the complexity of the wall configurations, R-values and layers of insulation.

STC Ratings

	With insulation	No insulation	With insulation	No insulation
Wood Frame, 2 x 4 (3½" – 4" Batt), 16" O.C.	**(with ½" gypsum wallboard both sides)**		**(with ⅝" Type X gypsum wallboard both sides)**	
Single studs/Single layer gypsum	38	35	38	34
Single studs/Resilient channel	47	39	50	40
Staggered studs/Single layer gypsum	49	39	51*	43
Double stud walls/Single layer gypsum	57	46	56	45
Steel Frame (2½" studs) (2½" – 2⅝" Batt), 25 gauge, 24" O.C.	**(with ½" gypsum wallboard both sides)**		**(with ⅝" Type X gypsum wallboard both sides)**	
Single layer gypsum	45	36	47	39
Double layer gypsum one side/Single layer gypsum other side	50	39	52	44
Double layer both sides	54	45	57	48
Steel Frame (3⅝" studs) (3½" – 4" Batt), 25 gauge, 24" O.C.	**(with ½" gypsum wallboard both sides)**		**(with ⅝" Type X gypsum wallboard both sides)**	
Single layer gypsum	47	39	50	39
Double layer gypsum one side/Single layer gypsum other side	52	42	55	47
Double layer both sides	56	50	58	52

*STC reflects two 2½" thick fiberglass batts used

Additional Assemblies	STC
Wood frame, 2 x 4 (3½" – 4" Batt), 24" O.C., ½" thick gypsum board, single layer one side, double layer other side, resilient channel	55
Wood frame, 2 x 4 (3½" – 4" Batt), 24" O.C., ½" thick gypsum board, double layer both sides, resilient channel	57
Wood frame, 2 x 4 staggered studs (3½" – 4" Batt), 24" O.C., ½" thick gypsum board, single layer both sides	52
Wood frame, 2 x 4 (3½" – 4" Batt), 24" O.C., ⅝" thick Type X gypsum board, single layer both sides	40
Wood frame, 2 x 4 (3½" – 4" Batt), 24" O.C., ⅝" thick Type X gypsum board, single layer both sides, resilient channel	52

A Sound Marketing Advantage

Home theatre and office upgrades may increase the buyer appeal of homes, but a few simple acoustical treatments can help close the deal. Home owners need assurance that they'll always be able to find peace and quiet in a noisy, fast-paced world. Builders who distinguish their homes as a tranquil refuge offer a sign of quality that buyers will appreciate and pay for.

Contact your Knauf Insulation Territory Manager for more information about how we can help you create a sound-secure home environment with fiberglass insulation.

CERTIFICATIONS

Check with your Knauf Insulation Territory Manager to ensure information is current.

The chemical and physical properties of this product represent average values determined in accordance with accepted test methods. The data is subject to normal manufacturing variations. The data is supplied as a technical service and is subject to change without notice. References to numerical flame spread ratings are not intended to reflect hazards presented by these or any other materials under actual fire conditions.

This product is covered by one or more U.S. and/or other patents.
See patent www.knaufnorthamerica.com/patents

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