How Noise Effects Us

Unwanted sound – or noise – that travels from room to room, from home to home, or office to office, may have a direct impact on people’s notions of privacy, as well as their work efficiency. The noise produced by appliances, piping, heating and air-conditioning systems, phones, radios, TVs and talking are among the major reasons people are dissatisfied with the privacy found in homes or office buildings. Additionally, external noises such as traffic, sirens and extreme weather conditions are equally disturbing. Designing structures to control noise effectively can make homes and offices much more pleasant places in which to live or work.
This Sound Control Guide recommends ways to construct walls and other assemblies using fiber glass insulation to help provide quality noise control.

The North American Insulation Manufacturers Association (NAIMA) developed these recommendations based on the results of numerous acoustical tests using American Society for Testing and Materials (ASTM) methods. However, the recommendations are presented here solely as a guide. NAIMA cannot guarantee, does not represent or warrant, and assumes no responsibility for building design or construction results based on information provided in this booklet because many other factors – including overall design and workmanship – are outside its control.

Methods Of Sound Control

Noise is unwanted sound that is transmitted by vibration through air, walls, floors or ceilings. In a home or office, there are three ways to control sound transmission:

- Increase the mass of partitions
- Break the path of vibration
- Cavity absorption.

Increasing the mass of walls and other structures can present a problem in lightweight construction because the increased weight may not be structurally practical or aesthetically pleasing, not to mention more expensive. Breaking the vibration path – commonly called discontinuous construction – offers a practical method of reducing sound transmission by as much as 6 to 10 dB. Cavity absorption, which uses fiber glass insulation to fill the space in walls and floors/ceilings, can further improve performance of discontinuous constructions by 5 to 15 dB.

Sound Transmission Class (STC) And Sound Control

STC ratings are a measure of the effectiveness of a given partition construction in reducing airborne sound transmission. Because of the frequency range covered (125-4000 Hz), STC ratings are best used to evaluate speech privacy for partitions and floors/ceilings separating adjacent offices, rooms in one and two family dwellings, hospital patient rooms, classrooms, dormitories, apartments, courtrooms, small conference rooms, etc. A more extensive acoustical analysis should be obtained from an acoustical engineer when isolating sound from locations such as music practice rooms, recording studios, large conference rooms and mechanical equipment rooms.

Ratings Based On Lab Tests

STC ratings are based on laboratory tests conducted under ideal construction conditions. Partition manufacturers acknowledge that the field STC of a partition can be up to 15 - 20 points lower than laboratory values depending on the quality of detailing and workmanship. Therefore, the importance of communication between the design team and the construction team cannot be overemphasized.
Factors That Degrade Performance

The presence of flanking paths, interconnecting ductwork, non-airtight edge joints, inadequate door and window constructions, untreated pipe and conduit penetrations, etc., all degrade the expected performance of a sound rated assembly. When proper attention to construction details are followed, field STC values can be equal to or even greater than laboratory values.

Differences Between Lab Tests
Not Unusual

Partitions with STC ratings within 1-2 points (1-2 dB) of the listed criteria would still be acceptable given the anticipated tolerances in repeat tests. In fact, differences between testing labs of 2-5 dB on identical test configurations are not unusual. (Subjectively, the human ear would consider a 1-2 dB change as “nondiscernible” at best, which is insignificant.)

STC Requirements Are From AIA

The STC requirements in Table 3 (pages 5-6) are from the American Institute of Architects (AIA) and assume acceptable background noise levels on both sides of the construction assembly. Normal background noise on the listening side of a partition has the effect of masking transmitted sound that might otherwise be objectionable. In fact, sound transmitted through a partition will be inaudible if its sound level is below the level of the background noise.

The Effects Of Insulation Thickness And Density On STC Ratings

Insulation thickness has a more significant effect on STC ratings than does density. For a typical steel stud wall construction, the first inch of fiber glass insulation can increase the STC value 6 or more points. Each additional inch of fiber glass insulation increases the STC value from one to two points. Conversely, density variations have minimal effect on the STC rating. (See Table 2.)

Controlling Impact Noise

Walls are rated only in terms of their STC value. Floor/ceiling assemblies - because they must also control sounds caused by impacts (such as walking or moving furniture) - are rated in terms of their STC and their impact insulation class, or IIC.

A person walking on a floor creates impact noise that is readily transmitted to the room below. While carpets and pads can cushion impacts and reduce the generation of impact noise, fiber glass insulation can reduce impact and airborne noise transmitted through the floor/ceiling assembly. As with STCs, the higher the IIC value of a floor/ceiling, the better its ability to control impact sound transmission. An acceptable IIC rating is typically 50 or above.

Improving Office To Office Sound Reduction

In offices where the separating partition stops at the ceiling, sound can flank around the partition by traveling through the ceiling. This flanking sound travels up through the ceiling in one office, across the top of the partition and then down through the ceiling in the adjacent office. In many offices this flanking path is significant and degrades the sound isolation between offices. This is particularly true if the STC of the separating partition is greater than 45.

<table>
<thead>
<tr>
<th>TABLE 2 - STC Values of Equal Thicknesses of Fiber Glass Insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Fiber Glass</td>
</tr>
<tr>
<td>Fiber Glass</td>
</tr>
<tr>
<td>Fiber Glass</td>
</tr>
</tbody>
</table>

Fiber Glass Insulation Reduces Sound Transmission

Fiber glass insulation in a partition or floor/ceiling assembly significantly reduces sound transmission. It also reduces sound transmission in roof/ceiling assemblies. It is economical, lightweight and easy to install. Some fiber glass insulation manufacturers sell acoustical or sound control batts for use in partitions. These batts are designed for easier installation in metal and wood stud partitions. They are essentially the same as their corresponding thermal batts, except that they may differ slightly in size and density. A partition with either fiber glass sound control or thermal batts having similar properties would achieve the same STC rating.
Preventing Ceiling Flanking Sound Transmission

Ceiling flanking sound can be prevented by building partitions from the floor to the roof or floor deck above. However, many times this is not possible because of obstructions such as pipes, conduit and HVAC ducts in the ceiling plenum. In some HVAC designs the ceiling plenum is also used as an air return and partitions can not block the plenum. When this is the case there are two methods to reduce ceiling flanking sound.

Backload Ceiling Panels With Low Density Fiber Glass Insulation

The first method is to back load the ceiling panels with low density fiber glass insulation. The ceiling attenuation class (CAC) can be improved by 6 to 15 points depending on the type of ceiling panel and the type of grid system. The CAC is the single number rating used to express the sound reduction or attenuation between two rooms sharing a common ceiling and/or plenum (See ASTM standard E 1414). These CAC improvements can be achieved by using unfaced 3 1/2 to 4 inch thick batts (R-11 batts). The batts only have to be placed on the back of the ceiling panels on both sides of the partition close to the plenum. Care must be taken not to cover light fixtures with the insulation. The insulation may cause the fixtures to overheat.

Install A “Fuzzwall”

The second method to reduce ceiling flanking sound transmission is to install a fiber glass wall above the separating partition. Such a wall or plenum barrier has been called a “fuzzwall.” (See figure below.)

Fuzzwall Can Improve CAC

Tests conducted by the National Research Council of Canada have shown that a fuzzwall can improve the effective CAC of a ceiling by 10 to 15 points depending on the type of ceiling panel in the ceiling, the type of ceiling grid system and the thickness of the fuzzwall. For air return plenums, openings can be provided in the fuzzwall for air flow. These openings would decrease the STC by approximately 5 points.

Controlling Exterior Sounds

Many residences and commercial buildings are adversely impacted by external sounds or noise. Therefore, it is critical to control both interior and exterior noise. Typical exterior noise sources are automobile and truck traffic, trains, aircraft and noise from other buildings.

Fiber Glass vs. Cellulose Insulation

Manufacturers of cellulose insulation claim that their insulation, when used in a partition, gives higher STC values than fiber glass insulation. This is not true.

Numerous sound transmission loss tests conducted at independent laboratories have shown that there is no significant difference in STC ratings using either fiber glass or cellulose insulation. The STC ratings of walls using cellulose or fiber glass insulation are within 1 or 2 points of each other.

Metal Framing vs. Wood Framing

Light gauge metal framing members are inherently flexible thus allowing the full potential of added cavity insulation to be realized. Single row wood stud framing, on the other hand, provides a high degree of mechanical coupling which can provide a “short-circuit” for sound transmission.

In order to realize the full benefit of cavity insulation in wood framed construction, it is recommended that the gypsum board be attached to either side of the wood framing members using resilient channels. Staggered or double rows of wood studs can also be used to achieve the same benefit. Tests have also shown that there is no significant acoustical difference between 2x4 and 2x6 inch wood studs.

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Controlling Exterior Sounds

Many residences and commercial buildings are adversely impacted by external sounds or noise. Therefore, it is critical to control both interior and exterior noise. Typical exterior noise sources are automobile and truck traffic, trains, aircraft and noise from other buildings.

Basic fuzzwall configuration

- Ceiling/floor slab
- Stack of batts
- Suspended ceiling
- Basic fuzzwall configuration
neighbors. The best way to reduce the impact of exterior noise is not to build near these noise sources. When this is not possible then special measures must be taken to reduce their impacts. The shell of a residence or building must be designed to keep out noise.

**Residential Construction**

In residences, exterior walls should be constructed with resilient furring channels and fiber glass insulation in the stud cavity. If a residence is impacted by overhead aircraft then resilient channels should be used in roof/ceiling assemblies as well as using at least 9 inches of blown-in fiber glass insulation in the attic. The insulation should cover the top of the joists by at least 1 inch.

There should be a minimum number of windows and doors on the side of home facing the exterior noise source. When windows are necessary on this side, they should be sound rated with an STC of at least 40. The same is true for doors facing a noise source.

Recent retrofit programs done on residences near airports to reduce interior noise levels due to aircraft have shown that it is very critical to seal all air (sound) leaks in the building envelope. All fresh air intakes and exhausts must have silencers or mufflers. Most of the residences also had additional insulation installed in the attics to further reduce overhead aircraft noise.

**Commercial Construction**

In commercial buildings built near a highway or train tracks, the exterior building walls should have at least an STC of 50. Windows and doors should have at least an STC of 40 or 45 depending on the amount of window or door area. The higher the window or door area the higher the STC value. Roof/ceiling systems should also have a minimum STC of 50 if aircraft fly over the building. Higher STC values may be required if aircraft fly close to the building. In this case, an acoustical engineer should be consulted.
<table>
<thead>
<tr>
<th>Type of Occupancy</th>
<th>Room(s) Considered (Source)</th>
<th>Adjacent Area(s) (Receiver)</th>
<th>Sound Isolation Requirement (Min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive areas, doctors' suites – confidential privacy requirements</td>
<td>Office</td>
<td>Adjacent offices, General office areas, Corridor or lobby, Washrooms and toilet areas, Exterior of building, Kitchen and dining areas, Manufacturing areas and mechanical equipment rooms</td>
<td>STC 52, STC 52, STC 52, STC 52, STC 37-60+†, STC 52, STC 52+†</td>
</tr>
<tr>
<td>Normal office areas – normal privacy requirements</td>
<td>Office</td>
<td>Adjacent offices, General office areas, Corridor or lobby, Washrooms and toilet areas, Exterior of building, Kitchen and dining areas, Manufacturing areas and mechanical equipment rooms</td>
<td>STC 45, STC 45, STC 45, STC 45, STC 37-60+†, STC 47, STC 52+†</td>
</tr>
<tr>
<td>Any normal occupancy, using conference rooms for group meetings or discussions</td>
<td>Conference rooms</td>
<td>Other conference rooms, Adjacent offices, General office areas, Corridor or lobby, Washrooms and toilet areas, Exterior of building, Kitchen and dining areas, Manufacturing areas and mechanical equipment rooms</td>
<td>STC 45, STC 45, STC 45, STC 45, STC 37-60+†, STC 47, STC 52+†</td>
</tr>
<tr>
<td>Normal business offices, drafting areas, banking floors, etc.</td>
<td>Large general office areas</td>
<td>Corridors or lobby, Exterior of building, Data processing areas, Manufacturing areas and mechanical equipment areas, Kitchen and dining areas</td>
<td>STC 37, STC 37-60+†, STC 42, STC 47+</td>
</tr>
<tr>
<td>Office in manufacturing, laboratory or test areas requiring normal privacy</td>
<td>Shop and laboratory offices</td>
<td>Adjacent offices, Manufacturing, laboratory, or test areas, Washrooms and toilet areas, Corridor or lobby, Exterior of building</td>
<td>STC 42, STC 42+, STC 42, STC 37, STC 37-60+†</td>
</tr>
<tr>
<td>Motels and urban hotels (similar to apartments)</td>
<td>Bedrooms</td>
<td>Adjacent bedrooms, separate occupancy, Bathrooms, separate occupancy, Living rooms, separate occupancy, Dining areas, Corridor, lobby, or public spaces, Mechanical equipment rooms, Exterior of building</td>
<td>STC 48+, STC 52+, STC 50+, STC 50+, STC 48+, STC 52+†, STC 37-60+†</td>
</tr>
</tbody>
</table>


* Depends on the nature of the exterior background noise – its level, spectrum shape, and constancy – as well as on the client’s budget and on thermal considerations. Use qualified acoustical consultants for analysis of high noise outdoor environments such as airport areas, highways (with heavy truck traffic especially), and industrial facilities.

† Use acoustical consultants for mechanical equipment rooms housing other than air handling equipment – chillers, pumps, compressors, etc. – and for heavy manufacturing areas employing equipment generating noise levels at or above OSHA allowable levels or generating high vibration levels.
### Table 3 – Sound Isolation Design Criteria (continued)

<table>
<thead>
<tr>
<th>Type of Occupancy</th>
<th>Room(s) Considered (Source)</th>
<th>Adjacent Area(s) (Receiver)</th>
<th>Sound Isolation Requirement (Min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apartments, multiple dwelling building</td>
<td>Living rooms</td>
<td>Adjacent living rooms, separate occupancy Bathrooms, separate occupancy Bathrooms, same occupancy Kitchen areas, separate occupancy Mechanical equipment rooms Exterior of building</td>
<td>STC 48-55* STC 50-57* STC 45-52* STC 48-55* STC 58-65* STC 37-60+†</td>
</tr>
<tr>
<td>Private, single family residences</td>
<td>Bedrooms (living rooms similar)</td>
<td>Adjacent bedrooms Living rooms Bathrooms, not directly connected with bedroom Kitchen areas Exterior of building</td>
<td>STC 40-48* STC 42-50* STC 45-52* STC 45-52* STC 37-60+†</td>
</tr>
<tr>
<td>School buildings</td>
<td>Classrooms</td>
<td>Adjacent classrooms - speech use only Adjacent classrooms - speech and audiovisual use Laboratories Corridor or public areas Kitchen and dining areas Shops Recreational areas Music rooms Mechanical equipment rooms Toilet areas Exterior of building</td>
<td>STC 42 STC 48 STC 48 STC 42 STC 47 STC 52+ STC 52+ STC 55+ STC 47 STC 37-60+†</td>
</tr>
<tr>
<td>Large music or drama areas</td>
<td></td>
<td>Adjacent music or drama rooms Corridor or public areas Practice rooms Shops Recreational areas Laboratories Toilet areas Mechanical equipment rooms Exterior of building</td>
<td>STC 52+ STC 52 STC 52+ STC 52 STC 57 STC 52 STC 52 STC 58-65+ STC 47+†</td>
</tr>
<tr>
<td>Music practice rooms</td>
<td></td>
<td>Adjacent practice rooms Corridors and public areas</td>
<td>STC 52+ STC 52+</td>
</tr>
<tr>
<td>Language laboratories</td>
<td></td>
<td>Same as for theaters, concert halls, auditoriums, etc.</td>
<td></td>
</tr>
<tr>
<td>Counseling offices</td>
<td></td>
<td>Same as for executive offices</td>
<td></td>
</tr>
<tr>
<td>Any occupancy where serious performances are given (requirements may be relaxed for elementary schools or other types of occupancy)</td>
<td>Theaters, concert halls, lecture halls, radio, TV, recording studios</td>
<td>Adjacent similar areas Corridors and public area Recreational areas Mechanical equipment spaces Classrooms Laboratories Shops Toilet areas Exterior of building</td>
<td>Use qualified acoustical consultants to assist in the design of construction details for these critical occupancies†</td>
</tr>
</tbody>
</table>

* Depends on nighttime, exterior background levels and other factors that affect actual location of building. (Grades I, II, and III are discussed in "A Guide to Airborne, Impact and Structure borne Noise Control in Multifamily Dwellings," HUD-TS-24, 1974, pp. 10-9ff.)

† Discretionary – depends on client’s budget, climate, interior planning (closed vs. open), site planning, and other factors. Use qualified acoustical consultants for analysis of high noise outdoor environments such as airport areas, industrial facilities, and highways.

† The STC ratings shown are guidelines only. These situations require, typically, double layer construction with resilient connections between layers or, preferably, structurally independent, “room-within-a-room” constructions. The level of continuous background noise, such as that provided by the HVAC system or an electronic masking system, has a significant impact on the quality of construction selected and must be coordinated with the other design parameters.

Guide Specification for Fiber Glass Acoustical Insulation

Part 1 - General

1.01 Summary
A. Provide glass fiber acoustical insulation as indicated in building plans.

1.02 Materials Provided in Other Sections
These sections are typically cross referenced. Delete sections not included in project manual
A. Section 09250-Gypsum Board
B. Section 09260-Gypsum Board Systems
C. Section 09100-Metal Support Systems

1.03 References
A. ASTM Standards
1. E 90, Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
2. E 413, Rating Sound Insulation
5. E 136, Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

1.04 Submittals
Product Data: Submit manufacturer's product literature, samples and installation instructions for specified insulation.

1.05 Delivery, Storage and Handling
A. Protect insulation from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.
B. Label insulation packages to include material name, production date and/or product code
Delete paragraph below if sections 01600 or 01620 are not included in project manual.
[C. Deliver and store materials under provision of section (01600) (01620).]

1.06 Limitations
A. Do not use unfaced insulation in exposed applications where there is potential for skin contact and irritation.

Part 2 - Products

2.01 Manufacturer
Name of insulation manufacturer

2.02 Material
Specify name of fiber glass insulation.
A. Type: Unfaced glass fiber acoustical insulation complying with ASTM C 665.
C. Surface Burning Characteristics:
   2. Maximum smoke developed: 50 When tested in accordance with ASTM E 84.*
E. Sound Transmission Class of the assembly: STC______
F. Size of the insulation Thickness__ Width__ Length__

2.03 Gypsum Board
A. Refer to Section (09250) (09260) for detailed specifications.
Select appropriate construction
[B. Type: 2-1/2" steel stud.]
[C. Type: 3-5/8" steel stud.]

Part 3 - Execution

3.01 Inspection and Preparation
A. Examine substrates and conditions under which insulation work is to be performed. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified.
B. Obtain installer's written report listing conditions detrimental to performance of work in this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
C. Clean substrates of substances harmful to insulation.

3.02 Installation - General
A. Comply with manufacturer's instructions for particular conditions of installation in each case.
B. Batts may be friction-fit in place until the interior finish is applied. Install batts to fill entire stud cavity. If stud cavity is less than 96" in height, cut lengths to friction-fit against floor and ceiling tracks. Walls with penetrations require that insulation be carefully cut to fit around outlets, junction boxes and other irregularities.
C. Where insulation must extend higher than 8 feet, supplementary support can be provided to hold product in place until the interior finish is applied.

* This standard is used solely to measure and describe the properties of products in response to heat and flame under controlled conditions. These numerical ratings are not intended to reflect hazards presented by this or any other material under actual fire conditions. Values are reported to the nearest fire rating.
Typical Wall Assemblies

Single Wood Stud Walls

STC-38 (Figure 1)

Single 2x4 wood studs, 16" o.c., single layer 1/2" gypsum board each side, one thickness (3/8"-4") fiber glass batt insulation.

Fire rating - NR.

Variation | Construction | Finish* | STC | Fire Rating
---|---|---|---|---
1A | 1/2" GB No insulation | Single | 35 | 1/2 hr.
1B | 5/8" Type X GB No insulation | Single | 34 | 1 hr.
1C | 5/8" Type X GB (3/8"-4") fiber glass batt | Single | 38 (est.) | 1 hr.
1D | Studs 24" o.c. 1/2" Type X GB (3/8"-4") fiber glass batt | Single | 40 (est.) | 1 hr.

STC-40 (Figure 2)

Single 2x4 wood studs, 16" o.c., single layer 1/2" gypsum board one side, double layer other side, one thickness (3/8"-4") fiber glass batt insulation.

Fire rating - NR

Variation | Construction | Finish* | STC | Fire Rating
---|---|---|---|---
2A | 1/2" GB No insulation | Unbal. | 38 | NR
2B | 5/8" Type X GB No insulation | Unbal. | 38 (est.) | 1 hr. (est.)
2C | 5/8" Type X GB (3/8"-4") fiber glass batt | Unbal. | 41 | 1 hr. (est.)

STC-45 (Figure 3)

Single 2x4 wood studs, 16" o.c., double layer 5/8" Type X gypsum board each side, one thickness (3/8"-4") fiber glass batt insulation.

Fire rating - 1 hr.

Variation | Construction | Finish* | STC | Fire Rating
---|---|---|---|---
3A | 5/8" Type X GB No insulation | Balanced | 39 | 1 hr. (est.)
3B | Studs 24" o.c. 5/8" Type X GB No insulation | Balanced | 39 | 1 hr. (est.)

STC-50 (Figure 4)

Single 2x4 wood studs, 16" o.c., with resilient channel, single layer 5/8" Type X gypsum each side, one thickness (3/8"-4") fiber glass batt insulation.

Fire rating - 1 hr.

Variation | Construction | Finish* | STC | Fire Rating
---|---|---|---|---
4A | 1/2" GB No insulation | Single | 39 | NR
4B | 5/8" Type X GB No insulation | Single | 40 | 1 hr.
4C | 5/8" GB (3/8"-4") fiber glass batt | Single | 47 | NR
4D | Studs 24" o.c. 5/8" Type X GB (3/8"-4") fiber glass batt | Single | 52 | 1 hr.

* Single - one wall finish each side  
Unbalanced - one wall finish one side, two wall finishes other side  
Balanced - two wall finishes each side.

Partitions with STC ratings within ±2 points of the listed criteria are acceptable given the anticipated tolerances in repeat tests. In fact, discrepancies between testing labs of ±10 dB on identical configurations are not unusual. (Subjectively, the human ear would consider a ±10 dB change as “non-discernible” at best, which is insignificant.)
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Partitions with STC ratings within 1-2 points of the listed criteria are acceptable given the anticipated tolerances in repeat tests. In fact, discrepancies between testing labs

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>6A</td>
<td>3/8&quot; Type X GB No insulation</td>
<td>Balanced</td>
<td>52</td>
<td>1 hr</td>
</tr>
<tr>
<td>6B</td>
<td>Studds 24&quot; o.c. 3/8&quot; Type X GB (3½”-4”) fiber glass batt</td>
<td>Balanced</td>
<td>57</td>
<td>1 hr (est.)</td>
</tr>
</tbody>
</table>

Typical Wall Assemblies (continued)

**STC-52**

(Figure 5)

Single 2x4 wood studs, 16" o.c., with resilient channel, single layer 3/8" gypsum board one side, double layer other side, one thickness (3½"-4") fiber glass batt insulation.

Fire rating - NR

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>5A</td>
<td>3/8&quot; GB No insulation</td>
<td>Unbal.</td>
<td>44</td>
<td>NR</td>
</tr>
<tr>
<td>5B</td>
<td>5/8&quot; Type X GB No insulation</td>
<td>Unbal.</td>
<td>48 (est.)</td>
<td>1 hr.</td>
</tr>
<tr>
<td>5C</td>
<td>Studds 24&quot; o.c. 5/8&quot; GB (3½”-4”) fiber glass batt</td>
<td>Unbal.</td>
<td>55</td>
<td>NR</td>
</tr>
</tbody>
</table>

**STC-55 (est.)**

(Figure 6)

Single 2x4 wood studs, 16" o.c., with resilient channel, double layer 3/8" Type X gypsum board each side, one thickness (3¾"-4") fiber glass batt insulation.

Fire rating - 1 hr.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>6A</td>
<td>3/8&quot; Type X GB No insulation</td>
<td>Balanced</td>
<td>52</td>
<td>1 hr</td>
</tr>
<tr>
<td>6B</td>
<td>Studds 24&quot; o.c. 3/8&quot; Type X GB (3½”-4”) fiber glass batt</td>
<td>Balanced</td>
<td>57</td>
<td>1 hr (est.)</td>
</tr>
</tbody>
</table>

**Staggered Wood Stud Walls**

**STC-50**

(Figure 7)

Staggered 2x4 wood studs, 16" o.c., 2x6 top and bottom plates, single layer 3/8" Type X gypsum board each side, two thicknesses (2½") fiber glass batt insulation.

Fire rating - 1 hr.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>7A</td>
<td>3/8&quot; GB No insulation</td>
<td>Single</td>
<td>39</td>
<td>NR</td>
</tr>
<tr>
<td>7B</td>
<td>4½&quot; Type X GB No insulation</td>
<td>Single</td>
<td>3</td>
<td>1 hr.</td>
</tr>
<tr>
<td>7C</td>
<td>3/8&quot; GB One thickness of (3½”-4”) fiber glass batt</td>
<td>Single</td>
<td>49</td>
<td>NR</td>
</tr>
<tr>
<td>7D</td>
<td>5/8&quot; Type X GB Two thicknesses of (2½”) fiber glass batt</td>
<td>Single</td>
<td>51 (est.)</td>
<td>1 hr.</td>
</tr>
<tr>
<td>7E</td>
<td>Studds 24&quot; o.c. 5/8&quot; Type X GB One thickness of (3½”-4”) fiber glass batt</td>
<td>Single</td>
<td>52</td>
<td>1 hr (est.)</td>
</tr>
</tbody>
</table>

**STC-53**

(Figure 8)

Staggered 2x4 wood studs, 24" o.c., 2x6 top and bottom plates single layer 3/8" gypsum board one side, double layer other side, one thickness (3¾") fiber glass batt insulation.

Fire rating - NR

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>8A</td>
<td>3/8&quot; GB No insulation</td>
<td>Unbal.</td>
<td>47</td>
<td>NR</td>
</tr>
<tr>
<td>8B</td>
<td>Studds 16&quot; o.c. 3/8&quot; GB (3½”-4”) fiber glass batt</td>
<td>Unbal.</td>
<td>51</td>
<td>NR</td>
</tr>
</tbody>
</table>
Staggered 2x4 wood studs, 24" o.c., double layer 5/8" Type X gypsum board each side, one thickness (3½"-4") fiber glass batt insulation.

Fire rating - 1 hr. (est.)

### Balanced Finish

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>9A</td>
<td>5/8&quot; Type X GB No insulation</td>
<td>Balanced</td>
<td>52</td>
<td>1 hr. (est.)</td>
</tr>
<tr>
<td>9B</td>
<td>Studs 16&quot; o.c. 5/8&quot; Type X GB (3½&quot;-4&quot;) fiber glass batt</td>
<td>Balanced</td>
<td>53</td>
<td>1 hr. (est.)</td>
</tr>
<tr>
<td>9C</td>
<td>Studs 16&quot; o.c. 5/8&quot; Type X GB (3½&quot;-4&quot;) fiber glass batt</td>
<td>Balanced</td>
<td>53</td>
<td>2 hr.</td>
</tr>
</tbody>
</table>

### Unbalanced Finish

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>11A</td>
<td>5/8&quot; GB No insulation</td>
<td>Unbal.</td>
<td>46</td>
<td>NR</td>
</tr>
<tr>
<td>11B</td>
<td>5/8&quot; Type X GB No insulation</td>
<td>Unbal.</td>
<td>52</td>
<td>1 hr.</td>
</tr>
<tr>
<td>11C</td>
<td>5/8&quot; GB One thickness of (3½&quot;-4&quot;) fiber glass batt</td>
<td>Unbal.</td>
<td>56</td>
<td>NR</td>
</tr>
<tr>
<td>11D</td>
<td>Studs 24&quot; o.c. 5/8&quot; GB Two thicknesses of (3½&quot;-4&quot;) fiber glass batt</td>
<td>Unbal.</td>
<td>64</td>
<td>NR</td>
</tr>
</tbody>
</table>

### Double Wood Stud Walls

**STC-57 (est.)**

Double 2x4 wood studs, 16" o.c., single layer 5/8" Type X gypsum board one side, two thicknesses (3½"-4") fiber glass batt insulation.

Fire rating - 1 hr.

### Single Finish

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>10A</td>
<td>5/8&quot; GB No insulation</td>
<td>Single</td>
<td>46</td>
<td>NR</td>
</tr>
<tr>
<td>10B</td>
<td>5/8&quot; Type X GB No insulation</td>
<td>Single</td>
<td>45</td>
<td>1 hr.</td>
</tr>
<tr>
<td>10C</td>
<td>5/8&quot; GB One thickness of (3½&quot;-4&quot;) fiber glass batt</td>
<td>Single</td>
<td>56</td>
<td>NR</td>
</tr>
<tr>
<td>10D</td>
<td>5/8&quot; Type X GB One thickness of (3½&quot;-4&quot;) fiber glass batt</td>
<td>Single</td>
<td>56</td>
<td>1 hr.</td>
</tr>
<tr>
<td>10E</td>
<td>Studs 24&quot; o.c. 5/8&quot; GB One thickness of (3½&quot;-4&quot;) fiber glass batt</td>
<td>Single</td>
<td>56</td>
<td>NR</td>
</tr>
<tr>
<td>10F</td>
<td>Studs 24&quot; o.c. 5/8&quot; GB Two thicknesses of (3½&quot;-4&quot;) fiber glass batt</td>
<td>Single</td>
<td>60</td>
<td>NR</td>
</tr>
</tbody>
</table>

### Balanced Finish

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>12A</td>
<td>1/2&quot; Type X GB No insulation</td>
<td>Balanced</td>
<td>54</td>
<td>1 hr.</td>
</tr>
<tr>
<td>12B</td>
<td>1/2&quot; Type X GB One thickness of (3½&quot;-4&quot;) fiber glass batt</td>
<td>Balanced</td>
<td>64</td>
<td>1 hr.</td>
</tr>
<tr>
<td>12C</td>
<td>Studs 24&quot; o.c. 5/8&quot; GB One thickness of (3½&quot;-4&quot;) fiber glass batt</td>
<td>Balanced</td>
<td>65</td>
<td>NR</td>
</tr>
</tbody>
</table>

*Single - one wall finish each side
Unbalanced - one wall finish one side, two wall finishes other side
Balanced - two wall finishes each side.

Partitions with STC ratings within 12 points of the listed criteria are acceptable given the anticipated tolerances in repeat tests. In fact, discrepancies between testing labs of 12 dB on identical configurations are not unusual. (Subjectively, the human ear would consider a 12 dB change as "non-discernible" at best, which is insignificant.)
Metal Stud Walls

STC-45 (Figure 13)

2\(\frac{1}{2}\)" metal studs (25 gauge), 24" o.c., single layer \(\frac{1}{8}\)" gypsum board each side, one thickness (2\(\frac{1}{8}\)-2\(\frac{3}{16}\)) fiber glass batt insulation.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>13A</td>
<td>(\frac{3}{8})&quot; GB No insulation</td>
<td>Single</td>
<td>36</td>
<td>NR</td>
</tr>
<tr>
<td>13B</td>
<td>(\frac{5}{8})&quot; Type X GB No insulation</td>
<td>Single</td>
<td>39</td>
<td>1 hr.</td>
</tr>
<tr>
<td>13C</td>
<td>(\frac{5}{8})&quot; Type X GB (2(\frac{1}{8})-2(\frac{3}{16})) fiber glass batt</td>
<td>Single</td>
<td>47</td>
<td>1 hr.</td>
</tr>
</tbody>
</table>

STC-50 (Figure 14)

2\(\frac{1}{2}\)" metal studs (25 gauge), 24" o.c., single layer \(\frac{1}{8}\)" gypsum board each side, double layer other side, one thickness (2\(\frac{1}{8}\)-2\(\frac{3}{16}\)) fiber glass batt insulation.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>14A</td>
<td>(\frac{3}{8})&quot; GB No insulation</td>
<td>Unbal.</td>
<td>39</td>
<td>NR</td>
</tr>
<tr>
<td>14B</td>
<td>(\frac{5}{8})&quot; Type X GB No insulation</td>
<td>Unbal.</td>
<td>44</td>
<td>1 hr.</td>
</tr>
<tr>
<td>14C</td>
<td>(\frac{5}{8})&quot; Type X GB (2(\frac{1}{8})-2(\frac{3}{16})) fiber glass batt</td>
<td>Unbal.</td>
<td>52</td>
<td>1 hr.</td>
</tr>
</tbody>
</table>

STC-47 (Figure 16)

3\(\frac{1}{4}\)" metal studs (25 gauge), 24" o.c., single layer \(\frac{3}{8}\)" Type X gypsum board each side, one thickness (3\(\frac{3}{4}\)-4") fiber glass batt insulation.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>16A</td>
<td>(\frac{3}{8})&quot; GB No insulation</td>
<td>Single</td>
<td>39</td>
<td>NR</td>
</tr>
<tr>
<td>16B</td>
<td>(\frac{5}{8})&quot; Type X GB No insulation</td>
<td>Single</td>
<td>39</td>
<td>1 hr.</td>
</tr>
<tr>
<td>16C</td>
<td>(\frac{5}{8})&quot; Type X GB (3(\frac{3}{4})-4&quot;) fiber glass batt</td>
<td>Single</td>
<td>50</td>
<td>1 hr.</td>
</tr>
</tbody>
</table>

* Single – one wall finish each side
Unbalanced – one wall finish one side, two wall finishes other side
Balanced – two wall finishes each side

Partitions with STC ratings within 1-2 points of the listed criteria are acceptable given the anticipated tolerances in repeat tests. In fact, discrepancies between testing labs of 1-2 dB on identical configurations are not unusual. (Subjectively, the human ear would consider a 1-2 dB change as "non-discernible" at best, which is insignificant).
**Typical Wall Assemblies (continued)**

**STC-52**
(Figure 17)

3\frac{3}{8}'' metal studs (25 gauge), 24'' o.c., single layer \(\frac{3}{8}''\) gypsum board one side, double layer other side, one thickness (3\frac{3}{8}''-4'') fiber glass batt insulation.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>17A</td>
<td>(\frac{1}{2}'') GB</td>
<td>No insulation</td>
<td>Unbal.</td>
<td>42</td>
</tr>
<tr>
<td>17B</td>
<td>(\frac{5}{8}'') Type X GB</td>
<td>No insulation</td>
<td>Unbal.</td>
<td>47</td>
</tr>
<tr>
<td>17C</td>
<td>(\frac{5}{8}'') Type X GB</td>
<td>(3\frac{3}{8}''-4'') fiber glass batt</td>
<td>Unbal.</td>
<td>55</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STC-56</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Figure 18)</td>
</tr>
</tbody>
</table>

3\frac{3}{8}'' metal studs (25 gauge), 24'' o.c., double layer \(\frac{3}{8}''\) Type X gypsum board each side, one thickness (3\frac{3}{8}''-4'') fiber glass batt insulation.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>Finish*</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>18A</td>
<td>(\frac{1}{2}'') Type X GB</td>
<td>No insulation</td>
<td>Balanced</td>
<td>50</td>
</tr>
<tr>
<td>18B</td>
<td>(\frac{5}{8}'') Type X GB</td>
<td>No insulation</td>
<td>Balanced</td>
<td>52</td>
</tr>
<tr>
<td>18C</td>
<td>(\frac{5}{8}'') Type X GB</td>
<td>(3\frac{3}{8}''-4'') fiber glass batt</td>
<td>Balanced</td>
<td>58</td>
</tr>
</tbody>
</table>

**STC-47**
(Figure 19)

Exterior frame wall, \(\frac{3}{8}''\)x10'' redwood siding \(\frac{1}{2}''\) sheathing, 2x4 studs, 16'' o.c., resilient channel, \(\frac{1}{2}''\) gypsum board, one thickness (3\frac{3}{8}''-4'') fiber glass batt insulation.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>19A</td>
<td>No insulation</td>
<td>43</td>
<td>NR</td>
</tr>
<tr>
<td>19B</td>
<td>No resilient channel</td>
<td>(3\frac{3}{8}''-4'') fiber glass batt</td>
<td>39</td>
</tr>
<tr>
<td>19C</td>
<td>No resilient channel</td>
<td>No insulation</td>
<td>37</td>
</tr>
</tbody>
</table>

**STC-57**
(Figure 20)

Exterior \(\frac{1}{2}''\) stucco, 1'' woven mesh and no.15 felt paper and, 2x4 studs, 16'' o.c., resilient channel, \(\frac{1}{2}''\) gypsum board, one thickness (3\frac{3}{8}''-4'') fiber glass batt insulation.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>20A</td>
<td>No insulation</td>
<td>49</td>
<td>NR</td>
</tr>
<tr>
<td>20B</td>
<td>No resilient channel</td>
<td>(3\frac{3}{8}''-4'') fiber glass batt</td>
<td>46</td>
</tr>
</tbody>
</table>

* Single – one wall finish each side  
Unbalanced – one wall finish one side, two wall finishes other side  
Balanced – two wall finishes each side.

Partitions with STC ratings within 12 points of the listed criteria are acceptable given the anticipated tolerances in repeat tests. In fact, discrepancies between testing labs of 12 dB on identical configurations are not unusual. (Subjectively, the human ear would consider a 12 dB change as ‘‘non-discernible’’ at best, which is insignificant.)
**Typical Wall Assemblies (continued)**

**STC-58 (Figure 21)**

Exterior brick veneer, ½” air space, ½” insulative sheathing, 2x4 studs, 16” o.c., resilient channel, ½” gypsum board, one thickness (3½’’- 4”) fiber glass batt insulation.

Fire Rating - NR

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>21A</td>
<td>No insulation</td>
<td>54</td>
<td>NR</td>
</tr>
<tr>
<td>21B</td>
<td>No resilient channel</td>
<td>56</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td>(3½”-4”) fiber glass batt</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STC-40 (Figure 22)**

Exterior 7⁄16”x10” hardwood lap siding, 7⁄16” foil faced foam sheathing, 2x4 studs, 16” o.c., ½” gypsum board, one thickness (3½”- 4”) fiber glass batt insulation.

Fire Rating - NR

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>22A</td>
<td>No insulation</td>
<td>36</td>
<td>NR</td>
</tr>
</tbody>
</table>

**STC-39 (Figure 23)**

Exterior ¾”x10” hardwood lap siding, ¾” foil faced foam sheathing, 2x6 studs, 16” o.c., ½” gypsum board, one thickness (5½”) fiber glass batt insulation.

Fire Rating - NR

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>23A</td>
<td>No insulation</td>
<td>38</td>
<td>NR</td>
</tr>
<tr>
<td>23B</td>
<td>With resilient channel</td>
<td>45</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td>(5½”) fiber glass batt</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Single - one wall finish each side  
Unbalanced - one wall finish one side, two wall finishes other side  
Balanced - two wall finishes each side

Partitions with STC ratings within 1-2 points of the listed criteria are acceptable given the anticipated tolerances in repeat tests. In fact, discrepancies between testing labs of 1-2 dB on identical configurations are not unusual. Subjectively, the human ear would consider a 1-2 dB change as “non-discernible” at best, which is insignificant.
### Wood Floor
Carpet and pad, ½" particle board, ⅛" plywood subfloor, 2x10 joists 16" o.c., one thickness (3½"- 4") fiber glass batt insulation, resilient channel, ½" Type X gypsum board.

Fire Rating - 1 hr.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>IIC</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>25A</td>
<td>No resilient channel</td>
<td>60</td>
<td>42</td>
<td>NR</td>
</tr>
<tr>
<td>25B</td>
<td>¼&quot; plywood floor</td>
<td>72</td>
<td>50</td>
<td>NR</td>
</tr>
<tr>
<td>25C</td>
<td>Vinyl floor instead of carpet and pad</td>
<td>49</td>
<td>50</td>
<td>NR</td>
</tr>
</tbody>
</table>

### Steel Joist Floor
Carpet and pad, ¾" T&G plywood subwood subfloor, steel joists (7¼", 18 ga.) 24" o.c., one thickness (3½"- 4") fiber glass batt insulation, resilient channel, ½" gypsum board.

Fire Rating - NR

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>IIC</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>27A</td>
<td>No resilient channel</td>
<td>57</td>
<td>43</td>
<td>NR</td>
</tr>
</tbody>
</table>

### Concrete Floor
Carpet and pad, ⅛" lightweight concrete floor, ⅛" plywood subfloor, 2x10 joists 16" o.c., one thickness (3½"- 4") fiber glass batt insulation, resilient channel, ½" Type X gypsum board.

Fire Rating - 1 hr. est.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>IIC</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>26A</td>
<td>No resilient channel</td>
<td>59</td>
<td>47</td>
<td>NR</td>
</tr>
<tr>
<td>26B</td>
<td>2x8 joists, 1½&quot; lightweight concrete floor</td>
<td>74</td>
<td>53</td>
<td>NR</td>
</tr>
<tr>
<td>26C</td>
<td>2x8 joists, Vinyl floor instead of carpet and pad</td>
<td>47</td>
<td>50</td>
<td>NR</td>
</tr>
</tbody>
</table>

### Plywood Floor
Carpet and pad, ⅛" plywood floor, 2" x 3" furring, ⅛" sound deadening board, ⅛" plywood subfloor, 2x8 wood joists, one thickness (3½"- 4") fiber glass batt insulation, ½" Type X gypsum board.

Fire Rating - NR

<table>
<thead>
<tr>
<th>Variation</th>
<th>Construction</th>
<th>IIC</th>
<th>STC</th>
<th>Fire Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>28A</td>
<td>With vinyl floor instead of carpet and pad</td>
<td>49</td>
<td>52</td>
<td>NR</td>
</tr>
</tbody>
</table>

---

*Single - one wall finish each side  Unbalanced - one wall finish one side, two wall finishes other side  Balanced - two wall finishes each side.*

Partitions with STC ratings within 1-2 points of the listed criteria are acceptable given the anticipated tolerances in repeat tests. In fact, discrepancies between testing labs of 1-2 dB on identical configurations are not unusual. (Subjectively, the human ear would consider a 1-2 dB change as “non-discernible” at best, which is insignificant.)

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14
Recommended Construction Methods for Controlling Sound

Doors
- Stagger doors across hallways and use gasketing.
- Avoid sliding doors in areas where sound control is desired.
- Use doors of solid wood or insulated cores wherever privacy is an important consideration; hollow-core doors will not be as effective.

Windows
- Minimize the size of windows facing noisy areas.
- Separate windows to reduce cross-talk.
- Arrange casement windows so sound is not reflected into adjoining units.
- Make sure movable windows close tightly and are weather-stripped.
- Use thick glass, insulating glass or storm windows to help reduce sound transmission through windows.

Wiring
- Wire each apartment as a unit; avoid penetration of walls or floors between apartments.
- Caulk holes (made by wiring) that penetrate connecting structures; use elastic, non-hardening caulk or dry packing.
- Connect vibrating equipment with flexible wiring.
Electrical Outlets

- Cut holes neatly to reduce leaks.
- Make sure outlets are airtight by using elastic, non-hardening caulk before installing the plates.
- Don’t install electrical outlets back to back.

Ceiling Fixtures

- Surface mount any ceiling fixtures on resiliently mounted gypsum ceilings.
- Make sure openings around boxes are sealed air tight.
- Don’t use recessed or “hi-hat” type fixtures without boxing in the fixture.

Electrical Distribution Panels

- Install these panels on interior walls within apartments and never on corridor or party walls.
**Plumbing**

- Design pipe runs with swing arms so expansion and contraction can occur without binding, thus eliminating noise.
- Isolate piping from structures with resilient pads and sleeves, then seal for air tightness.
- Develop a well-planned layout to minimize the noise of flowing water.
- Use oversized pipes and reduced pressures to slow the speed of flowing water and reduce noise.
- Provide air chambers to eliminate water hammer due to abrupt stopping of flowing water.
- Use quiet-action water closets that are isolated from the structure on a floating floor.
- Caulk all openings made in walls, floors and framing for supply and drain lines.

**Appliances and Air Conditioners**

- Select quiet, high-quality appliances.
- Use adequately-sized water piping and valves to minimize whistling.
- Select quiet air conditioners with balanced fans and motors.
- Select quiet external ballast on fluorescent fixtures.

**Phones and Other Noise-Making Equipment**

- Install phones, doorbells, intercoms, etc., on interior walls only – never on party walls or corridor walls.
Insulated Duct Systems

- Use performed fiber glass ducts or fiber glass duct liners to quiet fan noise and the sounds of air rushing through the ducts.

See chart below for an acoustical comparison between uninsulated (bare) ducts and various types of insulated ducts. For more information on insulated duct systems contact NAIMA and request a copy of publication number: AH121, A Guide to Insulated Duct Systems.

<table>
<thead>
<tr>
<th>Description</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bare Sheet Metal</td>
<td>.1</td>
<td>.1</td>
<td>.1</td>
<td>.1</td>
<td>.1</td>
<td>.1</td>
</tr>
<tr>
<td>Wrapped Sheet Metal</td>
<td>.2</td>
<td>.2</td>
<td>.2</td>
<td>.2</td>
<td>.2</td>
<td>.2</td>
</tr>
<tr>
<td>Lined Sheet Metal (1&quot; thick)</td>
<td>.3</td>
<td>.7</td>
<td>1.9</td>
<td>5.3</td>
<td>4.8</td>
<td>2.3</td>
</tr>
<tr>
<td>Fiber Glass Air Duct (1&quot; thick)</td>
<td>.4</td>
<td>1.4</td>
<td>3.3</td>
<td>3.9</td>
<td>5.0</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Duct Noise Attenuation Loss (dB/Lf)

2. ASHRAE HVAC Systems & Applications Handbook, 1987, Ch. 52

Medicine Cabinets

- Separate or surface mount medicine cabinets or install mirrors on party walls with medicine cabinets on interior partitions.

DO - Stagger

DO - Surface Mounting

Avoid recessed, back-to-back mounting of cabinets in party walls

DON’T
Equipment Noise

- Locate heating and cooling equipment far from bedrooms.
- Inquire about equipment noise levels before buying and insist on quiet units.
- Isolate equipment in rooms with a door to the outside or use a gasketed, solid-core door when access is from building interior.
- Mount equipment so as to keep vibrations from entering surrounding structures.
- Construct partitions separating living units from equipment rooms with an STC of 50 or better.

Wall Bases

- Install plates on sill sealers; run wall finish to floor where possible and caulk airtight on both sides.

Cracks in Floor

- Seal all cracks in the subfloor airtight with caulkimg.
Absorption The ability of a material to absorb rather than reflect sound waves striking it by converting sound energy to heat energy within the material.

Acoustics The science of sound, including its production, transmission and effects.

Airborne Sound Sound, produced by vibrating sources that radiate sound directly into the air, which is transmitted through air as a medium rather than through solids or the structure of the building.

Background Noise Normal sound always present in a space created either by outdoor sounds such as street traffic or indoor sounds such as ventilating noise, appliances, etc.

Decibel Logarithmic unit expressing the ratio between a given sound being measured and a reference point.

Discontinuous Construction Any of several construction methods, such as the use of staggered studs, double walls, or resilient mounting of surfaces, used to break the continuous paths through which sound may be transmitted.

Flanking Paths A wall or floor/ceiling construction that permits sound to be transmitted along its surface; or any opening which permits the direct transmission of sound through the air.

Frequency The number of complete cycles of a vibration performed in one second, measured in cycles per second (cps) and expressed in Hertz (Hz).

Hertz (Hz) A unit of frequency of a periodic process equal to one cycle per second.

Impact Insulation Class (IIC) A single number rating developed by the Federal Housing Administration to estimate the impact sound isolation performance of floor/ceiling systems.

Noise Unwanted sound.

Noise Reduction Reducing the level of unwanted sound by any of several means of acoustical treatment.

Noise Reduction Coefficient A single number index of the noise reducing efficiency of acoustical materials. It is found by averaging the sound absorption coefficients at 250, 500, 1000 and 2000 cps.

Sound A vibration in any elastic medium within the frequency range capable of producing the sensation of hearing.

Sound Attenuation Reduction of the energy or intensity of sound.

Sound Transmission The passage of sound through a material construction or other medium. Airborne Sound Transmission: Sound transmitted when a surface is set into vibration by the alternating air pressures of incident sound waves.

Sound Transmission Class (STC) A single number rating for evaluating efficiency of constructions in isolating airborne sound transmission. The higher the STC rating the more efficient the construction.

Transmission Loss The decrease or attenuation in sound energy (expressed in decibels) of airborne sound as it passes through a building construction.
Bibliography

**CertainTeed Corp.** Fire Resistance and Sound Control Guide. Available from CertainTeed Corp. P.O. Box 860, Valley Forge, Pennsylvania 19482.

**Knauf Fiber Glass.** The Sound Solution. Available from Knauf Fiber Glass, One Knauf Drive, Shelbyville, Indiana 46176.


**Office of Noise Control, California Department of Health Services.** Catalog of STC and IIC Ratings for Wall and Floor/Ceiling Assemblies, 2151 Berkeley Way, Berkeley, California 94704.


**Johns Manville.** Sound Control. Available from Johns Manville, PO Box 5108, Denver, Colorado 80217.


ABOUT NAIMA
NAIMA is a trade association of North American manufacturers of fiber glass, rock wool, and slag wool insulation products. NAIMA's role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation products and to encourage safe production and use of these insulation products.

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