Specified Technologies Inc.

Restoring STC
Through Proper Firestopping

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Introduction

- Standards used to measure sound
- What is sound?
- Direct vs. Indirect sound transmission
- Measurements units of sound
- Sound Transmission Class
- Privacy STC levels
- Smoke and Sound
- Construction Practices to Improve STC
- Firestopping and STC

Measuring the noise

- Over 1000 ASTM standards related to sound
- 53 ASTM standards relevant to Building and Environmental Acoustics
- Include test methods, specifications, practices, guides, and classifications for application techniques.

Designation: E90 – 09 (Reapproved 2016)

Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements[1]

This standard is issued under the fixed designation E90; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

INTRODUCTION

This test method is part of a set for evaluating the sound-insulating properties of building elements. It is designed to measure the transmission of sound through a partition or partition element in a laboratory. Others in the set cover the measurement of sound isolation in buildings (Test Method E336), the laboratory measurement of impact sound transmission through floors (Test Method E492), the measurement of impact sound transmission in buildings (Test Method E1007), the measurement of sound transmission through building facades and facade elements (Guide E966), the measurement of sound transmission through a common plenum between two rooms (Test Method E1414), a quick method for the determination of airborne sound isolation in multiunit buildings (Practice E597), and the measurement of sound transmission through door panels and systems (Test Method E1425).

1. Scope

1.1 This test method covers the laboratory measurement of airborne sound transmission loss of building partitions such as walls of all kinds, operable partitions, floor-ceiling assemblies, doors, windows, roofs, panels, and other space-dividing elements.

1.2 Laboratories are designed so the test specimen constitutes the primary sound transmission path between the two test rooms and so approximately diffuse sound fields exist in the rooms.

1.3 *Laboratory Accreditation*—The requirements for accrediting a laboratory for performing this test method are given in Annex A4.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
C634 Terminology Relating to Building and Environmental Acoustics
E336 Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings
E413 Classification for Rating Sound Insulation
E492 Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine
E966 Guide for Field Measurements of Airborne Sound Attenuation of Building Facades and Facade Elements
E1007 Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures
E1111 Test Method for Measuring the Interzone Attenuation of Open Office Components
E1289 Specification for Reference Specimen for Sound Transmission Loss
E1332 Classification for Rating Outdoor-Indoor Sound Attenuation

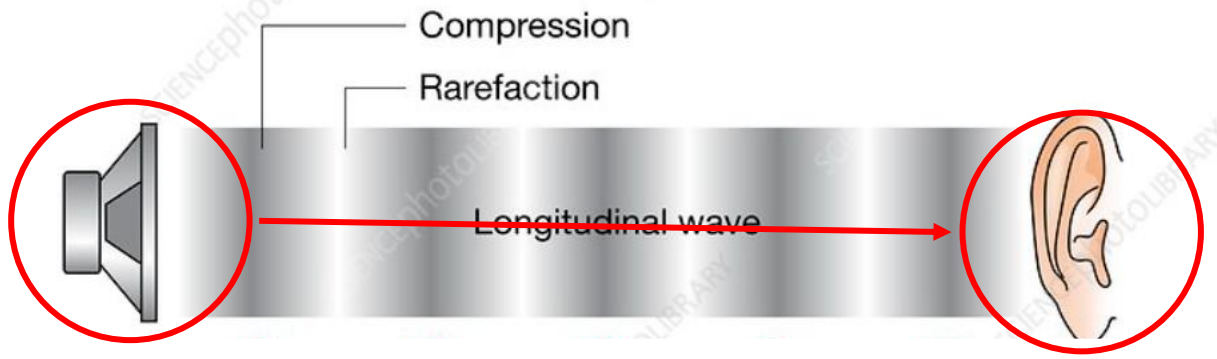
[1] This test method is under the jurisdiction of ASTM Committee E33 on Building and Environmental Acoustics and is the direct responsibility of Subcommittee E33.03 on Sound Transmission.

Current edition approved Dec. 1, 2016. Published January 2017. Originally approved in 1955. Last previous edition approved in 2009 as E90 – 09. DOI: 10.1520/E0090-09R16.

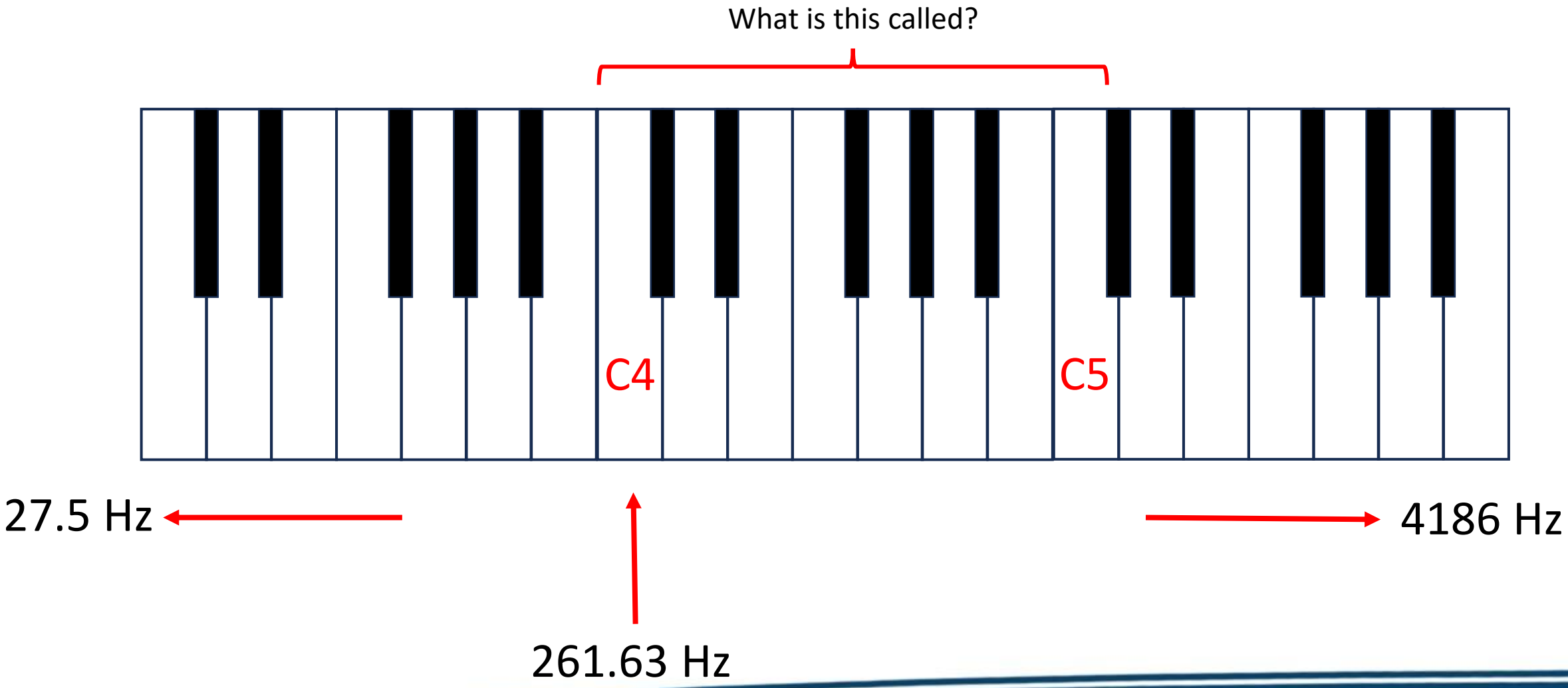
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

What is sound?

- A series of pressure pulses that travel as a wave through a medium.
- It has an amplitude (dB)
- It has frequency (Hz)
- Vibrating source creates the pulse waves.
- It registers at a hearing device (microphone or ear)

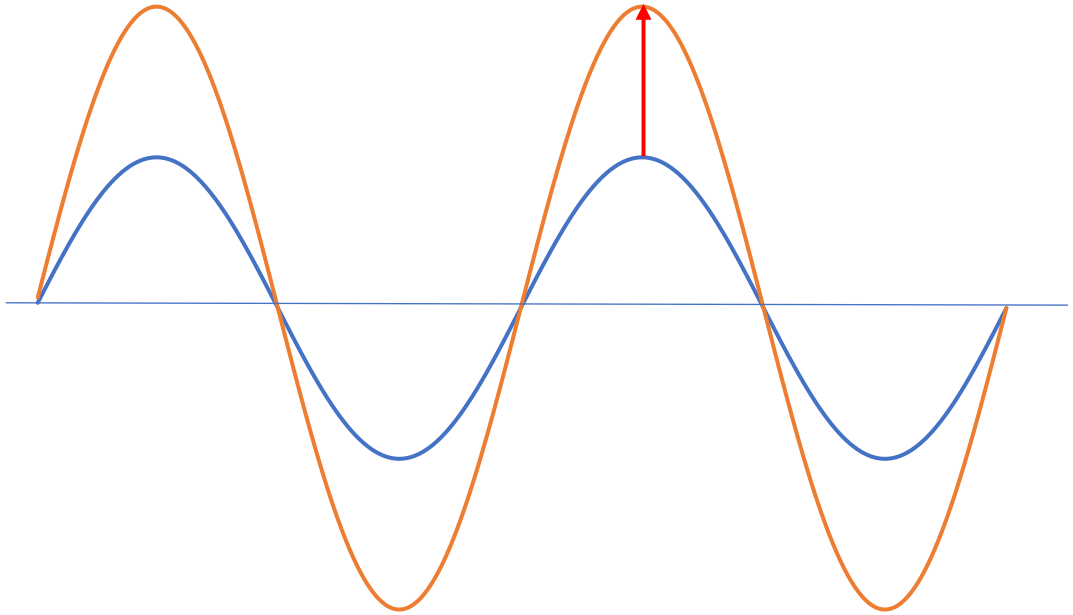


Amplitude vs. Frequency – Practical Example

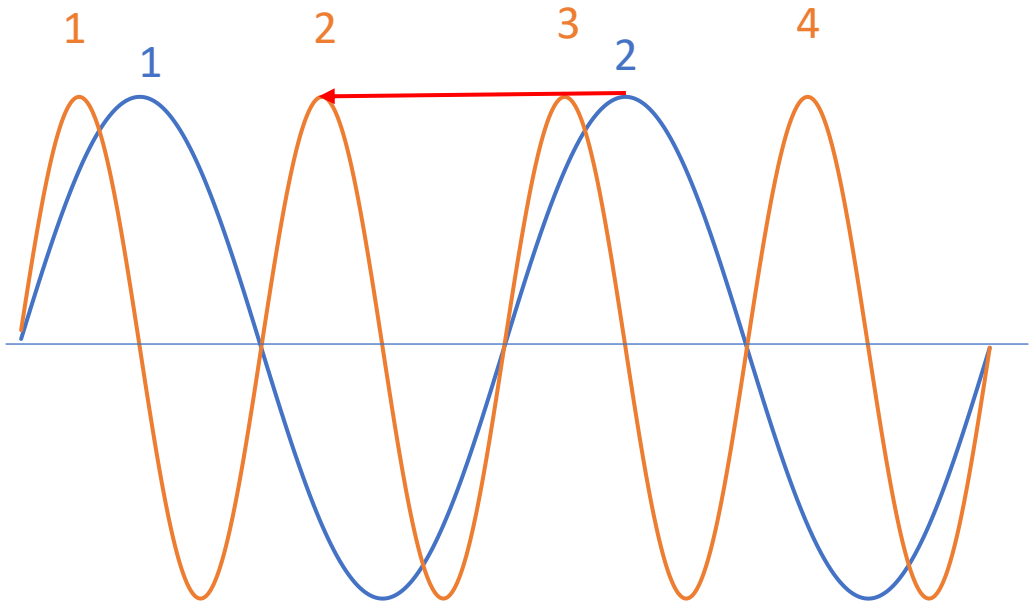


Amplitude and Frequency

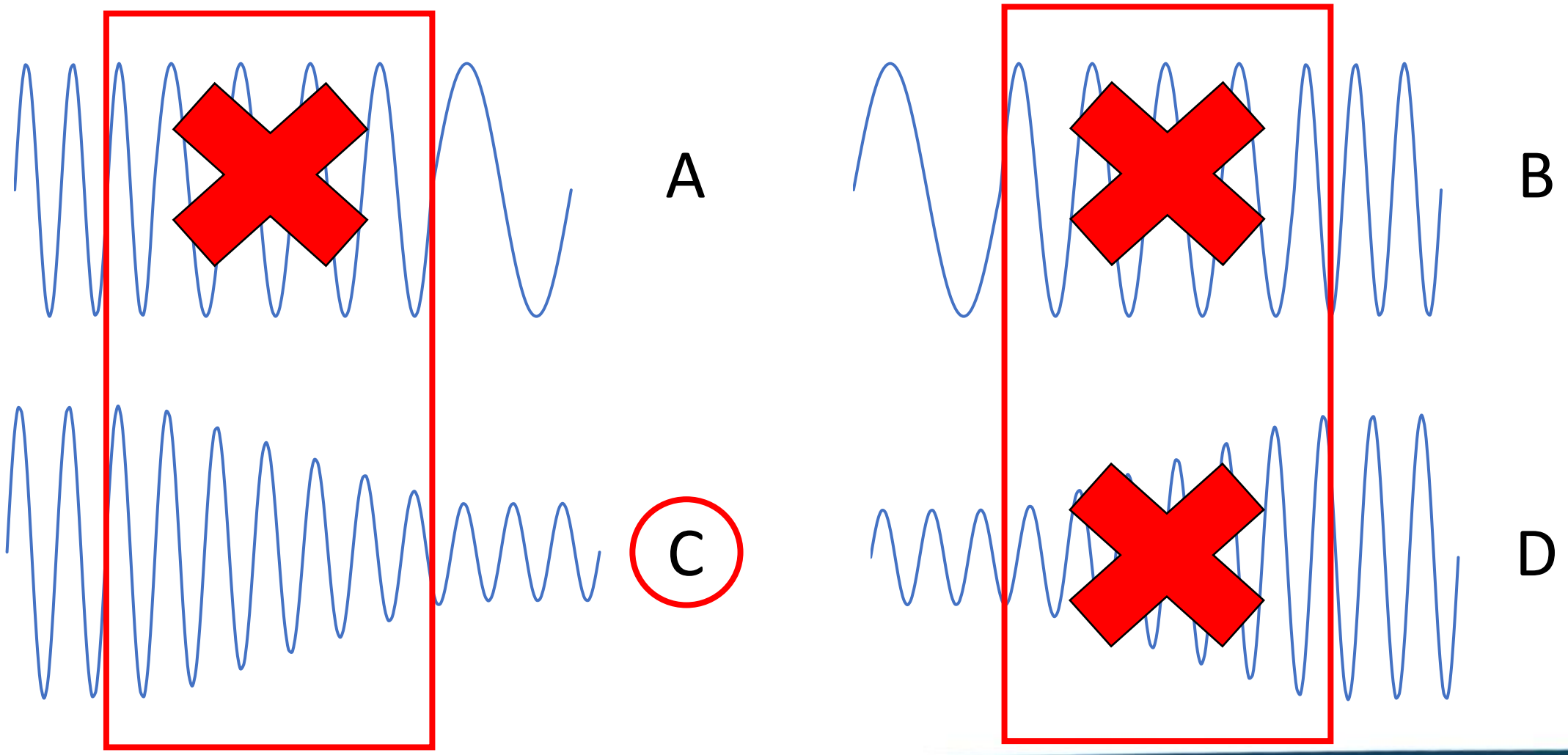
Ampitude and Volume



Frequency and Pitch

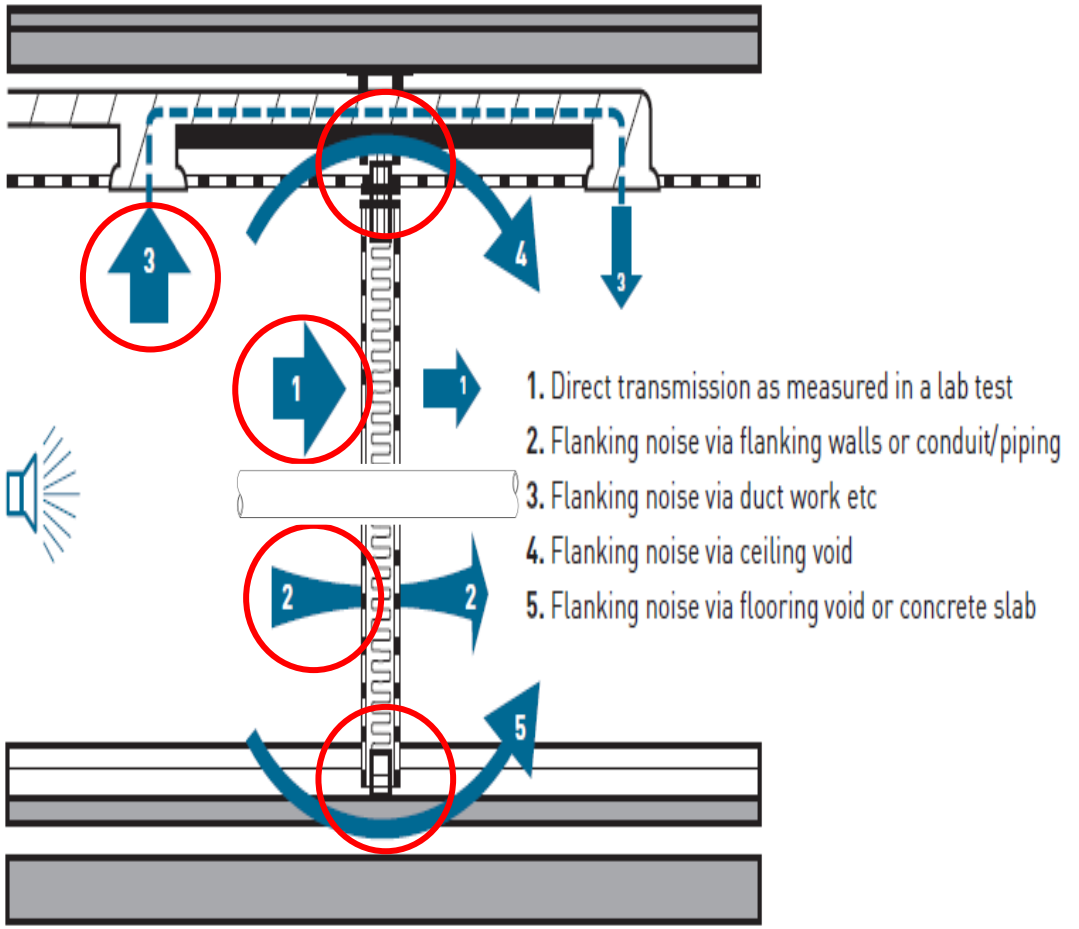


A little quiz

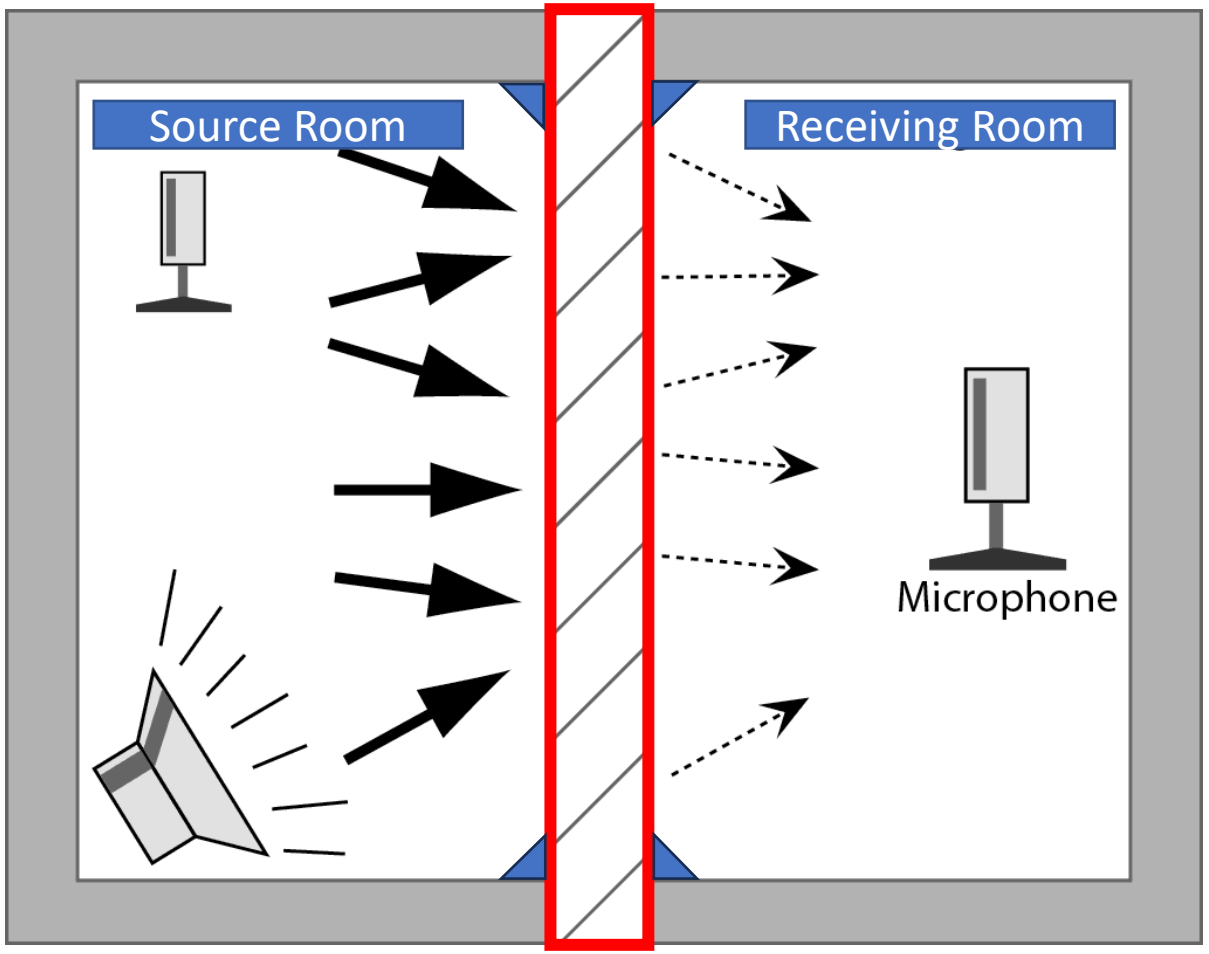


Direct path vs Indirect path

- Two types of sound transmission
- Direct Path – Enters an adjacent room directly through a wall.
- Indirect Path – Also called flanking path, enters an adjacent room through peripheral means that are usually connected in some way but are independent of the primary barrier.
  - Structural
  - Non Structural



Sound Transmission Coefficient (STC) Ratings



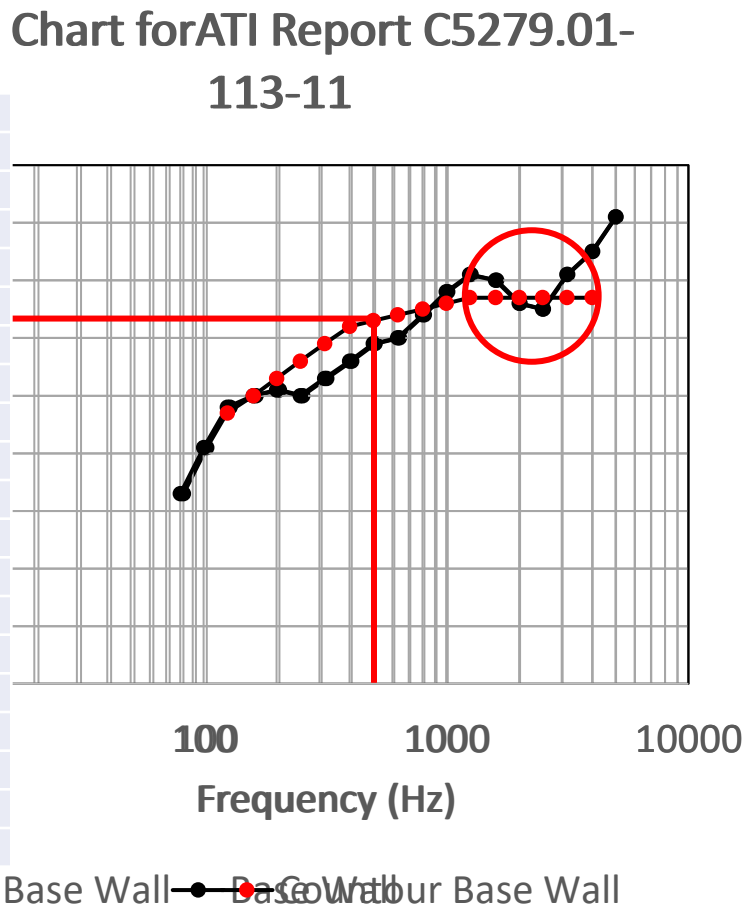
What is Pink Noise?

- White and Pink noise are a multitude of frequencies within a range that are played simultaneously.
- White noise is designed so the energy level is the same at every frequency.
- Pink noise is designed so the energy level across each octave is the same.
- An octave is a range within the sound spectrum that is doubled in frequency.
- Pink noise is said to have calming effects, similar to a rainstorm.
- Pink noise represents the sound energy most close to that of human perception.

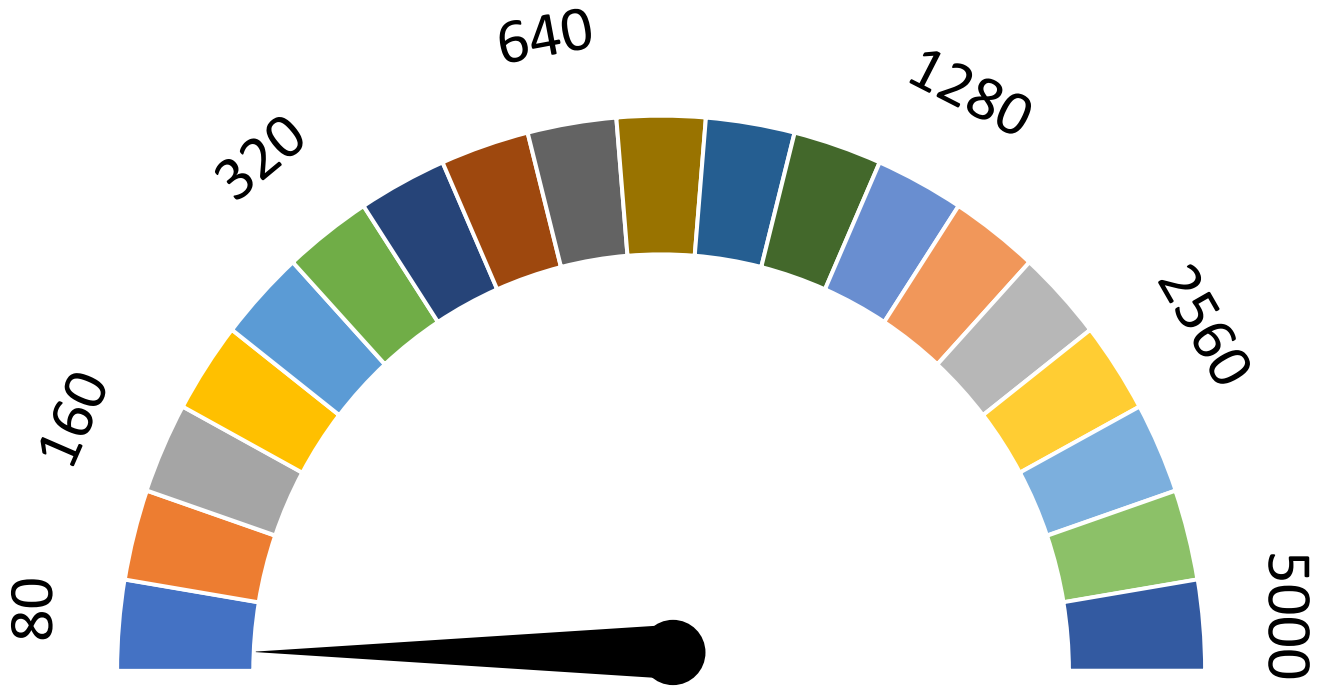
The testing path to an STC

- Begins with testing for Sound Transmission Loss E90
- Each incremental f evaluated as a cha source to the recei
- Data is converted t E413
- Can be field tested Normalized Noise (NNIC) using ASTM E336

Impact Insulation Class	IIC
Noise Isolation Class	NIC
Noise Reduction Coefficient	NRC
Normalized Noise Isolation Class	NNIC
Sound Absorption Average	SAA
Sound Transmission Class	STC
Absorption Normalized High Frequency Impact Rating	AHIR
Apparent Impact Insulation Class	AIIC
Apparent Outdoor-Indoor Transmission Class	AOITC
Apparent Sound Transmission Class	ASTC
Ceiling Attenuation Class	CAC
Door Transmission Class	DTC
Field Outdoor-Indoor Transmission Class	FOITC
High Frequency Impact Rating Class	HIIC
High Frequency Impact Rating	HIIR
Impact Sound Rating	ISR
Normalized Impact Sound Rating	NISR
Normalized Noise Isolation Class	NNIC
Outdoor-Indoor Noise Isolation Class	OINIC
Outdoor-Indoor Transmission Class	OITC

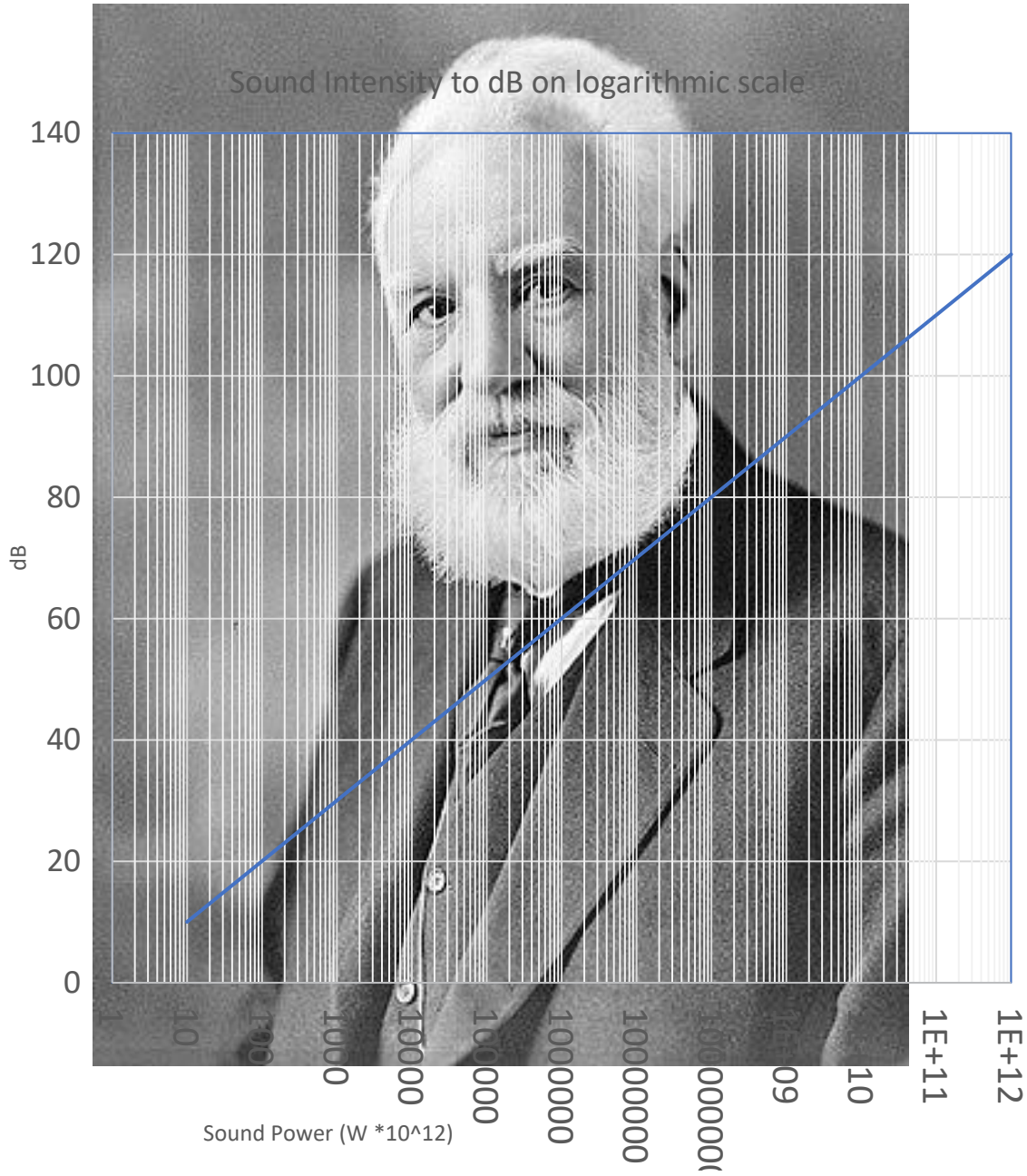


Frequency Intervals of Testing



Sound Power Levels of Various Sources (Peterson and Gross, 1974)

POWER (Watts)	POWER LEVEL (dB re 10^{-12} Watts)	SOURCE
25 to 40 Million	195	Saturn Rocket
100,000	170	Ram Jet
		Turbo Jet Engine with Afterburner
10,000	160	Turbo Jet Engine, 7000-lb Thrust
1,000	150	4-Propeller Aircraft
100	140	
10	130	75-Piece Orchestra } Peak RMS Levels in 1/8 Second Intervals
		Pipe Organ
		Small Aircraft Engine
1	120	Large Chipping Hammer
0	110	Blaring Radio
		Centrifugal Ventillating Fan (13,000 CFM)
0.1	100	Auto on Highway
0.01	90	Vane Axial Ventillating Fan (1500 CFM)
0.001	80	Voice - Shouting (Average Long-Time RMS)
0.000,01	70	Voice - Conversational Level (Average Long-Time RMS)
0.000,001	60	
0.000,000,1	50	
0.000,000,01	40	
0.000,000,001	30	Voice - Very Soft Whisper



What is a Decibel (dB)

- Loudness vs. Sound Power
- Five types of dB – the difference is the weighting.
  - dB-A – most common
  - dB-B
  - dB-C
  - dB-D
  - dB-Z
- For human hearing response, dB-A is used.

dB Rise	Result in Sensitivity
3	Noticeable Rise
5	Highly Noticeable
10	About twice as loud, not 10X

NOISE LEVELS

Decibels (dB)

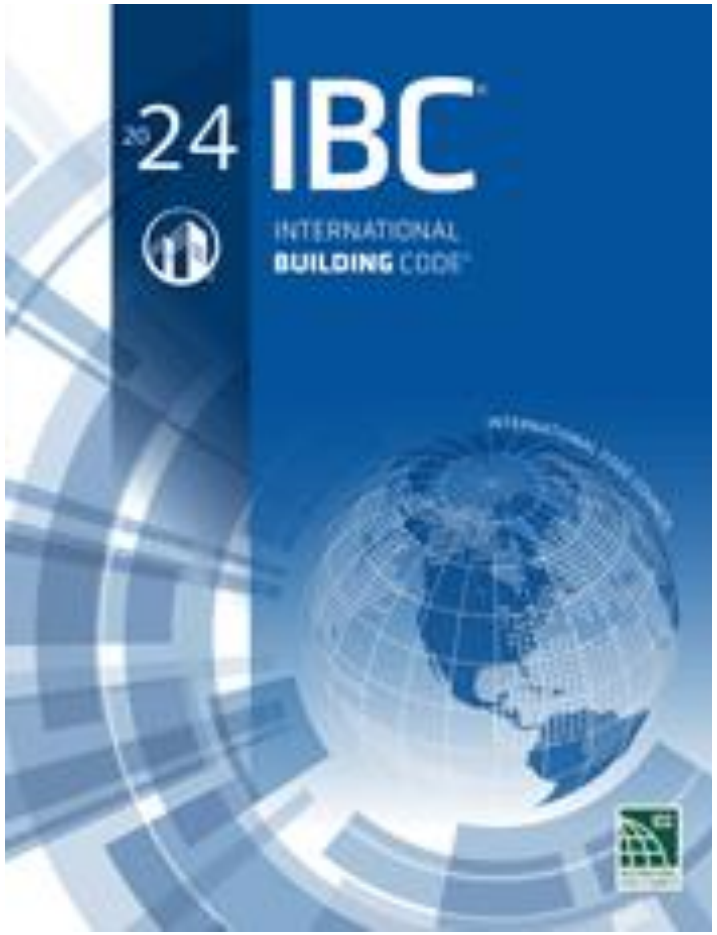
Gunshot

135

140

Jet engine
rom 100
ards

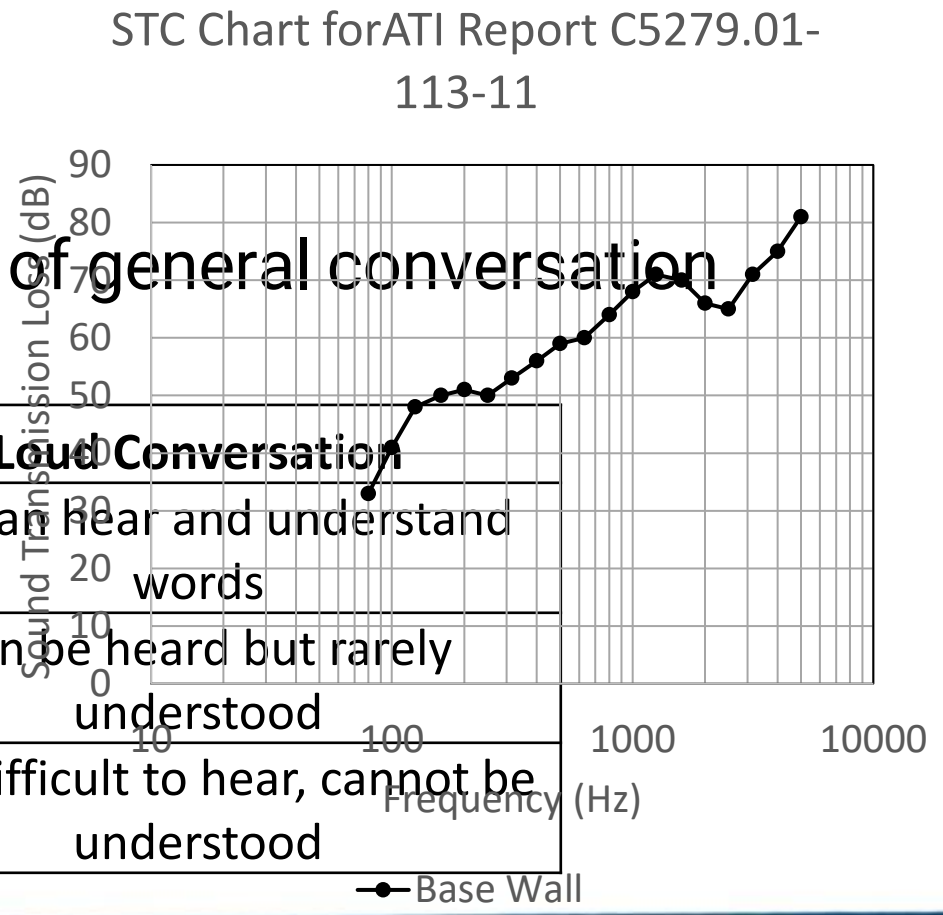
STC Requirements in Code



- Chapter 12 of the IBC
- Section 1206
- ICC A117.1 for Enhanced Classroom Acoustics
- Guidelines and Specifications

STC values for privacy

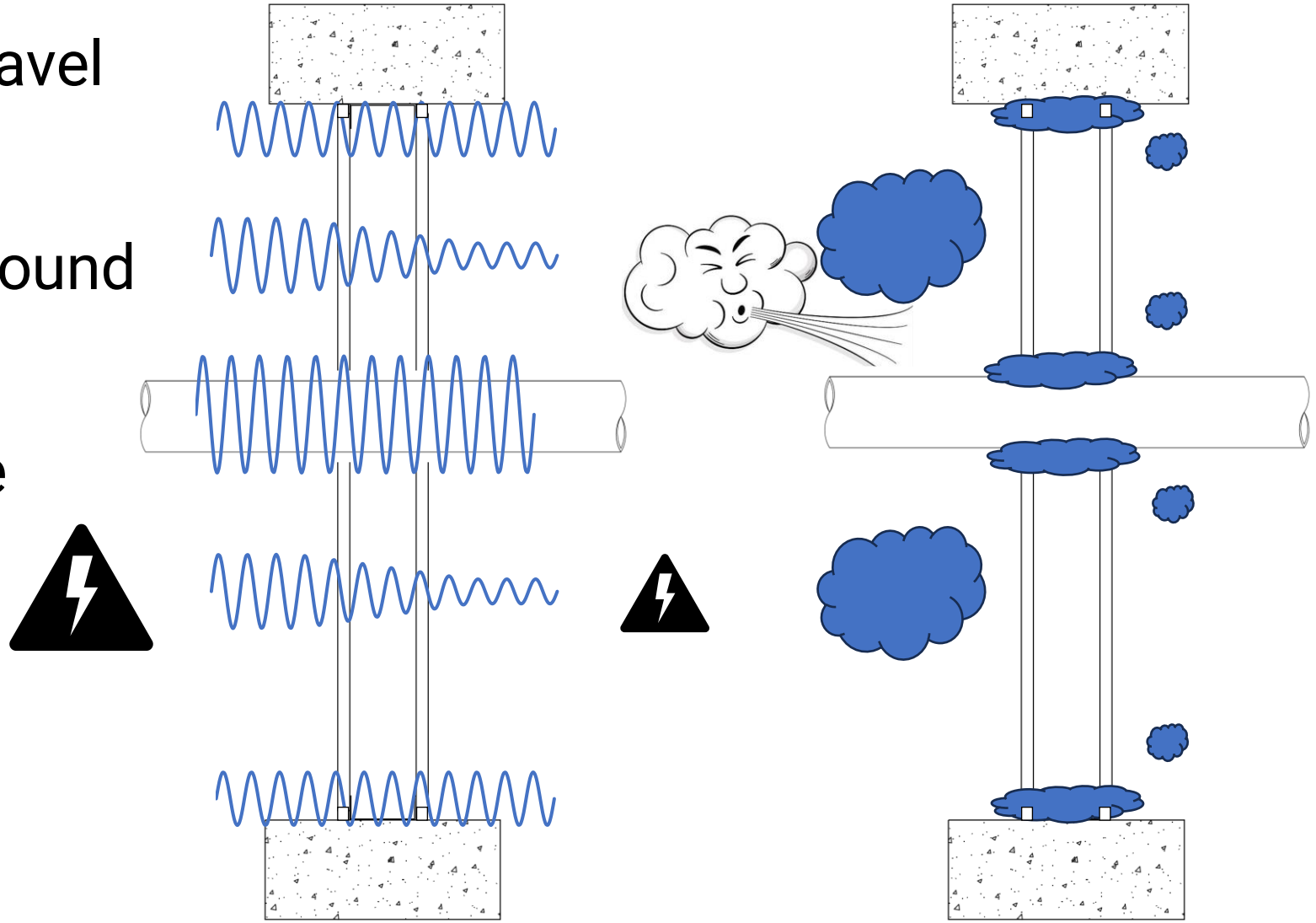
- STC roughly relates to reduction in decibels, but it is more complicated than that.
- General conversation is about 60 dB
- Privacy levels begin around STC 40
- STC 40 wall will reduce the sound intensity of general conversation roughly 60-40 or to about 20 dB



STC	General Conversation	Loud Conversation
40	Heard but not understood	You can hear and understand words
45	Virtually cannot be heard	Can be heard but rarely understood
50	Not heard	very difficult to hear, cannot be understood

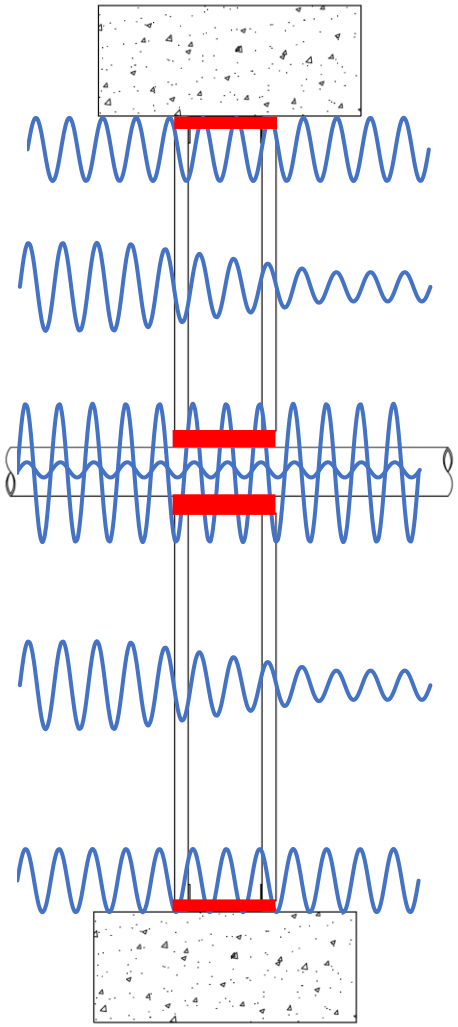
Where there is smoke there is sound

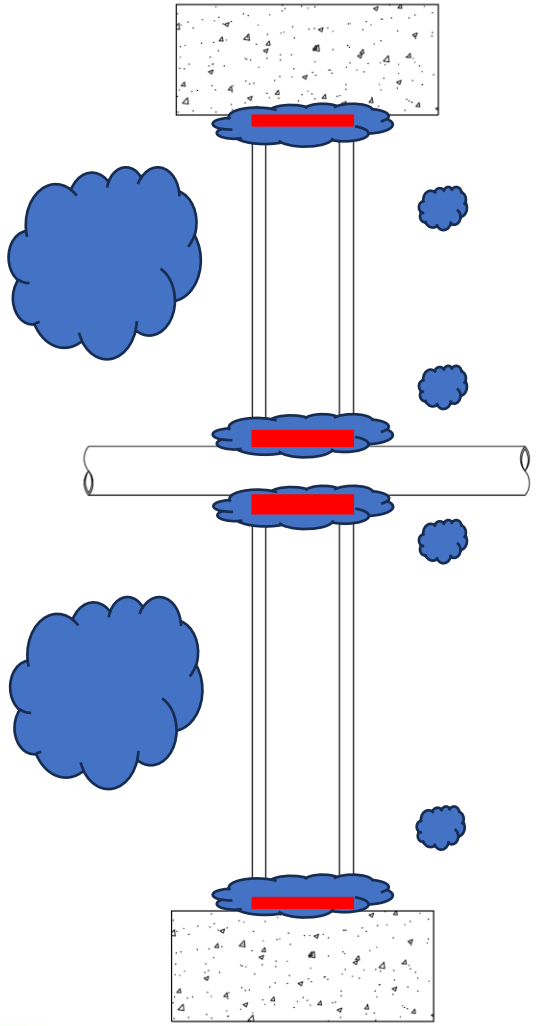
- Smoke and sound travel freely in air.
- Continuous wall is effective to reduce sound wave amplitude
- Continuous wall is effective as a smoke barrier
- Discontinuities
  - Joints
  - Penetrations



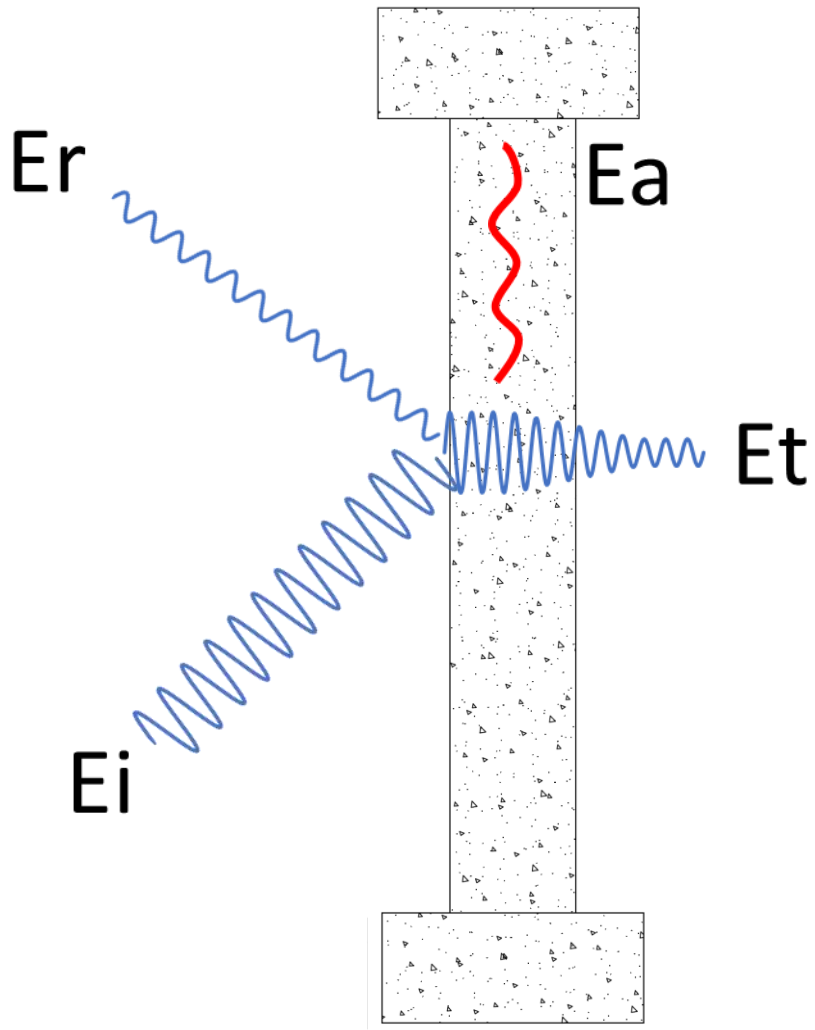
The affect of firestop on Smoke and Sound

- When you stop air, you stop smoke and sound
- Proper firestopping will stop the free transfer of sound and will absorb sound energy
- Some flanking can occur with penetrations.
- And we all know proper firestopping stops smoke





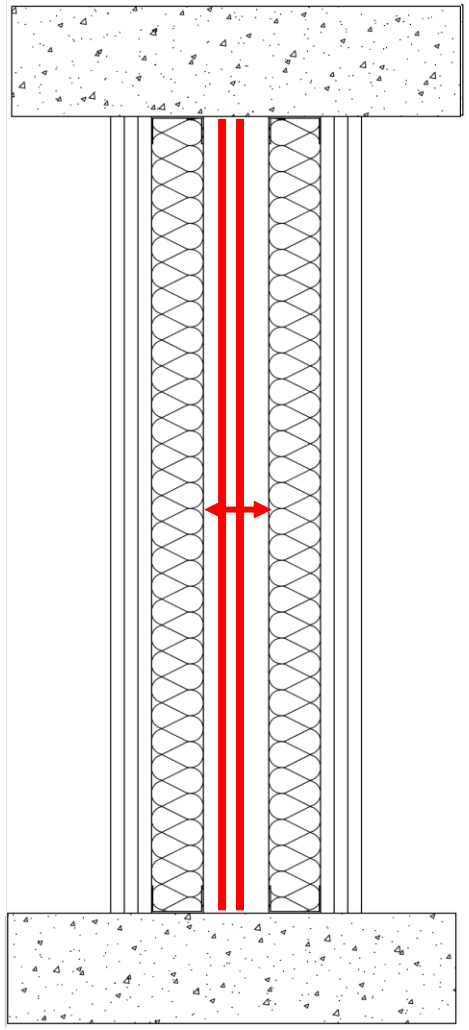
Energy Balance



- Energy is always balanced
- Total or Incident Energy
- = Energy Reflected
- + Energy Transmitted
- + Absorbed or Transformed Energy
- Mass walls

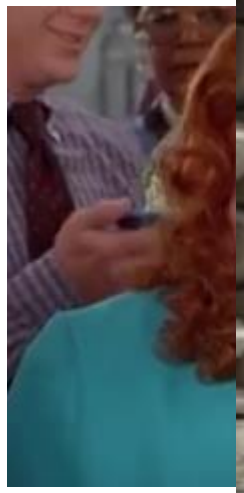
Construction Practices to Improve STC

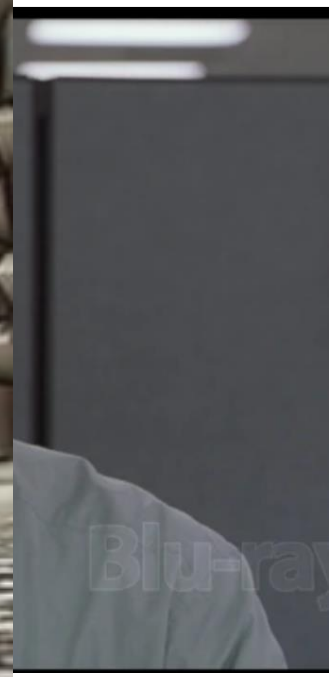
- About 35 – 39 STC - single
- About 45 – 50 STC - insulated
- About 50 – 55 STC - layered
- About 55 – 60 STC – divided
- About 60 – 65 STC – divided insulated
- About 65 – 70 STC – narrowed and divided with layers
- 70+ STC – narrowed, divided, insulated, layered



Other ways to improve STC

- Sound





Other ways to improve STC

- Resilient Channels
- Materials that trap air in cavity spaces or on surfaces.
- Sound attenuating underlayments
- Absorbing materials in rooms, such as furniture, wall hangings, and rugs.
- Acoustical ceiling panels
- Sound attenuating gypsum panels

:hat improve STC

Classified by
Underwriters Laboratories, Inc.
to ASTM/UL1479 (ASTM E814)

System No. F-A-2246

F Ratings - 2 and 3 Hr (See Item 3)

T Ratings - 0, 1/4, 1, 1-1/4, 1-1/2 and 3 Hr (See Item 3)

L Rating At Ambient - Less Than 1 CFM/sq ft (See Items 3, 4 and 6)

Galaxy S22 Ultra

Galaxy S22 Ultra

In Firestop Device Deck Adapter

Conclusions

- Build right, using all the proper materials ar
  specified in the design.
  - Use the proper screw spacing
  - Use the same gauge of framing as tested.
  - It is better to build to the design than to use ma
- Lighter framing helps STC, but hurts fire-re
- Once built, make sure all openings are seal
- If the barrier is fire-rated, use firestop mate
- If the barrier is not fire rated, use materials
  and sound
- Consider what might contribute to flanking
  steps to mitigate
- There is no sound barrier that will perform
  parts of the system work together.