DESIGNING FOR SOUND

Design Considerations:

1. Group noisy equipment together in the same area.
2. Choose equipment that generates less noise.
3. Consider enclosing the noisy equipment with partitions.
4. Consider the properties of the sound and the acoustical properties of the area.
5. Locate offices away from the noisy area.
6. Choose an area that is isolated and protected.
7. Design the office with doors and windows that are facing away from the noise source.
8. Design the office with matching sound deadening components.
9. Place closets or storerooms, etc. on the wall closest to the noise source.
10. It is usually less expensive to avoid noise problems than to correct them.

Examples of Sound Levels in Decibels

Decibels (db)	Sensory Response	Type of Sound
0	None	Threshold of Hearing
10	Very Faint	Whisper
30	Faint	Background Noise
50	Moderate	Private Conversation
70	Loud	Television
90	Very Loud	Concert Band
120	Pain	Jet Exhaust
180	Loss of hearing	Rocket Engine

Perceptions of Increases in Decibel Level

Increase in Sound Level	Perception of Change
1 dB	Imperceptible Change
3 dB	Barely Perceptible Change
5 dB	Clearly Noticeable Change
10 dB	About twice as loud
20 dB	About four times as loud

OSHA Regulations:

Manufacturing plants with noise levels above 90 decibels are required by OSHA to minimize the working time in those areas and to provide ear protection. Installing sound controlled rooms will maximize the productive time in an area.

OSHA Section 1910.95 – Occupational Noise Exposure

Permissible Noise Exposures

Allowed Work Shift	Decibel Level
8 Hour Work Shift	90 dB
6 Hours	92 dB
4 Hours	95 dB
3 Hours	97 dB
2 Hours	100 dB
1.5 Hours	102 dB
1 Hour	105 dB
30 minutes	110 dB
15 Minutes	115 dB

Sound Definitions:

Absorption - The properties of a material composition to reduce the amount of sound energy that can be reflected.

Acoustical - The properties of a material to absorb or reflect sound acoustically.

Ambient Noise - Ambient noise encompasses all sound present in a given environment.

Attenuation - The reduction or lessening of sound energy.

Decibel (dB) - A unit used to express relative difference in power or intensity, usually between two acoustic signals.

Frequency - The number of oscillations or cycles per unit of time. Acoustical frequency is usually expressed in units of Hertz (Hz) where one Hz is equal to one cycle per second.

Hearing Range
16 – 2000 Hz (Speech Intelligibility)
600 – 4800 Hz (Speech Privacy)
250 – 2500 Hz (Typical small table radio)

Loudness - A listener's auditory impression of the strength of a sound.

Mass - Mass is the fundamental property of a material relevant to sound transmission loss through that material. Generally, the more massive the material, the greater the sound transmission loss.

Noise - Unwanted sound that is annoying or interferes with listening. Not all noise needs to be excessively loud to represent an annoyance or interference.

Noise Isolation Class (NIC) - A single number rating of the degree of speech privacy achieved through the use of an Acoustical Ceiling and sound absorbing screens in an open office. NIC has been replaced by the Articulation Class (AC) rating method.

Noise Reduction (NR) - The amount of noise that is reduced through the introduction of sound absorbing materials. Most good absorbers are lightweight, porous, open-celled materials such as insulation, fabrics, and carpet. The level (in decibels) of sound reduced on a logarithmic basis.

Noise Reduction Coefficient (NRC) - The NRC of an acoustical material is the percentage of what sound waves that come in contact with the acoustical material are absorbed by the material and NOT reflected back within the room.

Sound Absorption Coefficient - The fraction of energy striking a material or object that is not reflected. For instance, if a material reflects70% of the sound energy incident upon its surface, then its Sound Absorption Coefficient would be 0.30.

Sound Level Meter - A device that converts sound pressure variations in air into corresponding electronic signals. The signals are filtered to exclude signals outside frequencies desired.

Sound Transmission – Involves the passage of sound through walls, doors, ceilings, and is the most frequent problem faced in designing a building system. In general, the prevention fo sound transmission requires heavy, dense materials such as steel and gypsum board.

Sound Transmission Class (STC) – A measure for the effectiveness in blocking sound transmission measured in terms on "decibels reduced". This is a rating for doors, windows, enclosures, noise barriers, partitions and other acoustical products. The rating is in terms of their relative ability to provide privacy against intrusion of speech sounds. This is a one number rating system, heavily weighted in the 500Hz to 2000Hz frequency range where speech largely occurs.

General Sound Isolation Criteria

Location	Use	Minimum STC
Light Duty Warehouse (70 dB)	Executive Offices 50 dB	20
	Normal Offices 55 dB	15
	General Offices 60 dB	10
	Shop Offices 65 dB	5
Light Manufacturing (80 dB)	Executive Offices	30
	Normal Offices	25
	General Offices	20
	Shop Offices	15
Medium Manufacturing (90 dB)	Executive Offices	40
	Normal Offices	35
	General Offices	30
	Shop Offices	25
Heavy Manufacturing (100 db)	Executive Offices	50
	Normal Offices	45
	General Offices	40
	Shop Offices	35

STC Value of Standard Components

Material	STC
1/4" Tempered Glass	27
7/16" Insulated Glass	32
Hollow Core Door	25
Solid Core Door	35
Roof Deck with Mineral Tile Ceiling	35
¼" Plywood	22
.024 Aluminum	19
24 Guage Steel	26

Note:
Most tests of STC ratings are made in laboratories which generally do not duplicate field conditions. Many tests are of the wall panel only and do not include doors, windows, HVAC units, etc. which are the weakest parts of the system.
Although it's very difficult to be exact with any acoustical situation, a general rule of thumb is that noise reduction will only be as good as the weakest component in the system. A fully insulated wall panel will not be efficient without comparable doors, ceiling materials, windows, etc. Any opening in the wall or poor fit of the wall components will substantially reduce the wall's acoustical performance. Think of noise like water. It will leak into the building through any opening.

TYPICAL SOUND TRANSMISSION CHARACTERISTICS