



Environmental Noise Due to Fans and Equipment

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Scott Arnold

Content Manager, AMCA International

Webinar Moderator

- Joined AMCA in 2017
- Leads development and publication of technical articles, white papers and educational materials.
- Editor-in-chief of the award-winning AMCA *inmotion* magazine.



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John Sofra

Member, AMCA Acoustic Attenuation Engineering Committee

- Over 32 years of experience including acoustics division manager for a sheet metal duct and fitting manufacturer.
- Currently the North America market manager for the Airflow Attenuation, Industrial and Environmental markets.
- Actively involved in several AMCA committees including: Acoustic Attenuation Engineering, Louver Engineering and North American Region Marketing.



Environmental Noise Due to Fans and Equipment

Purpose and Learning Objectives

The purpose of this presentation is to review the need for engineered controls to address environmental, “outdoor” sound propagation as it affects neighboring communities.

At the end of this presentation you will be able to:

1. Identify the characteristics of, and need for, a well written noise ordinance.
2. Explain why the sound spectrum and spectrum shape of a noise source is important, not all noise is the same.
3. Describe the factors affecting an outdoor sound propagation path.
4. Compare the different products used for controlling noise in an outdoor setting.

Controlling Outdoor Fan Noise—Items to Consider

Outdoor noise has become an important concern in our communities. Areas zoned for industrial, commercial and residential use are moving closer and closer to one another. This proximity results in noise complaints from neighbors. Many communities, which have never dealt with environmental noise issues until now, are addressing the problem with clear, fair and obtainable noise ordinances. Consequently, the need to educate others about environmental noise control products and solutions is increasing. Engineers and suppliers of fans, rooftop units (RTUs), outdoor air handling units (OAHUs), air-cooled chillers and cooling towers must show concern for the noise their products generate and its adverse effect on the surrounding community.

FACTORS TO CONSIDER

All equipment incorporating fans makes noise. Ventilation silencers, noise control barrier walls and enclosures all reduce equipment noise. In order to implement a cost-effective noise control solution, engineers must review information concerning the source (sound levels of the noise-producing equipment), path (the propagation of sound from the equipment, with common factors such as distance, atmospheric conditions, wind direction, natural barriers, elevation changes and surrounding structures), and the receiver (listener).

Building owners must remember that the cost for fixing a noise problem usually exceeds the cost of proper planning at the beginning of a project. Where communities set forth noise ordinances, owners must reduce noise levels per fan. In some cases, equipment will be shut down until it meets the ordinance sound level.

Fans, RTUs, OAHUs, air-cooled chillers and cooling towers may not be designed to operate under the adverse effects of being enclosed or in close proximity to a structure or barrier, and the effects of noise control products on performance must be considered. A successful solution controls noise and allows equipment to operate as intended. That solution accounts for the equipment manufacturer's warranty, local codes, equipment ventilation requirements, noise ordinances, location of equipment with respect to critical areas, equipment dimensions, maintenance access and structural issues such as mounting, supports, wind loading, seismic restraints, concrete footings, tie-ins, etc.).

BY JOHN SOPRA,
V.P. MARKETING MANAGER
AMCA FAN CORP.

FAN NOISE

Fan noise is often the most predominant noise source of mechanical equipment. It consists of a combination of fan inlet, discharge, motor drive train and casing-radiated noise. Many environmental noise issues stem from exhaust fans installed on grade or on the roof of commercial and industrial buildings. Typically, the fan intake is ducted, with the fan discharging to atmosphere. The environmental noise in this application is a function of the noise propagating from the fan discharge and radiating from the fan casing and drive. *Over-sized* fans operating under their optimal design speed and flow and *undersized* fans operating above their optimal design speed and flow will create increased noise levels. Sometimes adjusting a fan to run close to its design flow and pressure will help solve noise issues, requiring less noise control products. Often, a fan discharge silencer is all that is needed. However, sometimes an engineer may use a combination of silencer, noise control barrier wall and/or full enclosure. In extreme cases, an entirely different fan (which is quieter and more efficient) is chosen, along with noise control products.

Noise arises when engineers select fans while having little or no information concerning the actual installation site (source, path and receiver). Is the fan installed on grade, roof or wall? Is the fan oriented with horizontal or vertical discharge? Is the unit installed in an open field or close to a structure? Are there multiple noise sources in close proximity? What noise levels are allowed and is what distance with respect to the noise source? Bid specifications often state solely 85 dBA at 5'-0" — on what is this based? Proper acoustic design accounts for the answers to these questions, achieving the system acoustic levels upfront instead of reacting remedial action to accommodate for unfavorable noise levels.

ACOUSTIC ANALYSIS

Consultants must consider specific acoustic factors when performing environmental acoustic analysis. These factors are a function of the source, path and receiver relationship with each other.

Fan Sound Power Levels (L_w) A proper acoustic analysis begins with accurate fan sound power levels, measured in decibels (dB). Fan sound-power-level-estimating algorithms, though available, do not account for the development of new fan and

drive types and are often outdated. Engineers should avoid use of such algorithms. Fan sound power levels reported per the appropriate AMCA standard(s) can serve as engineers' basis of their environmental acoustic analysis. An overall A-weighted, single combined number noise level (abbreviated dBA) has been filtered to better match the human perception of noise. Communities use dBA for setting noise ordinances, and OSHA considers this noise level when creating its standards for sound exposure. A single, A-weighted (i.e., 100 dBA) sound power level is not sufficient to perform an acoustic analysis. Engineers must obtain discharge, intake and casing-radiated sound power levels per eight-octave bands: 63 hertz (Hz), 125 Hz, 250 Hz, 500 Hz, 1K Hz, 2K Hz, 4K Hz, 8K Hz, 16K Hz. The octave band sound power level data reveals the very important sound spectrum shape (low, mid, high frequency profile).

Power Split If only total fan sound power level (TFL) data is available, the engineer can estimate fan discharge and intake fan sound power levels while assuming an equal power split. Sound is logarithmic, not linear. The combination of two sound levels at a specific frequency of 100 decibels and 100 decibels yields 110 decibels, not 200 decibels. Assuming the intake and discharge fan sound power levels are like noise sources, an engineer can work backwards from total fan sound power level and subtract three decibels to yield estimated fan discharge and intake fan sound power level per frequency.

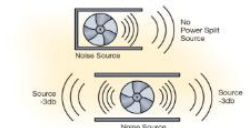


Figure 1. Estimated sound power levels for fan discharge and intake. Images courtesy of Acoustic Noise Forum.

End Reflection Fans are typically connected to either a horizontal discharge duct or vertical stack. When there is a significant change of area at this termination, some low-frequency acoustical energy reflects into the opening due to the change in acoustical impedance of the air stream. This situation occurs when an opening discharges sound directly into a large space with a rapid reduction in noise-reflecting surfaces (the atmosphere), a phenomenon called end reflection. End reflection is more significant a factor for small openings than large openings.

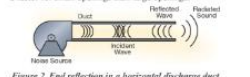


Figure 2. End reflection in a horizontal discharge duct.

Directivity When sound emits from a horizontal discharge duct or vertical stack to atmosphere, prevalence is one direction, thus characteristic is called directivity. Noise directly in the front of an opening is louder than it is to the sides. The point directly in front of the opening is referenced as 0°, typical side measurement positions are at 45°, 60°, 90° or 135° from the centerline of the opening. The frequency of sound (wavelength), the cross-sectional area and the shape of the opening influence the directivity effect.

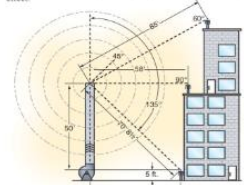


Figure 3. Orientation of noise source opening to receptors.

Divergence Divergence of sound, a term used to describe sound waves spreading from a source, is affected by the surrounding structures. Divergence is described as spherical and hemispherical radiation from two reflective surfaces and radiation from three reflective surfaces. The surfaces can be surrounding buildings, silencers, rooftop surfaces and surrounding equipment. Engineers must account accordingly for nearby hard surface (reflective) structures, which magnify noise.

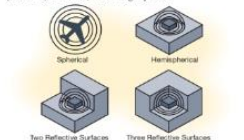


Figure 4. Different configurations of reflective surfaces result in different patterns of sound divergence.

Acoustic Treatment The proper noise control solution depends on the frequencies in which the predominant noise levels exist. A noise source can generate low, mid, high, or some combination of low to mid or mid to high frequency. Sometimes noise can be

noise-specific to only one frequency. Acoustic treatments presented can be used to tackle noise in the specific frequency ranges.

Ventilation Silencers Engineers can place ventilation silencers, consisting of outer casing and internal sound-absorbing baffles, upstream and/or downstream of the fan intake or discharge. Manufacturers produce silencers in a variety of configurations, such as rectangular, round, straight, elbow and transitional. Most rectangular silencers use internal baffles or, as they are called in round silencers, baffles. The acoustical performance of silencers is described in terms of insertion loss (I.L.). I.L. is a measure of the noise level reduction when a silencer is installed upstream/downstream of a fan compared to the noise level without the silencer.

Silencer-based noise reduction does not come without a cost. By design, baffles and baffle-type silencers block a portion of the airflow. This produces pressure loss and generates noise. Silencer baffles/baffles reduce the local cross-sectional area of the airstream and increase the velocity in the air passage between them. This causes an additional pressure drop that must be added to the pressure drop of the section in which the silencer is located. If the generated noise level (GNL) (otherwise described as noise caused by airflow through the silencer) at any frequency comes within 10 decibels of the attenuated fan sound power level after subtracting the silencer insertion loss, the engineer must add, logarithmically, the GNL to the attenuated fan sound power level. This will determine the actual sound power immediately upstream/downstream of the silencer. Engineers should base their silencer selection on attenuation requirements. Altering the silencer percent open area and/or baffle shapes, widths, lengths, thicknesses and spacing will tune a silencer to attenuate low, mid or high frequency noise or a combination of all of these. Silencer data should always include values for insertion loss, regenerated noise and pressure drop.

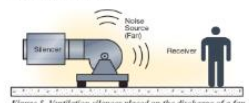


Figure 5. Ventilation silencer placed on the discharge of a fan.

Sound Barrier Wall and Enclosure Systems Sound barrier walls are suitable for controlling fan-causing radiated noise when an average 12-15 dBA noise reduction is required. Sometimes placing a sound barrier wall on a roof with receiver on grade can achieve even greater noise reduction. Walls are best constructed of materials of proper density and construction to both block and absorb noise. Factory-fabricated, double-wall modular acoustic wall panels or mass-loaded composite sound curtains offer these characteristics. Concrete, although a good sound blocker, has little sound absorptive qualities and redirects noise via reflection, causing noise issues elsewhere. Light-gauge

corrugated metal sheathing walls, although good at blocking sight, are also not suitable for noise control, they are of a low density, and noise travels easily through low density material. When incorporating a double-wall panel acoustic barrier wall system, equipment maintenance access is important, as is allowing enough clearance between barrier wall and fan unit to control recirculation of air.

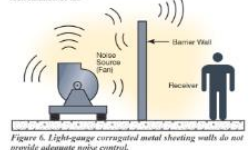


Figure 6. Light-gauge corrugated metal sheathing walls do not provide adequate noise control.

Sound enclosures are suitable when controlling fan-causing radiated noise if an average 25-35 dBA noise reduction is required. Engineers can achieve greater noise reduction using special designs. Noise is not the only concern. If applying a full enclosure, engineers must determine the required ventilation to maintain the interior temperature rise within the enclosure remains below a given design air temperature, ensuring equipment operation without overheating. Once they determine ventilation airflow, they can select enclosure ventilation silencers that will allow the required airflow ventilation at minimum pressure loss while controlling the noise breaking out the enclosure openings. Depending on the required airflow, forced (fan) or unforced (stack effect) enclosure ventilation methods can be used.

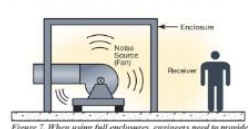


Figure 7. When using full enclosures, engineers need to provide ventilation to prevent overheating.

CONCLUSION

Environmental noise control is of great importance today. Educating engineers about the available noise control options, using only the acoustic algorithms appropriate for the application, making use of design standards and applying independently tested products (i.e., silencers, double-wall acoustic panel sound barrier walls and enclosure systems) will yield a solution that satisfies both owners and communities.

Overview

- Introduction
- Sample outdoor noise ordinance
- Fan noise generating components
- Components of acoustical modeling of fan noise and environmental surroundings. Determining if a noise problem exists.
- Noise control products and solutions – fan silencers, acoustic barrier wall systems, acoustic enclosures

Outdoor Noise Ordinance

- Outdoor noise = community noise
- Areas zoned industrial, commercial & residential moving closer together.
- Need to educate the community, city officials, building owners; many have never had to deal with environmental noise issues.
- Develop a fair and obtainable noise ordinance.

Outdoor Noise Ordinance

“Too Subjective” of Noise Ordinance

“Noise levels in the city limits shall not exceed those that bother surrounding neighbors.”

“Too Stringent” of Noise Ordinance

“Any noise level that exceeds ambient noise by three (3) decibels or more in any octave band is declared excessive or unreasonable.”

----- (3) dB increase is barely discernable

Outdoor Noise Ordinance

Sample – Well Written Noise Ordinance

At Property Line:

Ambient noise quality zone	Day-time standards (7am - 10pm)	Night-time standards (10pm - 7am)
Noise quality zone N-1 (Low density residential RL; land-use zones R-1 to R-3)	Leq=60 dB(A) measured for any one hour	Leq=50 dB(A) measured for any one hour
Noise quality zone N-2 (High density residential RH; land-use zones R-4 to R-10)	Leq=65 dB(A) measured for any one hour	Leq=55 dB(A) measured for any one hour
Noise quality zone N-3 (All Commercial and manufacturing land-use zones)	Leq=70 dB(A) measured for any one hour	Leq=70 dB(A) measured for any one hour

Outdoor Noise Ordinance

Common Sound	Noise / Sound Level
Rocket Launch Pad	180 dBA
Pile Driver	110 dBA
Garbage Truck	100 dBA
City Traffic	90 dBA
OSHA Permissible 8 hrs. Exposure	85 dBA
Noisy Restaurant	70 dBA
Conversational Speech	60 dBA
Light Auto Traffic at 100 ft.	55 dBA
Rural Ambient Noise Level	45 dBA
Library	30 dBA

Outdoor Noise Ordinance

- Where clear noise ordinances are set forth in a community, the owner may be forced to reduce noise levels or be fined.
- Citations can consist of monetary fines or the shutting down a business until the sound level dictated by the noise ordinance is met.
- Where clear noise ordinances are not set forth in a community, the owner may elect to take it upon themselves to reduce the noise levels.
- “Good Neighbor” in the eyes of the community.

Factors to Consider

Implementing a cost-effective noise control solution:

- Obtain as much technical data on the mechanical equipment (source) as possible
- Analyze all sound propagation (paths)
- Clearly define the location of neighbor (receiver)

Factors to Consider - Source

- Pertinent Technical Data of (source):
 - Airflow (cfm)
 - Operating Temperature of Airstream
 - Allowable External Static Pressure
 - Horsepower (HP)
 - Heat Generation (BTU/hr.)
 - Equipment Configuration & Installation Guidelines

Factors to Consider - Path

- Items affecting sound propagation (path)
 - Distance (source – receiver)
 - Atmospheric conditions
 - Downwind/upwind directions
 - Terrain (natural barriers)
 - Wooded areas
 - Surrounding buildings
 - Other noise sources

Factors to Consider - Receiver

- Location of Community / Noise Sensitive Area (receiver)
 - Is there a published noise ordinance?
 - Requirements of the noise source
 - Who was there first, the “noise maker” or the neighbor?
 - Topography of the source, neighbor and property line

Factors to Consider

- Cost for remedial work usually exceeds that which is properly planned and anticipated from the beginning of the project.

Factors to Consider

- Most important factor is to know how the noise source works.
- It is not good enough to only know and address acoustics.
- Most mechanical equipment is not designed to operate under the adverse effects of being enclosed or in close proximity to a structure or barrier.

Factors to Consider

- Maintenance access must be designed into any noise control solution.
- Access must be designed to be “easy”.
- Doors and hatches left open will short circuit any noise control solution.
- Allowance for removal of portions or entire equipment system in case of catastrophic failure.

Factors to Consider

- A Successful Noise Control Solution factors in:
 - Equipment Manufacture's Warranty & Installation Guidelines
 - Local Codes (i.e., electric, etc.)
 - Proper Equipment Ventilation
 - Local Noise Ordinance
 - Location of Equipment
 - Equipment Dimensions
 - Maintenance Access
 - Structural Supports (i.e., snow, wind and seismic loads, etc.)

Acoustic Terminology

- **Sound Power Level** - the total acoustic energy output of a noise source independent of the environment.
- **Sound Pressure Level** - dependent on environmental factors such as distance from the source, reflective surfaces, and other conditions of the room/building/ area hosting the source.

Acoustic Terminology

Logarithmic Addition

Difference between levels to be combined, dB	0 to 1	2 to 4	5 to 9	10 & more
Number of dB to add to highest level	3	2	1	0

$$86 \text{ dB} + 86 \text{ dB} = \mathbf{89} \text{ dB}$$

$$86 \text{ dB} + 85 \text{ dB} = \mathbf{89} \text{ dB}$$

$$86 \text{ dB} + 84 \text{ dB} = \mathbf{88} \text{ dB}$$

$$86 \text{ dB} + 83 \text{ dB} = \mathbf{88} \text{ dB}$$

$$86 \text{ dB} + 82 \text{ dB} = \mathbf{88} \text{ dB}$$

$$86 \text{ dB} + 81 \text{ dB} = \mathbf{87} \text{ dB}$$

$$86 \text{ dB} + 80 \text{ dB} = \mathbf{87} \text{ dB}$$

$$86 \text{ dB} + 79 \text{ dB} = \mathbf{87} \text{ dB}$$

$$86 \text{ dB} + 78 \text{ dB} = \mathbf{87} \text{ dB}$$

$$86 \text{ dB} + 77 \text{ dB} = \mathbf{87} \text{ dB}$$

$$86 \text{ dB} + 76 \text{ dB} = \mathbf{86} \text{ dB}$$

$$86 \text{ dB} + 75 \text{ dB} = \mathbf{86} \text{ dB}$$

$$10 \log \left(10^{\frac{100}{10}} + 10^{\frac{100}{10}} \right) = 103 \text{ dB}$$

Acoustic Terminology

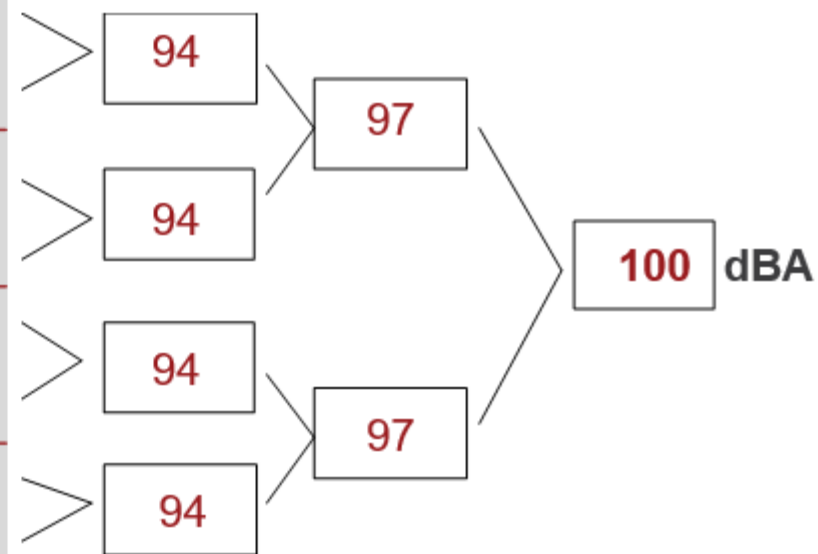
“A-Weighting” (dBA):

- Filters the spectrum to simulate the frequency response to sound by the human ear.
- Deemphasizes the low frequencies, compensating for the lower sensitivity of the human ear to low frequency.
- Add the 8 filtered bands to arrive at a single dBA level.
- Typically used for environmental / outdoor noise design criteria. But also in an “in-plant”, factory setting.

Mid-band Frequency (Hz)	A-weighted Correction (dB)
63	-26.2
125	-16.1
250	-8.6
500	-3.2
1000	0
2000	+1.2
4000	+1.0
8000	-1.1

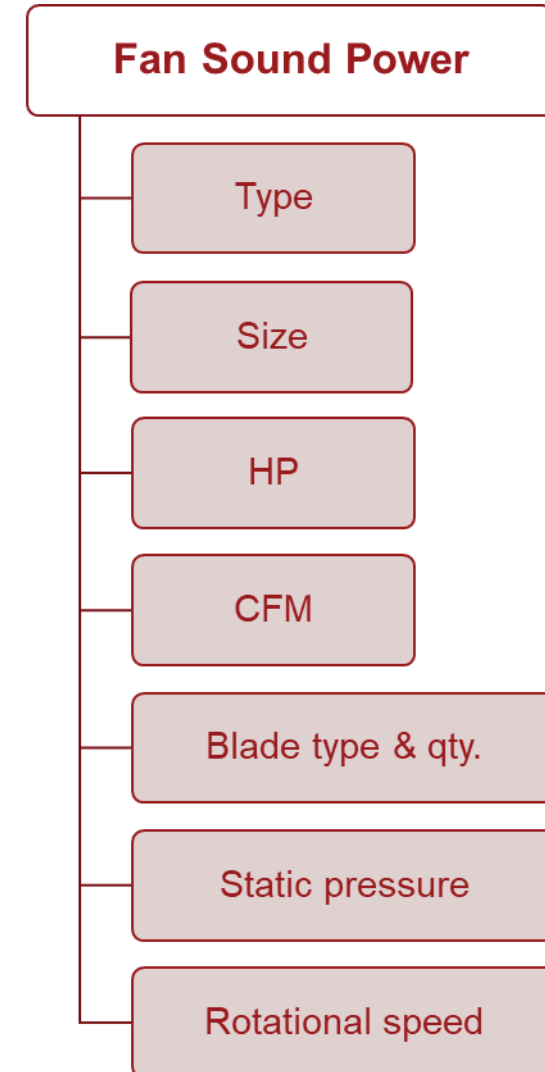
Acoustic Terminology

Center Frequency (Hz)	Sound Pressure Level (dB)	"A" Filter	Resultant
63	117	-26	91
125	107	-16	91
250	100	-9	91
500	94	-3	91
1k	91	0	91
2k	90	(+1)	91
4k	90	(+1)	91
8k	92	-1	91



Fan Noise

- Most predominant noise source of any industrial or commercial air system.
- Function of fan inlet, discharge, motor drive train and casing radiated noise.
- Magnitude and intensity of noise will vary per
- The rotating action of vanes produce a broad band sound spectrum consisting of low, mid to high frequencies.



Common Mechanical Equipment

- **Process/Vent Fans**

- Inlet, discharge, motor drive train & casing radiated noise

- **Air-Cooled Chillers**

- Screw Compressors & up-blast fans

- **Induced/Forced Draft Cooling Towers**

- Intake and up-blast fans

Common Mechanical Equipment

FANS



Common Mechanical Equipment

AIR-COOLED CHILLERS



Common Mechanical Equipment

INDUCED DRAFT COOLING TOWERS



Fan Noise

- A proper acoustic analysis begins with accurate FAN SOUND POWER LEVELS (dB), L_w , PWL
- It is important to obtain **discharge, intake** and **casing radiated** sound power levels per 8-octave bands: 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1K Hz, 2K Hz, 4K Hz, 8K Hz.
- Field sound level measurements via a hand-held sound level meter may be required for **retrofit applications**.

Fan Noise

- Some fan data is presented only as **inlet** and **outlet** FAN SOUND POWER LEVELS (dB)

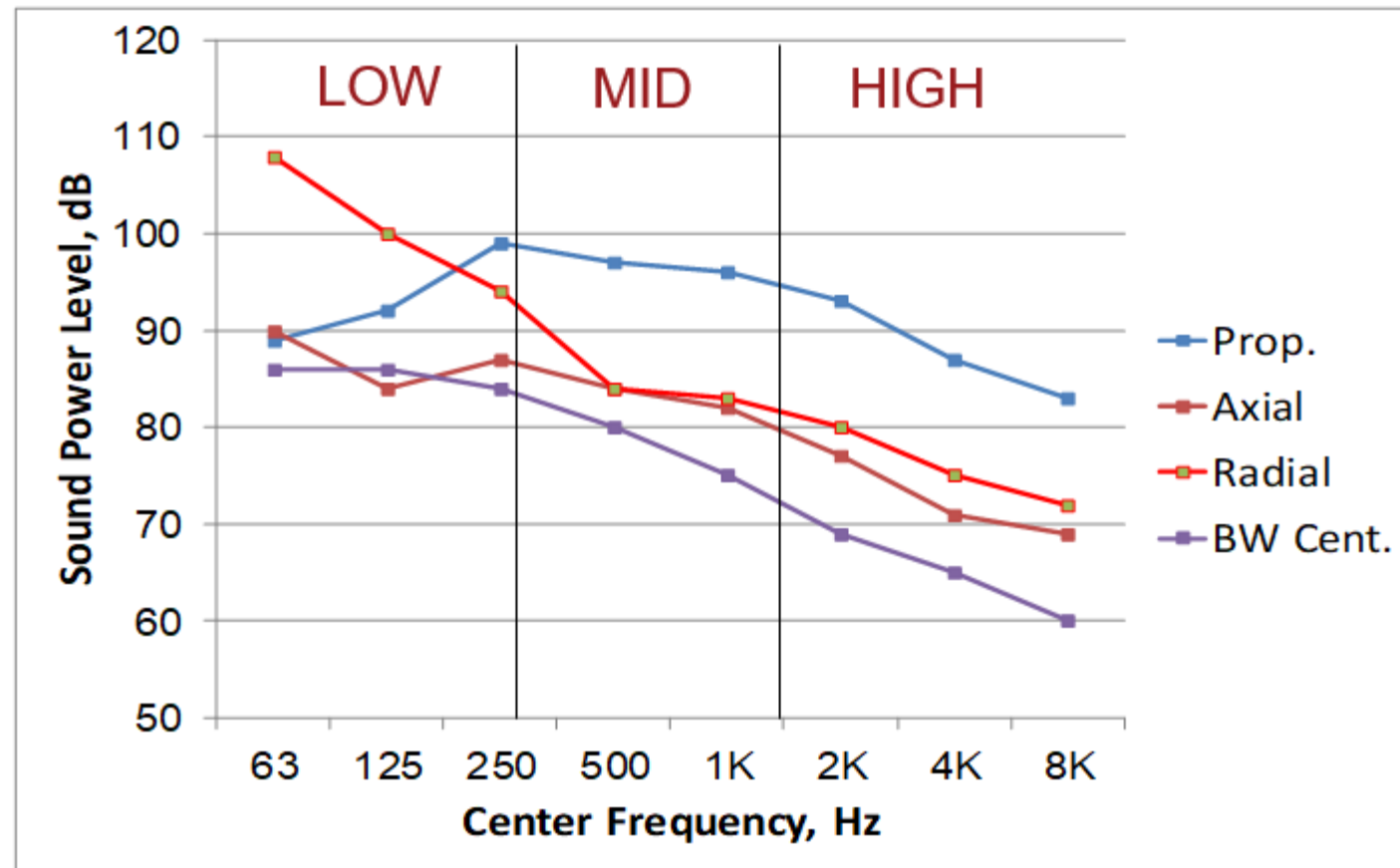


RPM	SP	Condition	SOUND POWER re 10 ⁻¹² WATTS								Lw _A
			OCTAVE BANDS								
			1	2	3	4	5	6	7	8	
1000	1	Inlet	72	77	76	71	70	66	59	52	75
		Outlet	80	89	79	74	74	69	59	51	79
1240	1	Inlet	78	81	82	77	75	73	67	60	81
		Outlet	85	88	87	80	78	75	68	59	84
	2	Inlet	74	76	77	71	71	69	63	58	76
		Outlet	81	84	82	75	73	70	63	56	79
1360	1	Inlet	82	83	87	80	79	78	74	66	85
		Outlet	90	87	91	84	82	80	75	65	88
	2	Inlet	80	80	84	78	76	74	68	61	82
		Outlet	87	86	91	83	80	77	70	60	86
	1	Inlet	86	84	90	83	82	82	79	72	88
		Outlet	94	88	93	88	86	83	81	71	91
1540	2	Inlet	85	82	88	81	80	79	74	67	86
		Outlet	92	87	93	87	84	81	76	67	90
	3	Inlet	84	80	86	78	77	77	70	65	83
		Outlet	90	85	91	84	82	79	72	64	88
	1	Inlet	88	88	92	87	85	84	82	76	92
		Outlet	96	92	95	91	89	86	84	76	94

1540	2	Inlet	85	82	88	81	80	79	74	67
		Outlet	92	87	93	87	84	81	76	67

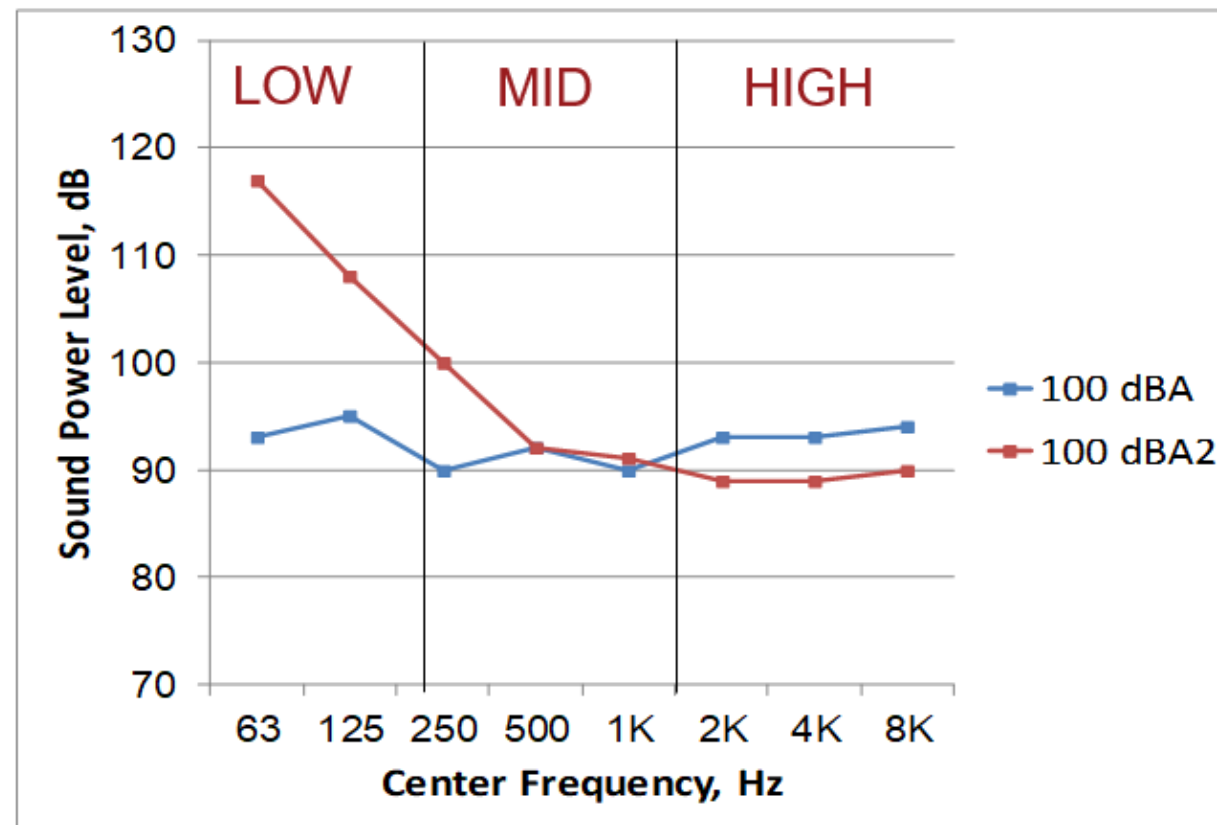
Fan Noise

- The sound spectrum shape (low, mid, high frequency) is very important and is revealed by the octave band sound power level data.



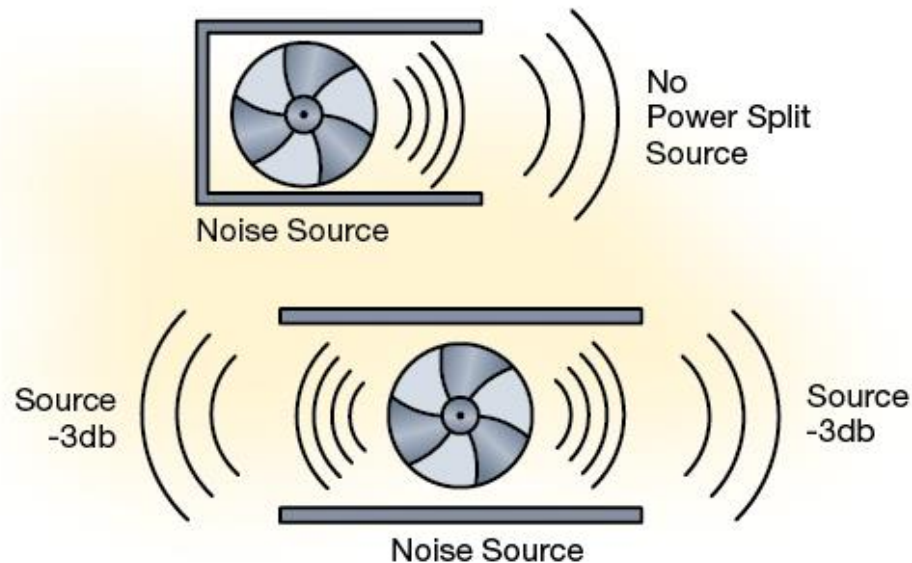
Fan Noise

- The following **two sound spectrums** are **both 100 dBA**. But one has predominantly low frequency noise requiring an entirely different noise control solution than the other. (Target 85 dBA @ 3 ft.)



Acoustic Analysis – Power Split

If only **TOTAL Fan Sound Power Levels (TFLw)** are **available**, the **INTAKE** and **DISCHARGE Sound Power Levels (Lw)** can be calculated assuming an equal power split.



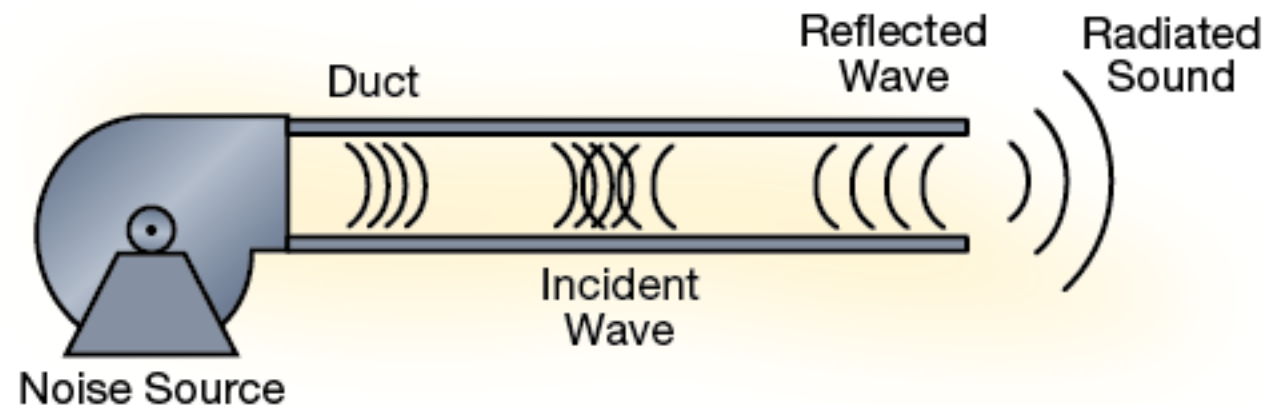
$$10\log(10^{\frac{100}{10}} + 10^{\frac{100}{10}}) = 103dB$$

Acoustic Analysis – Power Split

	Octave Band / Center Frequency, Hz								dBA
	1	2	3	4	5	6	7	8	
	63	125	250	500	1K	2K	4K	8K	
TFLw, dB	108	105	100	95	86	81	78	73	96
Adj., dB	-3	-3	-3	-3	-3	-3	-3	-3	
Inlet Lw, dB	105	102	97	92	83	78	75	70	93
outlet Lw, dB	105	102	97	92	83	78	75	70	93

Acoustic Analysis – End Reflection

- **Exhaust Fans** are typically **connected to** either a **horizontal** discharge duct or **vertical** discharge stack.
- **Low frequency (most predominant)** acoustic energy reflects back into the duct or discharge stack offering low frequency acoustic attenuation.



Acoustic Analysis – End Reflection

More significant a factor for small **non-flanged openings** than large openings.
Value to be subtracted from fan sound power level.

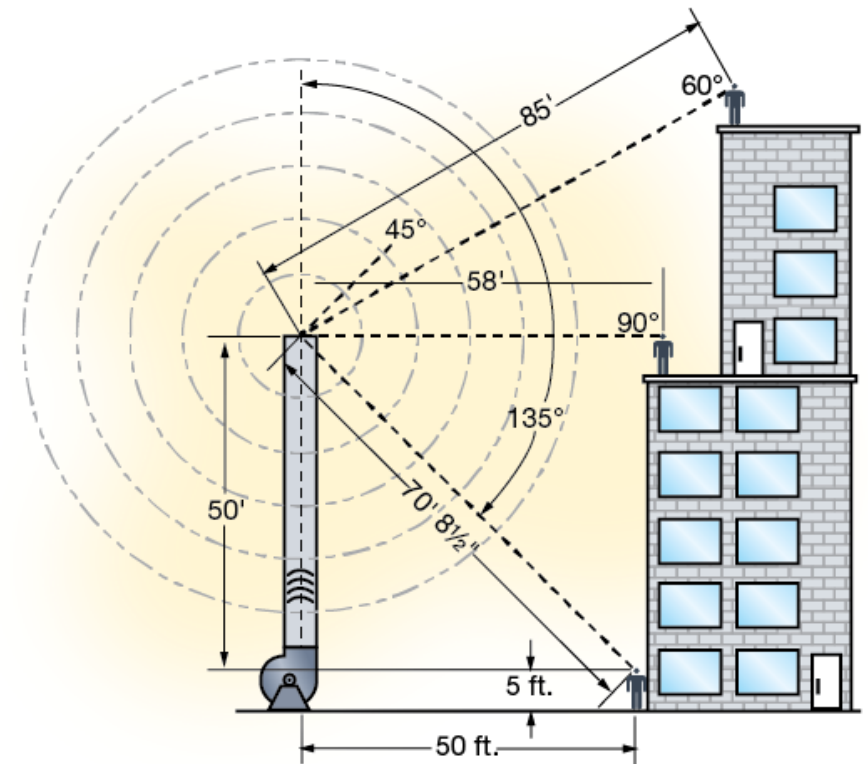
Equivalent Diameter, inches	Octave Band / Center Frequency, Hz							
	1	2	3	4	5	6	7	8
	63	125	250	500	1K	2K	4K	8K
4	25	19	13	8	3	1	0	0
12	15	10	5	2	0	0	0	0
18	12	7	3	1	0	0	0	0
36	7	3	1	0	0	0	0	0
48	5	2	0	0	0	0	0	0

Acoustic Analysis – Directivity

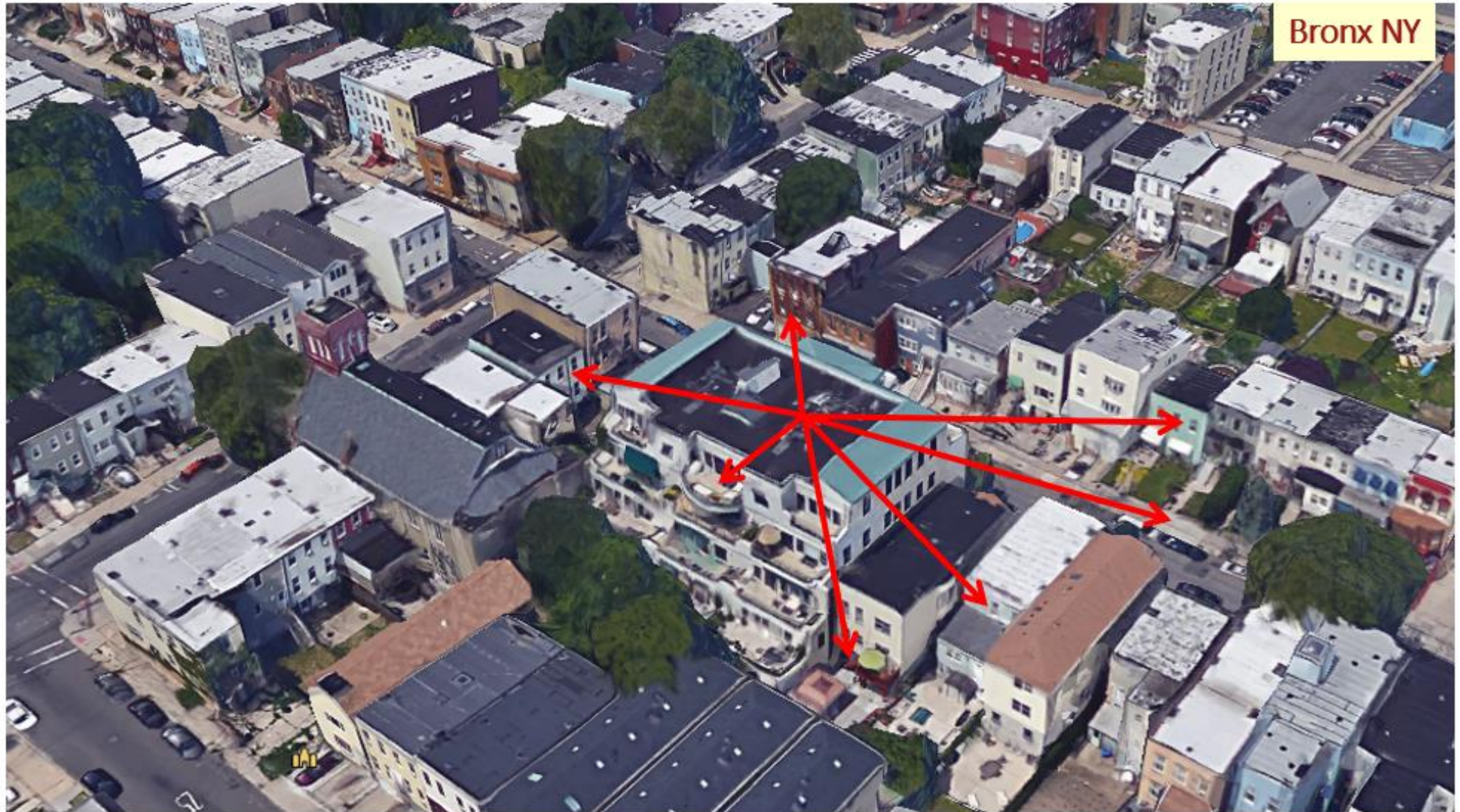
Sound from a horizontal discharge duct or vertical discharge stack is more prominent in one direction. Sound directly in front of an opening is louder than to the sides.

Elevation between sound source and receiver is important.

>> Prize question.... What does “SOHCAHTOA” refer to?



Acoustic Analysis – Directivity



Acoustic Analysis – Directivity

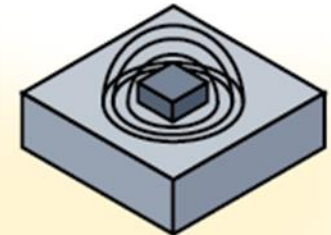


Acoustic Analysis – Divergence

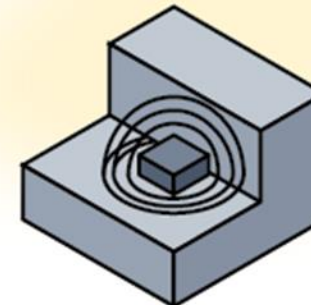
- Sound propagation is affected by surrounding structures (i.e., buildings, alcoves, roof top surfaces, surrounding equipment).
- Nearby hard surfaces magnify noise.
- Function of type and distance



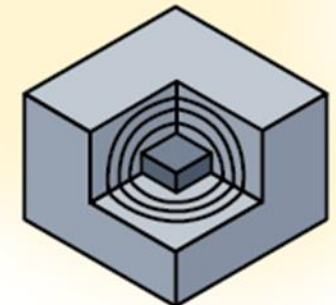
Spherical



Hemispherical



Two Reflective Surfaces



Three Reflective Surfaces

Acoustic Analysis – Divergence



Spherical



Acoustics Analysis – Sample – Fan Discharge

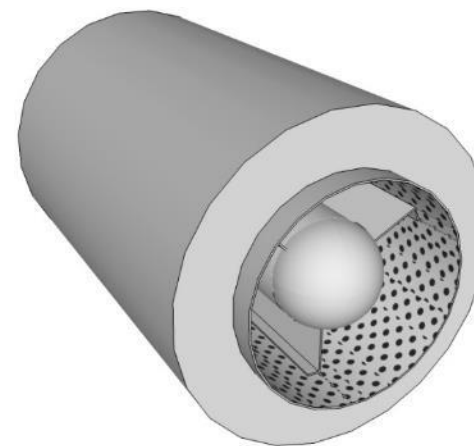
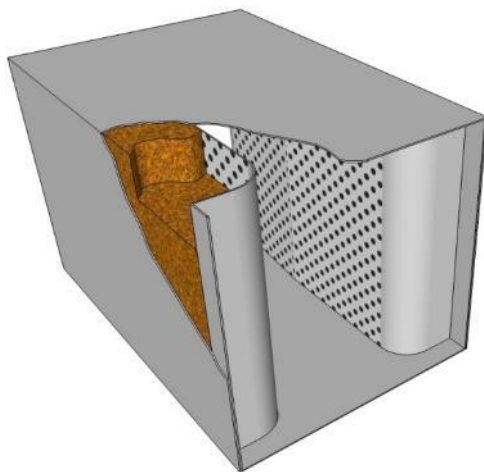
Factor	Octave Band / Center Frequency, Hz								dBA
	1	2	3	4	5	6	7	8	
	63	125	250	500	1K	2K	4K	8K	
TFLw, dB	108	105	100	95	86	81	78	73	96
Power Split, dB	-3	-3	-3	-3	-3	-3	-3	-3	
End Reflection, dB	-8	-4	-1	0	0	0	0	0	
Directivity, dB	+1	0	0	-1	-1	-1	-2	-2	
Divergence, dB	-7	-7	-7	-7	-7	-7	-7	-7	
Resultant, dB	91	91	89	84	75	70	66	61	85

Acoustic Treatment - Products

- Ventilation silencers
- Fixed-blade acoustic louvers
- Sound Barrier Walls
- Sound Enclosures

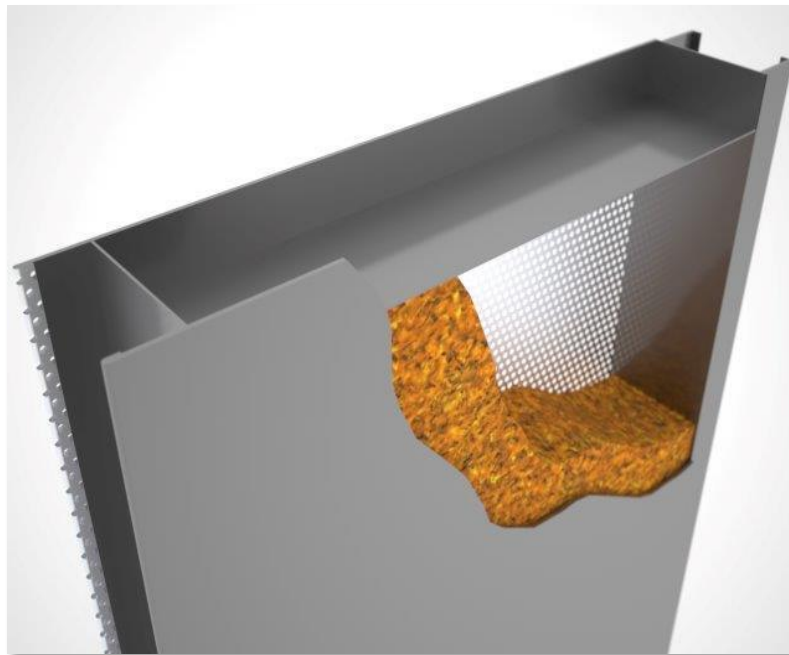
Noise Control Products

- Ventilation silencers
 - Industrial Grade
 - Commercial Grade
- Fixed-blade acoustic louvers



Noise Control Products

- Double-walled, acoustic barrier & enclosure panels



Noise Control Products

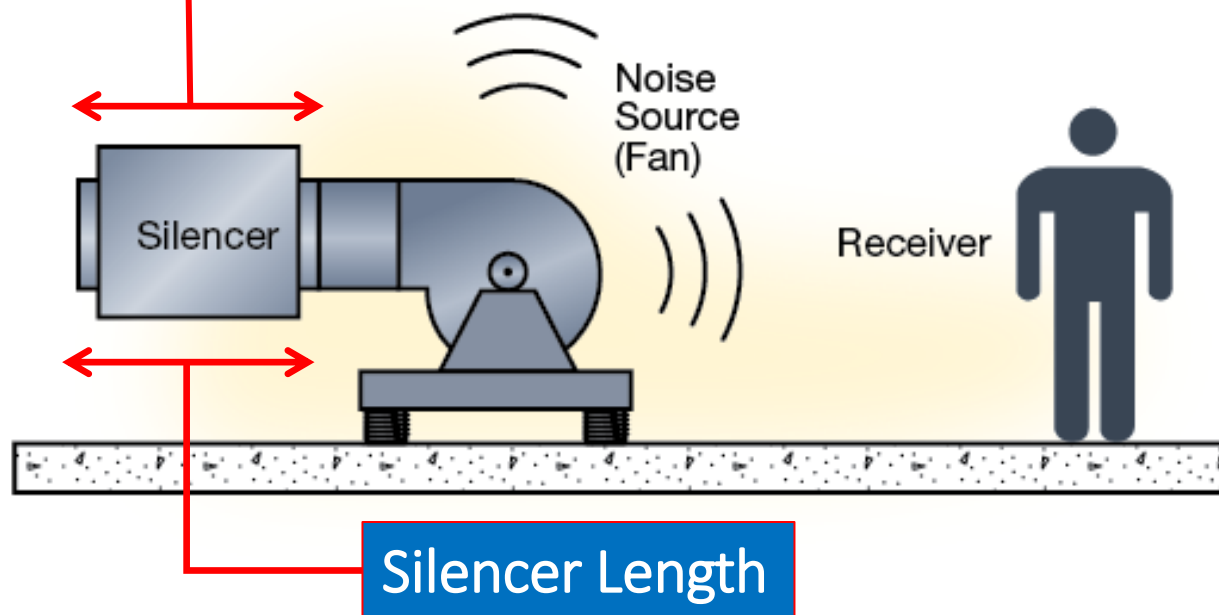
- Independently Tested Products:
 - **ASTM E477**, Standard test method for measuring **acoustical and airflow performance** of duct liner materials and prefabricated silencers.
 - **AMCA 1011-03 (R2010)**, Certified Ratings Program- Product rating manual for acoustical duct silencers.
 - **ASTM 423**, Standard test method for sound absorption and sound **absorption coefficients** by the reverberation room method.
 - **ASTM E90**, Standard test method for laboratory measurement of airborne sound **transmission loss** of building partitions and elements.

Expected Performance - Realistic

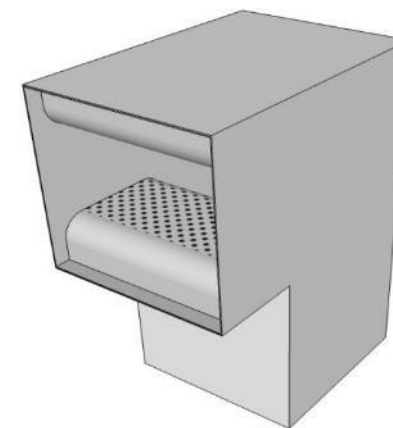
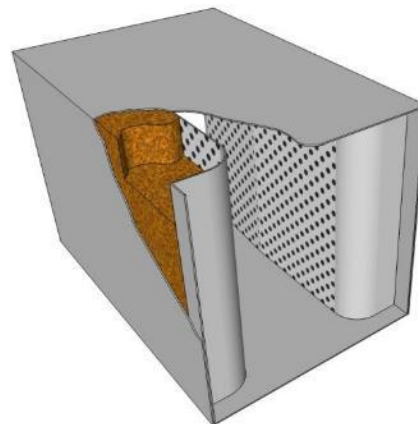
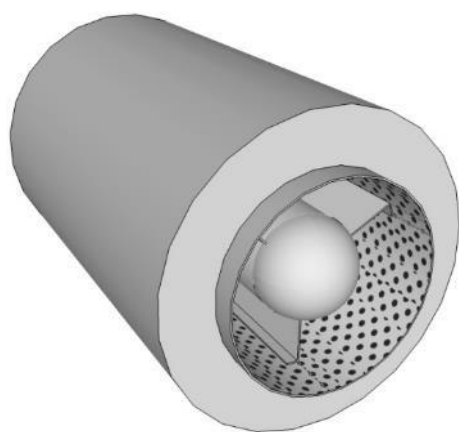
Mechanical Equipment	Applied Products	Noise Reduction & Pressure Loss
Fan	Silencers	25 dBA 85 Pa (0.35 inches of water)
Air-cooled chiller	Acoustical Louvers, Acoustic Barrier Walls, Silencers	<u>Walls</u> : 18-23 dBA @ 10'-0" <u>Top</u> : 8-10 dBA @ 10'-0" 25 Pa (0.10 inches of water)
Induced-draft cooling tower	Silencers – Intake & Discharge	10-20 dBA @10'-0" 25 Pa (0.10 inches of water)

Acoustic Treatment – Ventilation Silencers

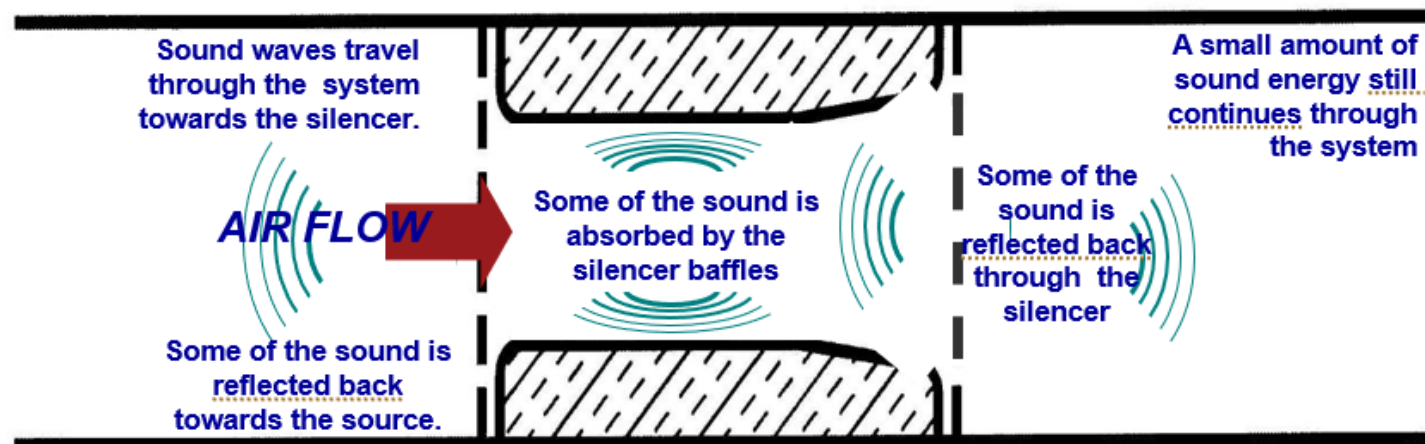
Allowable Pressure Loss + Required Attenuation



Acoustic Treatment – Ventilation Silencers



RECTANGULAR SILENCER



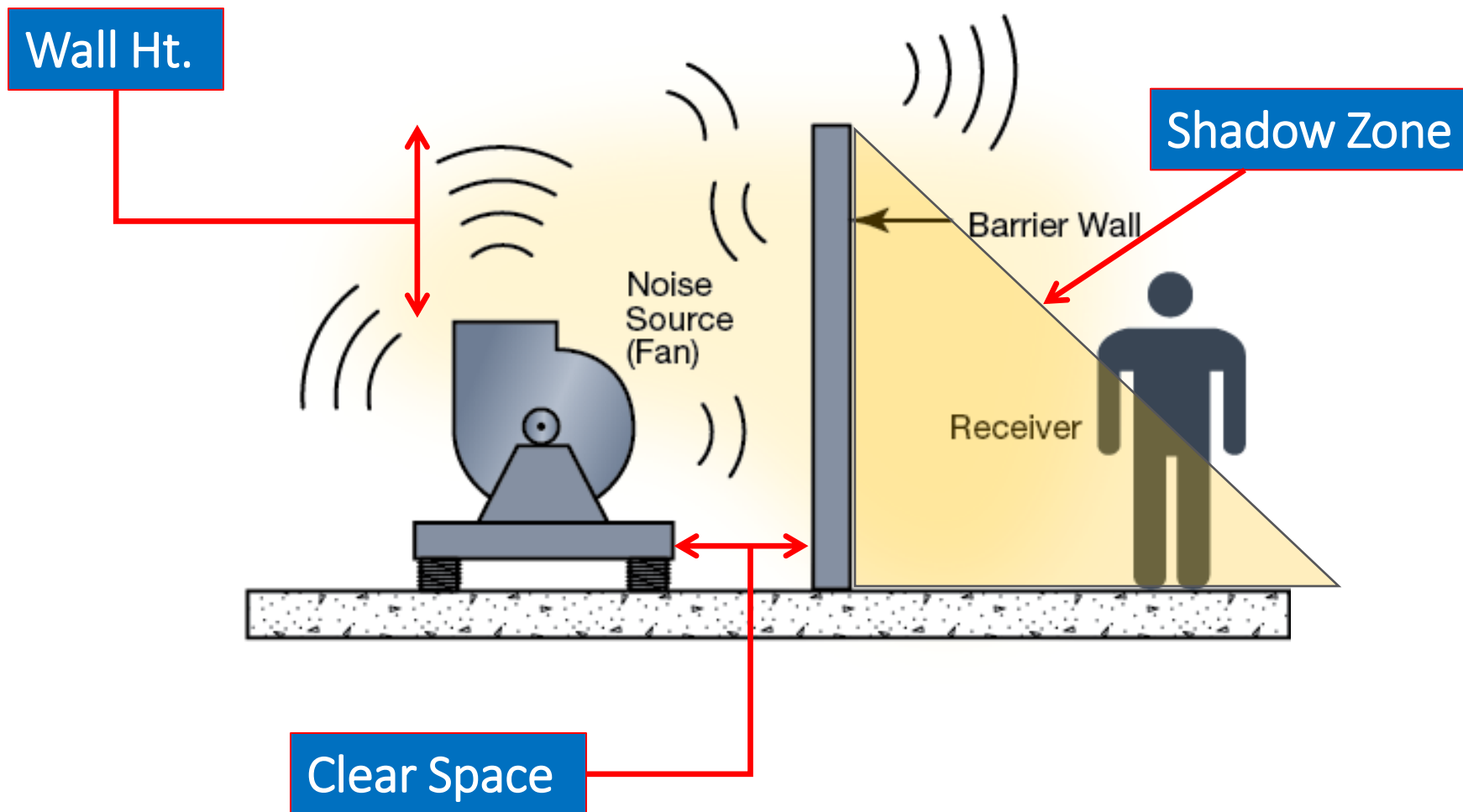
Acoustic Treatment – Ventilation Silencers

Dynamic Insertion Loss: The attenuation or reduction of sound power after the silencer is inserted. IL is stated in dB in octave bands from (63 Hz - 8000 Hz).

Pressure Loss (drop, PD): The differential pressure across the silencer at a given flow velocity. PD is stated in inches WG or Pa.

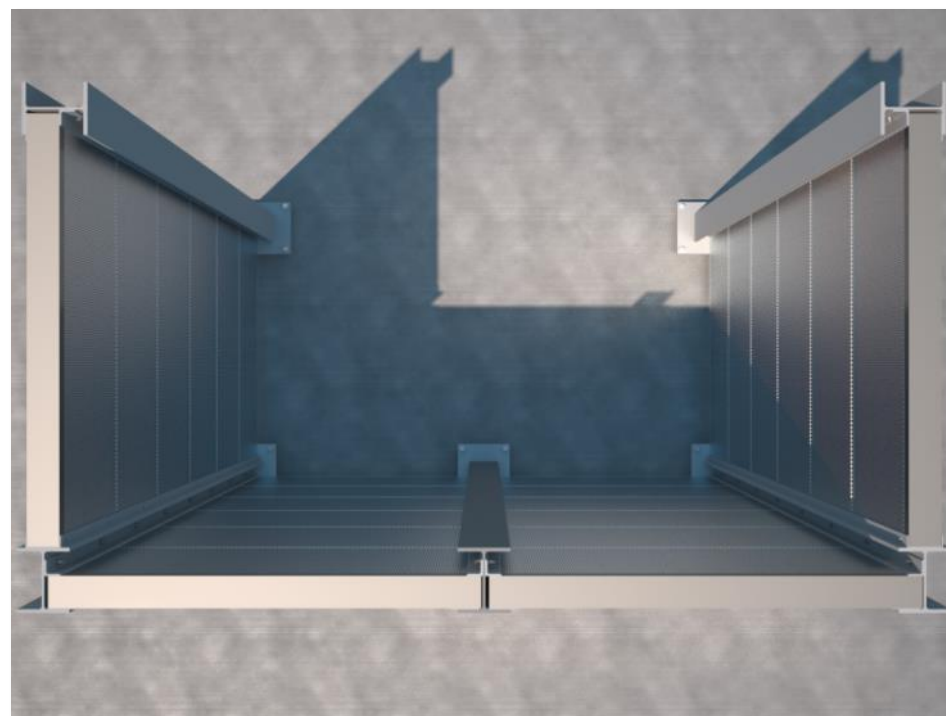
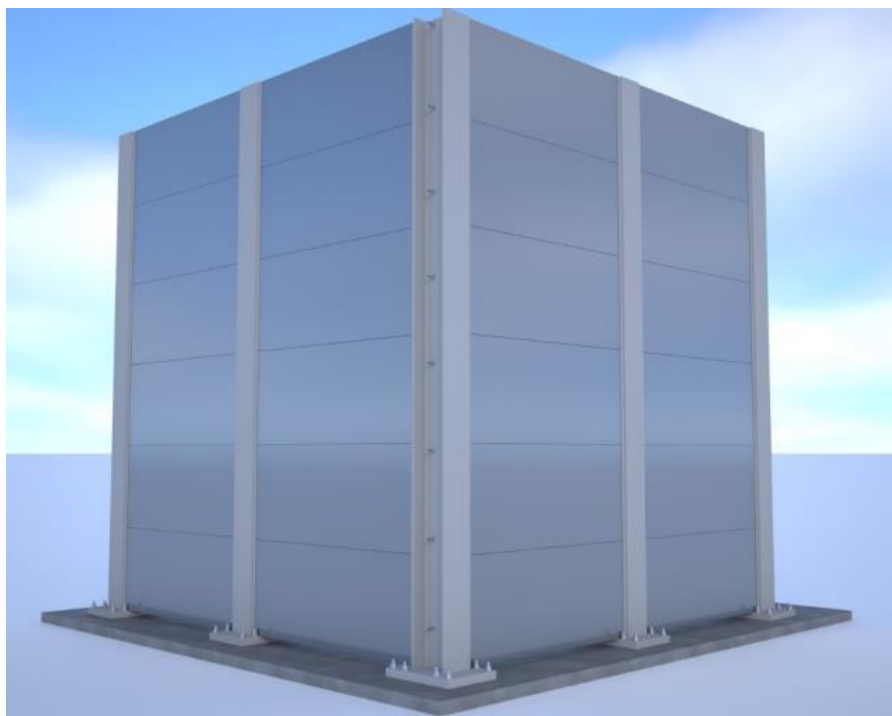
Flow-Generated Noise: Also called regenerated noise. The sound power generated by air flow through the silencer. GN is also stated in dB in octave bands from (63 Hz - 8000 Hz). (CFM) or liters per second (L/s)

Acoustic Treatment – Sound Barrier Wall



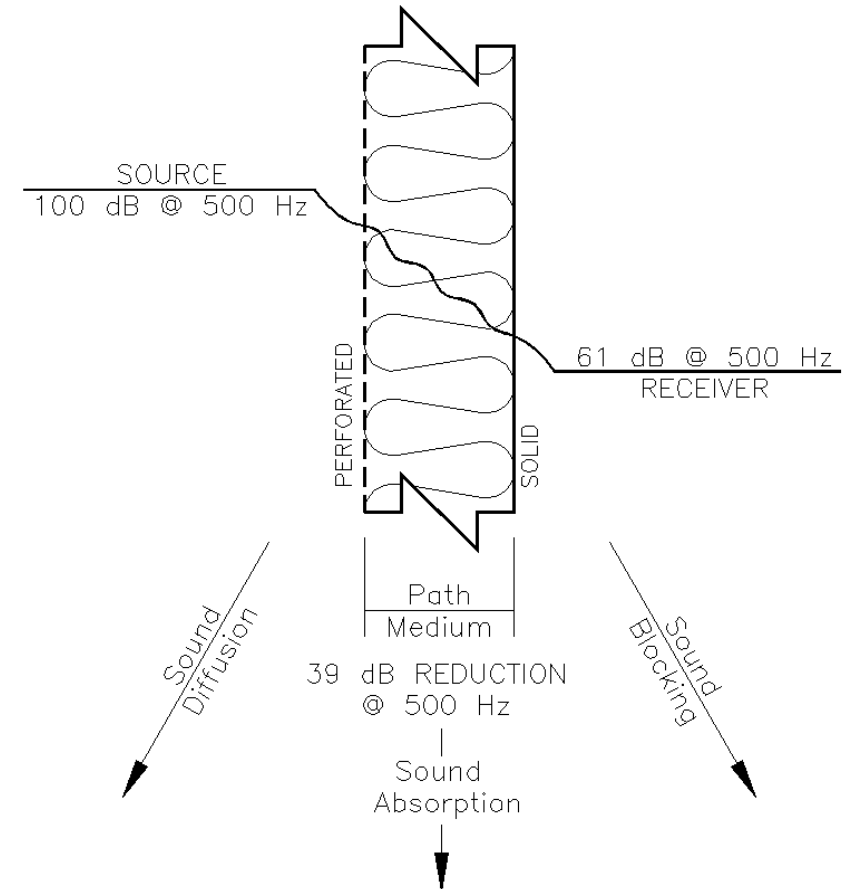
Acoustic Treatment – Sound Barrier Wall

Key Components: types, spacing & height determination

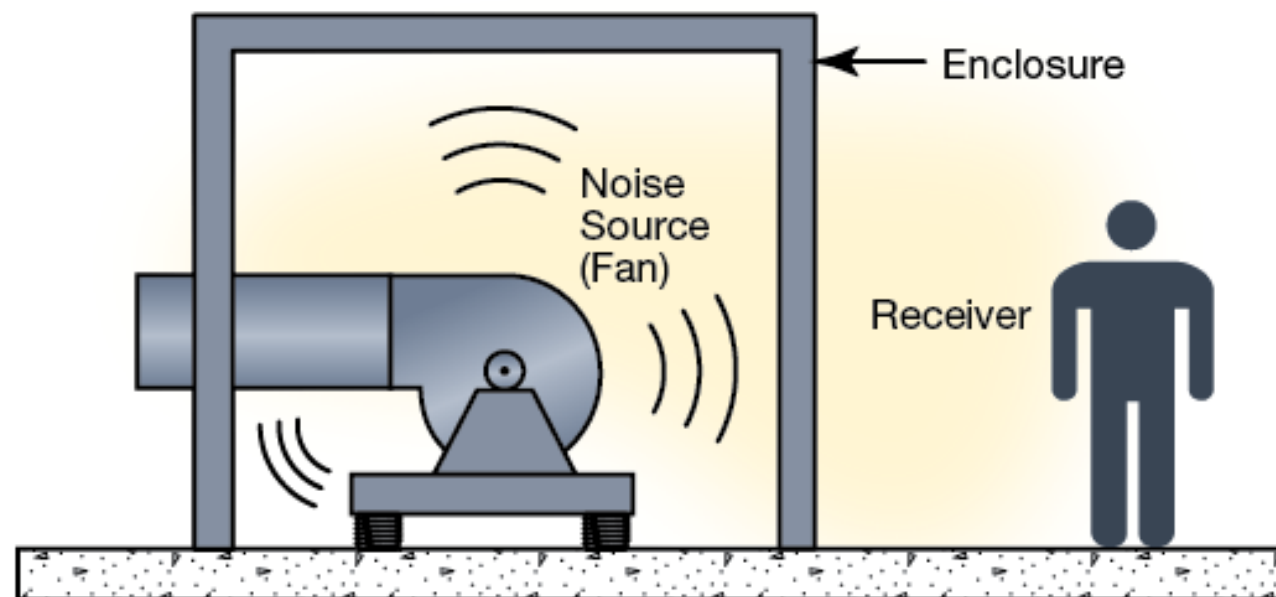


Acoustic Treatment – Sound Barrier Wall

- **Sound absorbing material** is used **on the sound source side** of the barrier to reduce the build-up of sound pressure level.
- **Absorbing material prevents sound reflection** from barrier surface.
- **Improves overall acoustic performance** of barrier system.
- **Solid outer skin blocks sound.**



Acoustic Treatment – Sound Enclosure



Acoustic Treatment – Sound Enclosure

- **Proper access** for routine maintenance must be designed into the sound enclosure.
- **Proper silenced ventilation** must be designed into the system to maintain a not to exceed operation temperature.
- **Improves overall acoustic performance** of barrier system.
- **Structurally designed** to withstand, snow, wind and seismic loads.

Conclusion

Environmental “outdoor” noise control is of great importance today.

Educating owners and communities on the available noise control options, using the most up-to-date acoustic algorithms and design standards and applying independently tested products (i.e., ventilation silencers, fixed-blade acoustic louvers, acoustic barrier wall and enclosure panel systems, and rigid perforated absorption panels) will yield a solution which makes the owner and community one “happy family.”

Resources

- **AMCA International:** www.amca.org
- **AMCA Publication 1011-03 (R2010)** (Free PDF Download):
www.amca.org/store
 - > Certified Ratings Program- Product Rating Manual for Acoustical Duct Silencers
- **2014 AMCA *inmotion* Magazine:**
<https://www.amca.org/educate/inmotion/amca-inmotion-magazine-2014-issue.html>
 - > Controlling Outdoor Fan Noise – Items to Consider



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Attendees will receive an email at the address provided on your registration, listing the credit hours awarded and a link to a printable certificate of completion.

Questions?

NEXT PROGRAM

Join us for our next **AMCA *insite*[™] Webinar**:

- Wednesday, October 14
- 1:00-2:00pm CT
- ***TOPIC: Basics of Fan Noise***
- Presenter: Rad Ganesh, Director, Product Applications, AMCA Member Company

>> For additional webinar dates go to: www.amca.org/webinar