ENGINEERING UPDATE

JANUARY 2013 - **VOLUME 9**

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TWO SIDES TO EVERY NOISE

By Alexander Michaud, M.Sc.
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Noise is usually either black or white – acceptable or annoying. The former often goes unnoticed, while the latter requires attention.

Price offers a wide variety of noise control products that are often viewed from the mechanical perspective (e.g. supply and return ductwork silencers). A more holistic method is to address the acoustical impact from both the architectural and mechanical design perspectives. This approach improves the opportunity for noise issues to be properly resolved by the responsible party who understands the problems and has the ability to solve them prior to construction. With this mindset, the following explores both noise types and provides some corresponding solutions.

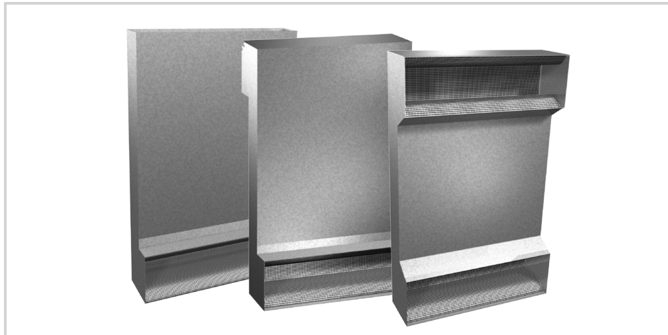
ARCHITECTURAL ACOUSTICS

Architectural design criteria typically focus on:

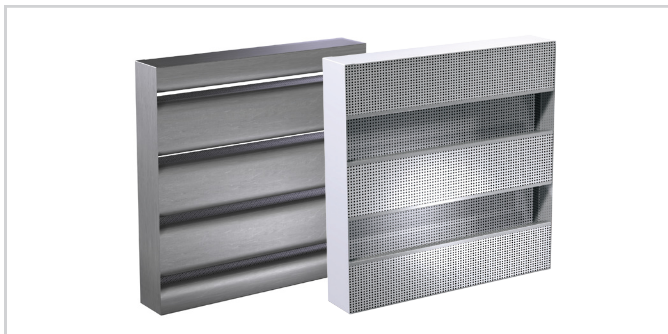
- Sound transmission across building assemblies (partitions, ceilings, etc.)
- Background or ambient noise (HVAC systems, equipment, outdoor)
- Speech privacy

Sound transmission is often described by STC (Sound Transmission Class), which measures the amount of noise that is reduced by a building assembly, such as a wall or floor. Our STC-rated Acoustical Panels (QLP) are available in various thicknesses and with absorptive media options. As depicted in **Figure 1**, one application for Acoustic Panels is to improve partition noise isolation performance.

A less obvious noise isolation application is for partitions that require an STC rating, but do not extend to the slab or have return air penetrations above the finished ceiling. In these cases, partition STC is compromised and often inadequate for more acoustically sensitive occupied spaces, such as conference rooms or private offices.



XTL, XTZ, XTU - *Cross Talk Silencers*



TLRD®, TLRD®-LP, TLRD®-LP-T - *Thin Line Return Dissipaters*

Our Cross Talk Silencers (XTL, XTZ, XTU) and Thin Line Return Dissipaters (TLRD) can provide additional noise reduction to ensure that overall partition assemblies provide adequate noise isolation. For example, two adjacent rooms separated by a non-full height partition can be negatively impacted by noise flanking through the common ceiling plenum. As depicted in **Figure 1**, this noise path can be addressed by using our Thin Line Return Dissipaters (TLRD) at return grilles with the added benefit of reducing visibility into the plenum space.

Background noise is often described using Noise Criterion (NC), a series of octave-band curves defining acceptable sound pressure levels from 63 to 8,000 Hz. Background noise is typically governed by mechanical equipment and industry guidelines of acceptable levels as outlined by ASHRAE (HVAC Applications 48.3).

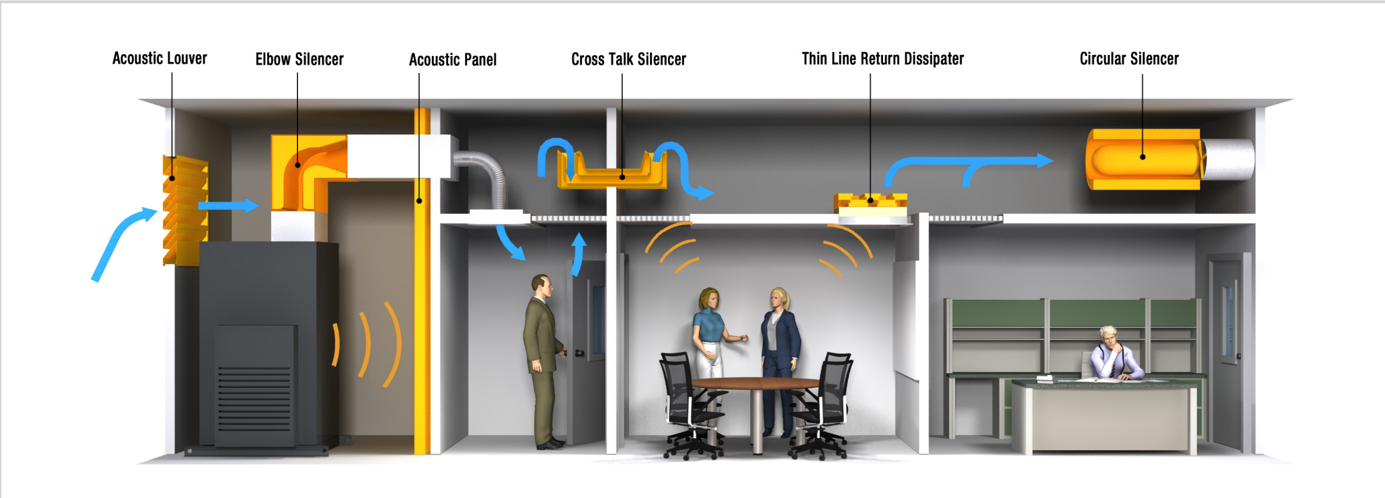


Figure 1: The Price Noise Control Solution

Background noise guidelines are provided in **Table 1**:

Table 1: Background Noise Guidelines

Room/Space Type	Recommended NC Level
Concert Hall, Theater	NC-20 to 25
Teleconference rooms	NC-25 to 30
Residences, Patient rooms	NC-30
Conference/Meeting rooms	NC-30 to 35
Private office	NC-35
Open office	NC-40 to 45
Lobby, Pantry, Restroom, Corridor	NC-45
Kitchen, Laundry	NC-50

Speech privacy between two closed-plan spaces can be described using Speech Privacy Potential (SPP) and is the combination of background noise (NC) in the receiving space and acoustic separation (STC) of the total construction between the spaces:

$$SPP = NC + STC$$

This formula illustrates the compromise between maintaining a low background noise level (NC) and the noise isolation (STC) required to achieve acceptable speech privacy (SPP). For reference, typical conference rooms and private offices should have a minimum privacy (SPP) rating of 75.

MECHANICAL NOISE

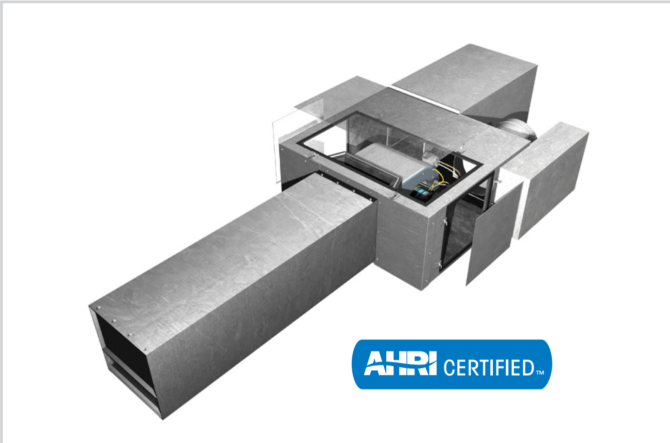
Acoustic criteria for mechanical design focuses on achieving specific background noise levels within an occupied space. Mechanical noise is typically addressed by looking at three major paths:

- Supply/discharge
- Return/intake
- Radiated

Supply noise is probably the most commonly addressed path, since the airflow and noise are travelling in the same direction. In actuality, supply noise is often the least problematic because it is well recognized by the design community. Supply noise is typically addressed by using a combination of long ductwork runs, branches, elbows, and duct silencer components to reduce noise transmission.

A traditional rule of thumb for “safe” design often includes requiring a minimum of 15 - 20 ft of lined ductwork between relevant mechanical equipment and the diffusers in the occupied space. This simple rule is not always feasible or allowed in modern construction. Price offers rectangular, circular, and elbow silencers with various media types including absorptive (fiberglass), film lined (fiberglass with thin plastic liner), and packless (no acoustic media).

A variety of options within these larger parameters are also offered, such as high transmission loss (HTL) casing and tuned silencers that focus on specific frequencies to reduce tonal noise. Our Quiet Terminals (‘Q’ series) provide another supply noise control solution by combining



Quiet Terminal with Optional Return Attenuator

terminal units with 3 ft long silencers to ensure rated performance with no system effects. This engineered solution is AHRI certified and reduces both installation complexity and prevents performance mismatch.

Return noise is addressed similarly to supply noise, though the duct runs are often shorter or nonexistent and require silencers to make up the difference. Fan powered terminal unit intake noise is often not considered until the final stages of design when it is too late to simply relocate the boxes over less sound sensitive locations. Price Quiet Terminals can be provided with optional 3 ft and 5 ft lined attenuators to reduce the associated intake noise. Utilizing our Dissipative Silencers (TLRD) at return grilles as depicted in **Figure 1** is another method for reducing noise from common return plenums. Situations with noise transferring through un-ducted return openings can be addressed using our Cross Talk Silencers.

Custom Price Acoustic Enclosure at 1230 3rd Avenue New York, NY

Finally, **radiated noise** is often not addressed because of a lack of communication and understanding among the design and construction trades involved on the job. Price Acoustic Panels (QLP) greatly reduce the transmission of noise from rooftop units, generators, and internal mechanical equipment. Additional noise attenuation is achieved by using our acoustic enclosures, which combine our Acoustic Panels with relevant silencers and/or Acoustic Louvers (QA, QAF) to meet airflow requirements. The same Dissipative Silencer (TLRD) applications described above can also reduce terminal unit radiated noise transmission through open return grilles by providing insertion loss performance similar to ceiling tile. Table 2 compares the insertion loss of the Price Dissipative Silencer (TLRD) and general ceiling tile (ASHRAE).

Table 2: Insertion Loss Comparison

Assembly	Insertion Loss, dB						
	63	125	250	500	1000	2000	4000
Price TLRD	1	2	3	4	9	13	9
Ceiling Tile	1	2	4	8	9	9	14

SUMMARY

Solutions to most “noise problems” typically require the holistic evaluation of multiple paths with each requiring individual attention. By properly addressing all noise sources, offices are more productive, conference room meetings are more effective, and hospital patients are more comfortable. All of the design criteria described above may not be directly relevant for every job, but each should be considered. Doing so will not only improve the end result, but also provide more opportunity for involvement throughout the building process. Most importantly, clients will be confident that all of their noise control concerns, not just the “usual suspects”, are addressed prior to construction.

In addition to offering the widest selection of noise control products in the industry, Price provides acoustical analysis services to ensure that desired project goals and design criteria are satisfied.

For more information on our Noise Control Products, please contact us at **noisecontrol@price-hvac.com** or visit us online at **price-hvac.com.**

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PRODUCT FEATURE: FAN POWERED TERMINAL (FDCOA)

By Alf Dyck
Vice President Product Engineering

The FDCOA, a new Price Fan Powered Terminal Model, is specifically designed to operate with dedicated outdoor air systems (DOAS).

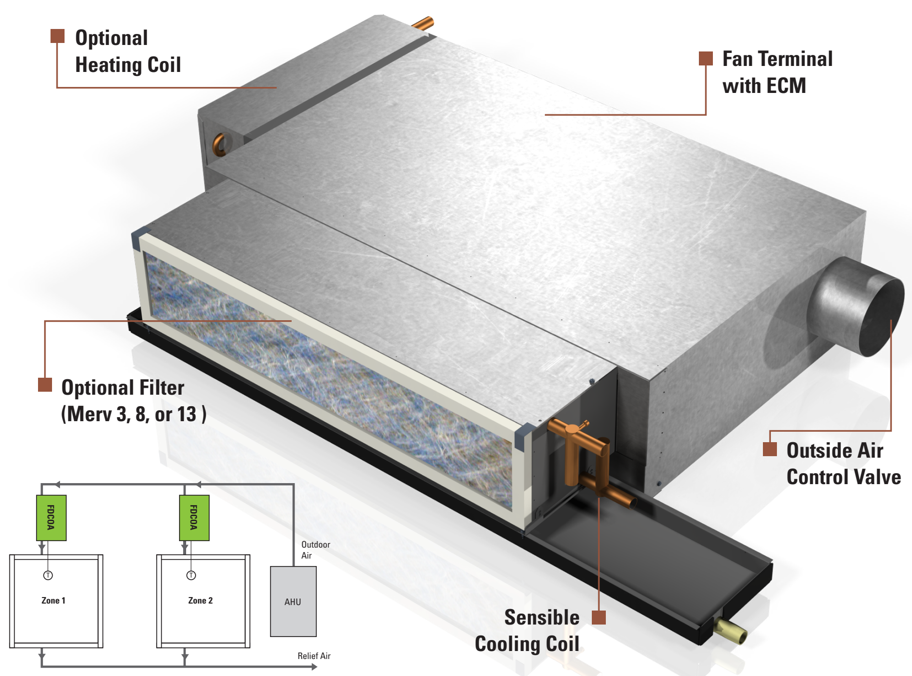
The FDCOA operates similarly to a series fan powered unit, but with the addition of a cooling coil on the return air inlet that handles the sensible load in the space. Because the cooling coil is taking care of the sensible load, the DOAS air handler can be sized to deliver only the air flow required for ventilation and latent loads. This air flow reduction results in a smaller HVAC system and increased fan energy savings. These savings are complemented by an energy efficient ECM motor that is programmed for constant flow to compensate for filter loading.

The new model works by inducing warm air from the ceiling plenum through a return air opening, and then filtering it through a large face, high efficiency MERV 3, 8, or 13 filter. This improves indoor air quality (IAQ). Finally, the air is cooled over the cooling coil and mixed with fresh air from the DOAS air handler.

The FDCOA has a low profile casing design for restricted ceiling spaces, and also features a small, variable air volume (VAV) inlet valve equipped with a Price SP300 Velocity Pressure Sensor. Additionally, the model can be ordered with a stainless steel drain pan, a variety of Price Liners, and – for zones requiring heat – an optional electric or hot water coil.

FDCOA OPTIONS

- 1 to 6 rows of cooling coils
- 1 to 2 rows of hot water coils or electric heat
- Stainless steel drain pan
- Liner options:
  - Solid Metal
  - Perforated Metal
  - Foil Face Fiberglass
  - Fiber Free Foam
- MERV 3, 8 or 13 return air filter for improved IAQ and LEED credit



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TECH TIPS: WHAT IS SYSTEM EFFECT?

By Jerry Sipes, Ph.D., P.E.
Vice President of Engineering

In duct design and installation, system effect is the generation of higher than expected pressure drops through changes in duct direction or geometry. It can also be caused by improper installation of fittings, which result in excessive, unanticipated turbulence in the air flow. In short, system effect is the installed pressure drop which is different from the design pressure drop.

System effect typically refers to fan installations, but can also be determined for silencers and any geometry or directional change with non-ideal inlet or outlet conditions. Components that commonly experience system effect include duct take-offs, terminal units, chilled beams, diffusers, silencers, fans and water coils.

Symptoms of system effect include excess static pressure drop, instability in air volumes through a device, excessive power consumption in a blower, incorrect flow readings from sensors, lower fan air volumes, and higher levels of radiated and discharge sound.

Duct designers lay out their ductwork in a way that minimizes the potential for system effect. However, as is often the case, the real world interferes. Obstructions such as fire suppression piping and electrical conduits can prevent the duct from being installed as drawn. As a result, additional fittings such as elbows may be installed without the length of inlet or discharge duct to allow the air velocity to be equalized.

When air experiences a change in direction, the air velocity profile in an elbow will shift **(Figure 1)**. If another fitting is attached to the discharge of that elbow, the air velocity profile will not be fully formed. This will result in a higher pressure drop.

To minimize this effect, turning vanes – as well as a length of straight ductwork – are often used to settle the air into a more ideal air velocity pattern. A typical recommended minimum length of straight ductwork is three equivalent diameters. Depending upon the velocity in the duct, the length of straight ductwork may be longer.

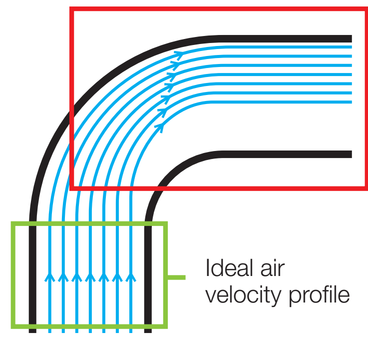
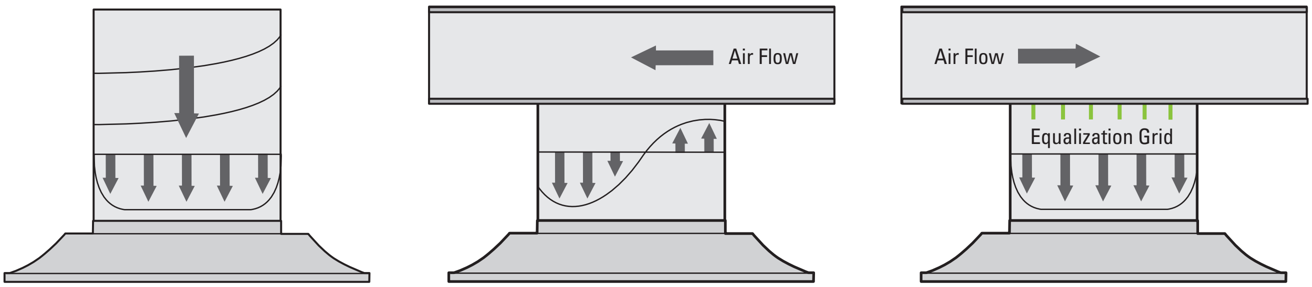


Figure 1: Ideal and non-ideal air velocity profiles in ductwork

A great way to see the impact of system effect is to look at silencers, as the inlet and discharge conditions can have a significant impact in sound absorption. A silencer should be tested to the ASTM Standard E477-06a (ASTM, 2006b), which states that there shall be straight duct of no less than five equivalent duct diameters upstream of the silencer, and not less than ten duct diameters downstream of the silencer. In “real life” applications these conditions are rarely possible, but three to four duct diameters on both sides of the silencer should be a minimum design goal. Diffusers can also be impacted by system effect. This results in higher sound levels and poor discharge air patterns. **Figure 2** shows the air velocity patterns in a diffuser with varying air inlet conditions. The addition of the equalizing grid helps to diminish system effect by minimizing any non-ideal air velocity profile in the duct. Another way of minimizing the system effect would be to use three equivalent diameters of straight inlet duct which has a leveling effect on the air velocity profile.

Terminals can be affected by this as well. For example, when a designer uses acoustic data for a terminal that was tested according to ASHRAE Standard 130, and then adds a silencer that was tested according to ASTM E477, the results will not be what the math would suggest



Basis of manufacturer's rating

Sound levels up to 12 dB higher with NO equalizing grid

Sound levels same as manufacturer's rating with equalizing grid

Figure 2: Various inlet conditions for a diffuser

(see **Figure 3**). This is because the inlet and discharge ductwork lengths are now different than what was tested. Table 1 shows the predicted NC value of the installation is 24, while the actual NC value is 35.

When attaching silencers to terminals it is best to use units that are designed and tested as an assembly, such as the Price SDVQ.

One thing to keep in mind is that static pressure drop is related to noise generation. The higher the turbulence due to pressure drop, the higher the noise generation. For more information on this topic, the Price Engineering Handbook has several chapters that are relevant – *Chapter 8: Duct Design, Chapter 9: Mixing Ventilation, Chapter 10: Noise Control, Chapter 12: Terminals, and Chapter 13: Fan Coils and Blower Coils.*

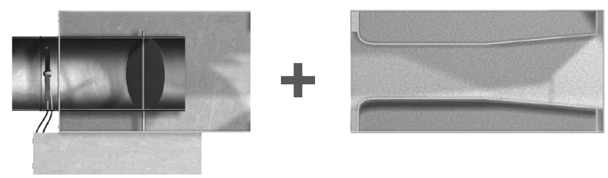


Figure 3: SDV (ASHRAE 130) + Silencer (ASTM E477) can be unpredictable

Discharge Sound Power Octave Bands Mid Frequency							
Octave Band	**125**	**250**	**500**	**1000**	**2000**	**4000**	**NC**
Size 10 SDV	73	74	71	66	64	63	**38**
Silencer IL	5	11	22	29	25	18	
Predicted Values	68	63	49	39	41	45	**24**
Std. SDV/Silencer Test Results	72	61	51	43	49	51	**35**

Table 1: Impact of inlet and discharge conditions on estimated sound values for a discrete single duct terminal and discrete rectangular silencer (non – integrated silencer).