ENGINEERING UPDATE

OCTOBER 2013 - **VOLUME 12**

THIS PACKAGE INCLUDES A COLLECTION OF ARTICLES FROM VOLUME 12 OF THE OCTOBER 2013 ENGINEERING UPDATE.

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DUCT SILENCERS 101

By Alex Michaud – M.Sc., Senior Product Manager - Noise Control

Selecting correct silencers can be daunting even for those familiar with HVAC acoustics. Challenges include evaluating various performance metrics, knowing what is relevant to a specific project, and proper performance comparison between manufacturers. The three main noise aspects to consider when selecting a silencer are:

- **Source** sound power levels in octave bands
- **Path** of sound transmission (i.e. duct, walls, etc.)
- **Receiver** design criteria in an occupied space

With this information, a detailed **Acoustic Analysis** can be performed to determine if noise mitigation measures are required. Not every job requires a silencer, but when there are short duct runs and the design criteria is stringent (typically below NC-35), silencers are often necessary. When selecting a silencer, some essential project specific information is required:

- **Airflow requirements** through the silencer
- **Duct geometry** that must match the silencer
- **Space constraints** that often limit length
- **Allowable pressure drop** of the system

APPLICATION

Projects go much smoother if silencer requirements are clearly indicated in a schedule and/or specification. When the project is still in the design phase, appropriate silencer types must often be determined. Typical applications and appropriate silencer media are listed below:

Table 1. Silencer media by typical application

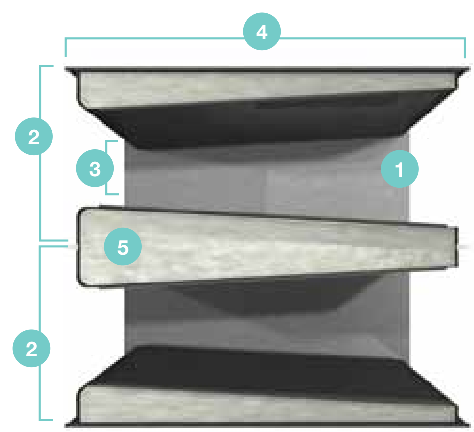
Application	Media	Notes
Offices & Retail	Absorptive	Most cost effective & best performing
Hospitals & Schools	Film-lined	Reduced insertion loss due to polymer liner
Labs & Cleanrooms	Packless	Best for corrosive & high-heat applications

Media type is often conflicting between schedule and specification. For example, scheduled performance might be based on absorptive silencer insertion loss and corresponding specification requirements designate packless or film lined silencers. **Media type has a profound impact on silencer performance, and it is crucial that the appropriate type is selected.**

PERFORMANCE

Dynamic insertion loss (DIL) and **pressure drop** are two critical performance metrics that often drive silencer selection. Both metrics are proportional to each other. That is, when DIL increases, the pressure drop also increases. There are many silencer attributes that can be modified to meet performance requirements. Several factors for rectangular silencers are listed and depicted below:

1. Internal Geometry
2. Number of Air Passages
3. Free Area
4. Length
5. Media Type



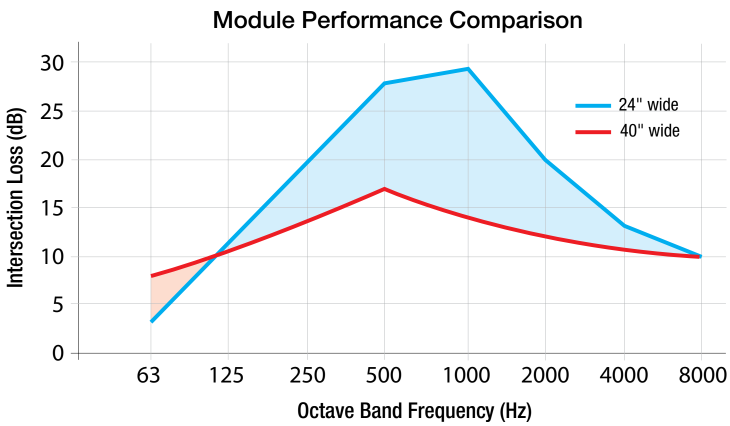
While the Price All-In-One selection software determines these factors based on performance requirements, it's important to understand the additional impact that each factor can have. For example, increasing the number of air passages will typically increase insertion loss performance, but the cost will also increase as more material and labor is necessary.

GEOMETRY & SPACE CONSTRAINTS

Ductwork shape and layout impacts appropriate silencer geometry. For example, elbow silencers are very appropriate when there is minimal ductwork between the equipment (source) and occupied (receiver) space. The tradeoff is that elbow silencers are more expensive and have lower velocity limits than corresponding rectangular silencers. Ultimately, silencers are selected to solve specific noise problems and must fit within the mechanical design. As a result, flexibility and customized geometry are often necessary when selecting silencers.

CONSTANT PERFORMANCE

In the real world, duct size is driven by airflow requirements. Unfortunately, **many legacy silencer manufacturers publish constant performance data based on a single module size** (e.g. 24” x 24”). This constant performance data is applied to all silencer units, and can differ substantially between tested geometry and actual project duct geometry. The graph below illustrates the potential insertion loss performance difference between a 24” wide module and a 40” wide module silencer. At 1000 Hz, for example, the 24” module provides approximately 15 dB more insertion loss than the 40” module. As the difference between tested and actual geometry increases, so too does the insertion loss performance difference. Clearly, the 24” module performs much better, which can result in an apples-to-oranges comparison depending on the manufacturer. As a result, it is important to realize what type of silencer performance is presented in order to ensure an apples-to-apples comparison.



AGE BEFORE BEAUTY

Another common difference in silencer performance between manufacturers is the testing standard upon which performance is derived. The standard applicable to duct silencers, **ASTM E477, has undergone many revisions since it was originally published in 1973.** These revisions have improved the utility and accuracy of the measured results. Many manufacturers provide outdated performance data because it elevates their silencer performance. Price silencers are tested in strict accordance with ASTM E477-13 in our NVLAP-Accredited laboratory. To ensure the highest level of accuracy, it is very important to **specify that performance data is based on the latest version of the test standard, which is currently ASTM E477-13, released earlier this year.**

TERMINOLOGY

- ***Insertion Loss*** *is the sound level difference due to the placement of a silencer in the sound transmission path. It compares an empty duct with an attenuated silencer duct.*
- ***Dynamic Insertion Loss*** *(DIL) is the measured insertion loss with airflow through the test silencer.*
- ***Forward Flow*** *refers to sound travelling in the same direction as the airflow (i.e. supply duct).*
- ***Reverse Flow*** *refers to sound travelling in the opposite direction as the airflow (i.e. return duct).*
- ***ASTM E477*** *is the standard applicable to duct silencers. The current version is ASTM E477-13.*

IF YOU ARE INTERESTED IN LEARNING MORE ABOUT NOISE CONTROL, PLEASE CONTACT **NOISE**CONTROL@PRICE-HVAC.COM

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PRODUCT FEATURE: LFD3 - LAMINAR FLOW DIFFUSER

By Nolan Hosking– Senior Product Manager, Critical Environment Products

The LFD3, a new Price Laminar Flow Diffuser, is specifically designed to facilitate the quick and easy removal of all internal components without the need for tools, setting the premier standard for product cleaning and serviceability.

Price's LFD3 showcases the most consistent face velocity performance of any laminar flow diffuser on the market. Its non-aspirating, unidirectional laminar flow is ideal for applications where low velocity and minimal entrainment of air is required, such as cleanrooms, laboratories and hospital operating rooms.

PRODUCT FEATURES

- Dual chamber design with 3-piece removable equalization baffle
- Room-side accessible cone damper
- One-piece fully welded plenum (4.75" height)
- Aluminum or stainless steel construction
- Baked powder coat finish (B12 white) or anodized clear aluminum
- Suitable for surface mount or lay-in applications

IF YOU ARE INTERESTED IN LEARNING MORE ABOUT LAMINAR FLOW DIFFUSERS OR OTHER CRITICAL ENVIRONMENT SOLUTIONS, CONTACT **CRITICAL**ENVIRONMENTS@PRICE-HVAC.COM

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TECH TIP: CONDENSATE AND CHILLED BEAM COOLING COILS

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

The concept of condensate formation on cool surfaces, such as radiant panels or cooling coils, is a topic of great interest when discussing the application and selection of active chilled beams, and particularly when the building in question is located in a humid climate.

As most designers and end users have concerns about the potential for condensation, it is common for the concept of using a condensate pan to be considered. To me, using a condensate pan appears to be an expensive option for active chilled beams, as the beams are often located in the ceiling and would require a condensate pump on each beam, or a sloped ceiling to allow the condensate to properly drain. A coil with condensate (moist fins) would require a filter for the induced air since the moisture will act like 'glue', and tends to bond the particulates to the fins (see **Figure 1**). Over time, the particulate deposition can fill the spaces between fins in a cooling coil and would require cleaning the coil. As a result, operating a chilled beam in latent mode (moisture removal) tends to have a more stringent maintenance routine, as filters must be inspected frequently and drain pans checked to verify that moisture and biological materials are not building up. A sensible only cooling coil does not have any of these issues associated with it.

The physics are straight forward – condensate pans are not required if the system is designed to use chilled supply water that is above the zone dew point temperature and considered safe, particularly if both a proactive and reactive control approach are taken. One type of proactive control is zone humidity, or dew point monitoring, and chilled water supply temperature moderation. A type of reactive control would be a condensate sensor that is mounted to the piping servicing the active chilled beam, where the sensor would shut off the water valve and notify the building management system when condensate forms.

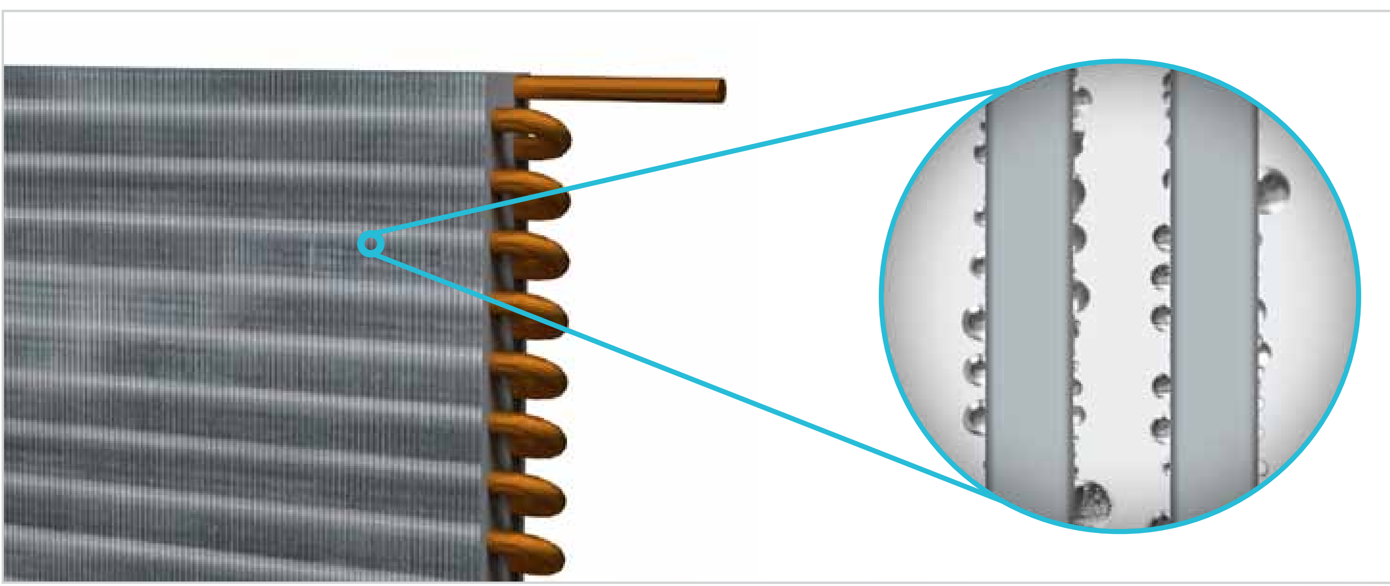

Figure 1: Coil fin with water droplets

Worldwide, there are active chilled beams installed in humid areas that do not need, nor have drain pans installed. Having stated that, most building codes have historically required drain/condensate pans for cooling coils. Recently, the chilled beam section at AHRI filed an interpretation request with the International Code Council (ICC) concerning the requirement in the International Mechanical Code (IMC) that cooling coils must have a drain pan. We asked why a sensible only cooling coil requires a drain pan, and submitted a proposed change to the language in the IMC. The ICC sent out the proposed change to the IMC and after public review, Section 307.2 was adopted in November 2012 and becomes effective at the next printing of the IMC in 2015.

Recently, ASHRAE Standard 170 has approved addendum h, which allows the use of induction units (active chilled beams) in healthcare patient rooms. There was good discussion concerning the use of a wet versus dry cooling coil. The result of the approval of addendum h was that a cooling coil with wet fin surfaces must have at least a MERV 6 filter immediately upstream of the coil, as well as a drain pan. A cooling coil selected and operated in sensible only mode would not require a filter, or a drain pan.

Overhead mixing systems (diffusers) require a minimum of 6 air changes per hour (ach) to each patient room, of which at least 2 ach are filtered outdoor air. Since one of the provisions of addendum h allows active chilled beams to use the minimum required 2 outdoor air room changes (ach) and move the other 4 ach locally through induction, significant energy can be saved with the use of active chilled beams compared to overhead mixing systems through the reduced fan power consumption, as well as lowered amounts of reheat energy required.

In the case of a chilled beam running in latent removal mode, a filter will be required to meet the provisions of addendum h. Due to the additional pressure drop by the filter, the amount of room air induced would be reduced compared to a sensible only unit without the filtration requirement. This would lead to either more beams or higher static pressures to drive the required 4 ach induction to make up for the reduced induction associated with the filter static pressure drop. Higher inlet static pressure requires additional fan horsepower and can lead to higher levels of sound generated by the active chilled beam. A typical chilled beam running at an inlet static pressure between 0.2 and 1.0 inches w.c. can induce from 2 to 8 or more (depends on the model type) of room ach.

The goal is, of course, a thoroughly mixed patient room. An active chilled beam is a very effective mixing device. Active chilled beams have been installed in patient rooms in various locations across North America, and are shown in **Figure 2**.

Active chilled beams have a place in many types of buildings and climates.

For more information, please see the Price Engineering Handbook, or www.price-hvac.com.

Figure 2: Memorial Hospital and Health Care Center

307.2: *Evaporators and Cooling Coils*

Condensate drain systems shall be provided for equipment and appliances containing evaporators or cooling coils. Condensate drain systems shall be designed, constructed and installed in accordance with Sections 307.2.1 through 307.2.4.

Exception: *Evaporators and cooling coils that are designed to operate in sensible cooling only and not support condensation shall not be required to meet the requirements of this section.*

Reason: *The introduction of chilled beam technology is relatively new in the North American market. The code does not take into consideration the fact that dry coils are utilized in most chilled beam designs; it is an integral part of the design. The chilled beam products have been successfully operating in applications all over the world in this dry manner for over 25 years. Additionally, it is more hygienic and provides greater energy efficiency to design these systems with dry coils. Finally, condensation prevention strategies are already employed as part of the design of chilled beam systems.*

Cost Impact: *The code change proposal will not increase the cost of construction.*

IF YOU ARE INTERESTED IN LEARNING MORE ABOUT OUR BEAMS TECHNOLOGY CONTACT YOUR LOCAL PRICE REPRESENTATIVE TODAY.