Duct Liner Material Selection Considerations

The ideal duct liner material would offer the following properties:

- High NRC (Noise Reduction Coefficient) value
- High R-value (sufficient to meet code)
- Moisture Resistant
- Mold / Mildew Resistant
- Low friction loss (air velocity)
- Compatible with a variety of adhesives
- Easy to install using a coil line
- Easy to install in a spiral, round or oval duct
- Easy to clean (smooth surface)
- Non-fibrous
- Low VOC / formaldehyde free
- Damage resistant (tear, compression, etc)

As with most products, duct liner physical properties are generally a trade-off of performance features, and no one product rates highest in all areas. This technical bulletin will discuss each property and review the various materials available. A summary chart at the end allows for easy comparisons and selection of the product that best fits your needs.

NRC

Noise reduction (NRC) is one of the key physical properties of any duct liner. Duct liner's NRC values for a 1" thickness range from .25 to .70 (meaning it absorbs 25% - 70% of the noise from an air handler traveling down a duct) depending on material type. Most acoustical engineers would conclude that an NRC of .50 or better is sufficient for most applications.

R-value

The R-value of a duct liner is mandated by state and city building codes. The R-value of the insulation is directly dependent on the thickness and the thermal conductivity (k) value of the insulation. Most commercial duct liners have fairly similar thermal conductivity (k) values, meaning they provide equivalence in the area of thermal insulation. Thermal insulation properties of a duct liner are certainly very important as this is what ensures distribution of uniform air temperatures throughout the building as well as to control heating / cooling costs.

Moisture Resistance

Moisture resistance of duct liners can be very different. Duct liners can be classified into three categories: fibrous/open cell, non-fibrous open cell or non-fibrous closed cell. Fibrous and open

cell materials do not have the ability to resist moisture intrusion without a moisture barrier. A closed cell product inherently resists moisture intrusion (moisture and moisture vapor). Generally, moisture barriers are thin, concentrated films/layers that can be easily damaged, resulting in moisture intrusion. In fact, many non-closed cell duct liner materials not only allow moisture intrusion, they wick moisture throughout the material if the thin moisture barrier is damaged. Moisture absorption is important for two reasons: 1) it degrades the thermal conductivity of the material (reduces the effective R value) and 2) it increases the propensity for mold and mildew growth.

Moisture absorption resistance of a duct liner is probably the single most important factor in determining its long-term performance. Because closed cell elastomeric duct liners have such a good reputation in the area of moisture resistance, they have historically been specified in indoor pool venue (natatorium) applications, where humidity and moisture are a major concern for the HVAC system design.

Mold / Mildew Resistance

Most duct liners claim mold and mildew resistance. Mold and mildew need three things to grow: dirt (always present), warm air (always present) and moisture. Mold may not grow on a clean duct liner material under laboratory conditions, but will grow on the dirt attached to the duct liner. Thus, a material that resists moisture and dirt accumulation becomes very important. Even if a product contains an antimicrobial additive, it does not guarantee that mold will not grow on the dirt attached to the product. Moisture resistance is the key to resisting mold and mildew.

UL Environmental maintains a program for mold resistance. Materials that are under a UL follow-up service and pass UL 2824 / ASTM D6329 mold growth tests are UL Validated for Mold Resistance.

Easy to Clean (Smooth Surface)

A duct liner with a smooth, tough surface that is easy to clean will generally resist mold / mildew growth better than one with a rough surface.

Non-fibrous

Fibers in the air stream have been an issue with duct liners for many years. Many hospitals have banned the use of duct liners for this reason. Some building codes require double wall duct construction or encapsulation of duct liner in a mylar film to prevent fibers from entering the air stream. The problem with this type of mandate is that it precludes the use of non-fibrous materials, such as elastomeric-based duct liners, that do not have this issue. Elastomeric duct liners are non-fibrous and non-dusting, and have no problem with this issue.

Low VOC / Formaldehyde Free

The VOC's given off by construction materials and furnishings are a major concern to the IAQ of a building. Materials located in a duct, such as duct liner, are particularly critical. One of the best assurances you can have to be certain a material is low VOC is a certification from a 3rd party, such as UL Environmental's GREENGUARD certification program, that the product is a low VOC material when tested according to a nationally-recognized test method. The highest certification UL GREENGUARD offers is the GOLD rating (formerly "Children and Schools"). With this rating, you can be assured that the product is a low VOC material.

Fiberglass duct lining materials historically used a formaldehyde binder. Fiberglass liners today use alternative non-formaldehyde binders. Elastomeric insulation materials have always been formaldehyde free.

Adhesive Compatibility

There are a variety of adhesives used to adhere duct liner to the metal duct, including water-based, solvent-based, hot melt, and pressure sensitive, among others. The adhesive must be compatible with the insulation, i.e. water-based adhesives work on open cell fibrous materials but only a limited number of "fast tack" water based adhesives can be used on closed cell materials as the water in the adhesive cannot dissipate through a closed cell material and would be too slow to dry. Some materials have a difficult surface to glue to and rely primarily on mechanical fasteners (pins) to hold the material in place, i.e. fibrous materials. It is always recommended to both pin (mechanically fasten) and glue the duct liner in place in accordance with SMACNA guidelines.

Easy coil line installation

For large jobs, an automated coil line is the fastest way to fabricate a duct and install liner at the same time. Coil lines are designed to work with fiberglass, the material historically used as a duct liner. For a material to be used on a coil line, it must be readily (quickly) attached to the metal and able to cut with the metal and form corners when bent with the metal. Fiberglass meets these requirements as it can be used with a water-based adhesive that "tacks" the material in place until it is pinned and is easily compressed to form the corners. Closed cell elastomeric products require adjustment to the coil line to adhere the product to the sheet metal with a solvent based or specific fast tack water based adhesive. The in-line cutting tools may not work with all insulation thicknesses and / or products from different manufacturers. Likewise, the ability to bend without leaving air gaps in the corners will be a function of the specific product and insulation thickness.

Easy to install on spiral duct

Some of the same issues in using an automated coil line are present when dealing with spiral duct. Fibrous materials work well in the manufacture of spiral duct. Adjustments to the process

will be required if closed cell elastomeric insulation is used. Elastomeric insulation is easier to install on larger diameters of single wall spiral round and oval duct. Double wall round duct can be insulated using elastomeric insulation more easily than single wall spiral duct, especially if the duct is being insulated primarily for sound control as opposed to thermal insulation / code compliance.

Damage Resistance

The ability of a material to resist damage (tearing) and compression (loss in thickness) are important to the long-term performance of a duct liner. The R-value of the product is directly related to the ability of the product to maintain its thickness. Damage resistance and moisture resistance are primary considerations when duct liner has to be cleaned regularly.

	Closed Cell Elastomeric	Open Cell Elastomeric	Fibrous / Open Cell
High NRC	.55	.60	.70
High R-value (meets code)	x	x	x
Moisture Resistance	x		
Mold / Mildew Resistance (UL Validated)	x Some		x some
Low friction loss (air velocity)	x	x	x
Low air erosion	x	x	x
Compatible with variety of adhesives	x	x	x
Water-based Adhesive	x	x	x
Other Adhesive	x	x	x
Easy to install using coil line	Limited	Variable results	x
Easy to install on spiral duct	Diameter dependent	x	x
Easy to clean (smooth surface)	x	x	
Non-fibrous	x	x	
Low VOC (UL GREENGUARD certified)	x Some	x	x
Damage Resistant (tear, compression)	x		Variable

Note: Not all manufacturers in any material category meet the same performance standards.

Summary

When selecting the ideal duct liner material, compromises in physical properties, installation features and cost may be required to obtain the best long-term performance for the application. IAQ requirements may be more stringent in a school, hotel or hospital than in an industrial or warehouse installation, which may affect the decision process when selecting a duct liner. Cost is also a factor. When considering the cost of a duct liner, it is important to view it in terms of the cost of the complete HVAC system or even the cost of the building, as the building is only as good as its weakest link. Installing a poor performing duct liner can affect the performance of the entire HVAC system. With proper design and specification, the system should perform for many years, meeting the requirements of the initial design.