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Fabric Air Distribution

by

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General Discussion:

Air distribution in America has been undergoing a material change over the past few years, literally. Engineers, interior designers, architects, facility owners and contractors have found that the use of fabric material ducts has provided the technical answer to air distribution problems that traditional sheet metal ducts haven't been able to achieve without significant additional cost. The use of fabric air distribution systems can be a paradigm shift that sets stagnant engineering and architectural minds in motion on a building design team. With the recent uncontrolled rising cost of steel the use of fabric air distribution systems has become a more viable alternative than ever before.

Although the term "duct" is used with fabric air distribution systems, they are actually classified as an "Air Distribution Device" by Underwriters Laboratories (UL: Northbrook, IL) and as a "Fabric Air Dispersion Product" by the International Code Council (ICC). In this regard, fabric air distribution is performing as a replacement for the supply air devices in a space and the exposed ductwork that these air devices are mounted on.

Applications that require non-condensing duct surfaces, light weight material installations in facilities with light weight roof construction, lowest overall first costs, non-denting materials of construction or low maintenance downtime are just a few of the applications that have found solutions with fabric duct systems.

Advantages To Using Fabric Duct:

Some of the advantages to using fabric duct systems are that they:

- can be less expensive to install than other air distribution systems,
- can be installed in a less time than other air distribution systems,
- are flexible and not subject to denting like metal ducts,
- can provide more even air distribution than traditional grilles & diffusers,
- are portable and adaptable to changing air distribution requirements,
- are colorful and aesthetically pleasing,
- are easily cleanable with minimal system or process downtime,
- are essentially self-balancing,
- are easily shipped in boxes,
- are simple and easy to install,
- provide lower shipping and handling cost due to less weight,
- provide quiet air delivery,
- have multiple fabric material options to fit essentially any application,
- come in a variety of shapes and sizes with optional fittings,
- provide draft free air distribution,
- are not subject to condensation on the "duct" surface,



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- have some manufacturers certified as “green” product for LEEDS certified facility designs,
- are a soft fabric that provides an additional acoustical absorptive surface in the space,
- can be used for spot cooling,
- can handle a wide range of pressures,
- can be fabricated in a wide range of diameters from small to very large,
- can be used in Variable Air Volume as well as constant volume systems.

Installations/Applications:

There are a variety of room and building types in which fabric air distribution systems have already been installed. There are usually multiple reasons why fabric air ducts are used in different applications to fulfill the functional requirements of the application. The applications discussed herein do not present an exhaustive list of applications for fabric air distribution systems. The potential use of fabric air ducts is only limited to the imagination and creativity of the engineer, interior designer and architect looking for a solution to the design challenge.

The use of fabric duct systems is generally limited to exposed applications and not allowed by code for concealed applications. However, there may be some areas such as crawl spaces and other non-occupied concealed spaces where fabric air distribution systems may be allowed. The local building code AHJ (Authority Having Jurisdiction) should be consulted in these applications.

Food Processing:

There are several types of food processing industries that could be considered as good candidates for fabric duct installations. Some examples of successful installations include such industries as meat packing, dairies, canned food goods, candy factories, beverage producers, etc. The fabric ducts can be used in both the production and storage areas. One of the key benefits of using fabric ducts in food processing facilities is the ease of cleaning the fabric duct as compared to traditional sheet metal duct. When properly designed and installed, the fabric duct can be cleaned faster and allow for shorter production downtimes during the cleaning periods.

Industrial, Manufacturing, Warehousing, Distribution Centers:

Examples of these types of facilities are such industries as paper processing, printing, steel production, automobile industry, any product manufacturing facility, etc. Any large open facility where ventilation is needed is a good candidate for fabric air distribution. Providing forced supply air as opposed to using exhaust fans is a more effective way to provide proper ventilation in these types of large spaces.



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Photo courtesy of DuctSox

Pools/Natatoriums:

Fabric ducts have found a major niche market in buildings with enclosed pools and natatoriums. These spaces have high humidity and chlorine in the air that can cause corrosion in some steel duct installations. Fabric ducts can offer a cost effective, non-condensing, corrosion proof solution to these air distribution challenges. Architects and engineers who still use underground metal or concrete ducts may be creating higher costs for their clients and providing systems that are prone to having standing water in the supply air ducts that could cause indoor air quality issues or corrosion of the underground duct over time.



Photo courtesy of DuctSox



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Gymnasiums:

Gymnasiums have become very popular places for fabric ducts for a variety of reasons. Fabric ducts don't dent when a ball is kicked into the duct. Fabric ducts provide a soft material to help absorb noise from the yelling and screaming in a gymnasium during a sporting event. Fabric ducts can be used to provide custom colors, logos or advertising in a fun yet functional way. Fabric ducts are light weight compared to steel ducts and thereby don't impose as much weight on the structure. Fabric ducts can be installed quickly in existing facilities where ventilation needs to be added or improved.



Photo courtesy of DuctSox

Auditoriums/Sports Arena/Convention Centers:

Public facilities like major auditoriums, arenas, indoor stadiums and convention centers are generally needing low initial first cost construction methods when tax dollars are on the line. Fabric duct can answer this challenge. Revenue generated by silk-screened advertising on replaceable sections of fabric ducts can effectively pay for the cost of the HVAC system.



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Photo courtesy of DuctSox

Large Public Spaces:

Large public spaces like casinos, concert/music halls, museums, convention center meeting rooms, etc. typically require air distribution from high ceilings. Fabric air distribution systems can accomplish this in a manner that is not only effective for air distribution but also adds another dimension to the interior design of the space. Signage and advertising can be provided on the fabric ducts to help inform the public of areas of interest while in these facilities.

Refrigerated Storage Or Processing Areas:

Uniform air temperatures are sometimes desired or required for product quality control in refrigerated storage of food or beverage production facilities. Fabric air distribution systems can accomplish this by providing more uniform air distribution than can be accomplished with traditional sheet metal ducts and diffusers. By using non-vented porous fabrics a draft free system can be provided.

Office Spaces:

Ventilation effectiveness is one of the key goals of office ventilation. Comfort and indoor air quality hinge on good air distribution. Fabric ducts can provide a more cost effective method to get air distributed in an office space in a manner that is not generally cost effective or possible with traditional ceiling diffusers or diffusers mounted on exposed steel ducts or high ceiling applications. With fabric air distribution, the air can be distributed more evenly by using vents/nozzles evenly spaced across the entire length of the fabric duct. This provides a great way to cover a large length of floor to ceiling glass that might otherwise have hot and cold spots due to the spacing of traditional metal air devices.

Retail/Grocery Stores:

Public spaces that are designed to get shoppers to buy products need to have architectural and interior designs that create a mood for shopping. These are design challenges that require



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creative solutions. Fabric duct air distribution systems provide this creative opportunity. With fabric ducts the designers can use colors and shapes and air distribution creativity that is not generally economically feasible with steel duct products. Signage and informational message imprints on the fabric ducts can also be used to help shoppers find the products they are seeking more easily. In areas where open case refrigeration displays are used the fabric air distribution systems can provide a draft free supply air so that the “air curtain” of the display case is not affected. This becomes a major energy saver for the store and allows the refrigerated product to be unaffected by the supply air stream that might be blowing warm air onto it when using traditional metal supply air devices.

Restaurants/Lounges:

Eating in America is an event; an event that demands interior designs that are enjoyable to the eye. Architects have found that the use of fabric ducts provides the ambiance in restaurants and lounges that create a fun environment and at the same time provides a comfortable draft free space.

Libraries/Schools/Churches/Hospitals:

Public places such as these have spaces that architects attempt to make aesthetically pleasing and enjoyable to be in. Manufacturers of fabric ducts have researched and found fabrics that can be used to provide some new creative solutions to air distribution in these types of spaces. The use of fabric ducts provides a softer look, provides a quiet method of air distribution, provides good air coverage in the space and is simply just fun to work with in the design. Creative silk screening on the fabrics can be used to enhance the space in many ways.

Electronics Rooms:

Rooms that have electronic equipment generally require materials of construction that minimize or eliminate static electricity charges. Some manufacturers of fabric ducts have found fabrics that do not cause static electricity charges. These fabrics can also provide draft free air distribution in rooms where this is needed.

Temporary Structures/Tents:

The use of temporary tents and other structures for various events like weddings, parties, holiday celebrations, family reunions or more tragic events like tornado and hurricane disaster relief efforts and military operations have become very common. Since these structures and tents need to be mobile it only makes sense that the air distribution systems are mobile also. Fabric duct systems provide the mobility, flexibility, versatility, durability and ease of installation that meet these design requirements. In addition, fabric ducts are lightweight and do not impose an unnecessary structural load on the framework of these structures and tent. Lastly, the fabric air ducts provide a very effective way to achieve air movement in these structures and tents that are generally placed in direct exposure to the sun.

Laboratories/Clean Rooms:



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Laboratories generally require large amounts of supply air to compensate for the research hood exhausts. It is important to get this supply air into the space without disturbing the airflow pattern into the hood. It is also generally desirable to provide a comfortable environment with minimal drafts in the space for the occupants. Properly designed fabric air distribution can provide solutions to these design challenges.

Kitchens:

Fabric ducts can provide a draft free solution for providing replacement air in kitchens required because of the kitchen hood exhaust. The draft free air distribution is important so that the effectiveness of the hood is not compromised, for worker comfort and so that the food is not cooled by air blowing on it before it is served. The local building code AHJ should be consulted for this application to ensure compliance with local codes and ordinances. Special fabrics with USDA approval for food processing applications may be considered for kitchen applications as well.

Other Applications:

There are several other facility types that could be considered for using fabric air duct systems. Many of the major manufacturers of fabric air ducts have photo galleries on their web pages and in their catalogs that can be used as a stimulus to help the architect, engineer and facility owner think in creative new ways. The use of fabric air distribution is only limited by the innovative creativity of the design team. If a building owner finds that a design team isn't receptive to the innovative use of fabric air distribution or claims that it can't be used for the application, then the owner may wish to challenge the motives of the design team. Innovative design utilizing fabric air distribution can be used in any practically any application.

Design Intent:

The design intent of using fabric duct air distribution systems needs to be established from the beginning of the design. As with the selection and installation of traditional air distribution duct and diffusers, the functional requirements need to be clearly outlined in order to ensure that they are met by the end result. Terminal velocity, supply air temperature, available pressure and throw distance are all parameters that need to be taken into account just like in a traditional metal duct and diffuser system.

Selection Of Fabric Duct Materials:

With fabric duct it is recommended to consider the use of performance specifications. In the sheet metal industry there are some long establish standards for the construction materials and gauges used to fabricate the duct (ASTM, SMACNA, etc.). In the fabric air distribution industry the manufacturers essentially research and select the materials that they use with no industry guidelines on fabric types, porosity, etc. In this regard, the basis-of-design manufacturer may be able to provide a material type and size that meets the design functional requirement; however,



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another manufacturer may have to use a different fabric and size to meet the same functional performance requirements. The project specifications and submittal review need to allow for this type of industry product uniqueness.

Sizing Of Fabric Ducts:

Manufacturers of fabric ducts should have sizing guidelines based on their specific fabrics. Some manufacturers have engineering services and computer programs to help the professional engineer with this task. The sizing of the fabric duct system is manufacturer specific due to the uniqueness of the fabrics used by each manufacturer. Manufacturers publish sizing information and charts; however, care should be used when comparing “or equal” products when such things as duct diameters, orifice sizes and material porosity are compared.

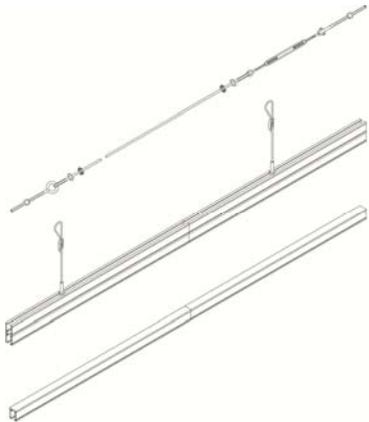
The design criteria needed for sizing of fabric duct is essentially the same as for sizing metal ducts and diffusers. However, for sizing the fabric duct it is necessary to decide what inlet pressure is available at the inlet to the fabric duct and then the sizing is done based on this available pressure (generally 0.5” W.C. minimum) and velocity in the duct. For the air distribution nozzles/vents it is necessary to determine the throw distance, terminal velocity and supply air temperatures for cooling and heating. Manufacturers of fabric duct do not all provide NC levels for all of their fabric options; however, some sound data is available in some case. If an ADPI analysis is desired it needs to be done with some engineering discretion since there is some subjective judgment as to which type of air diffuser a fabric nozzle/vent might most represent depending on the installation location of the nozzle/vent on the fabric duct. Fabric air distribution would most likely fall under the classification of a ‘high sidewall grille’ when using the ADPI selection procedure shown in the ASHRAE Handbooks; however, if placed on the ceiling by using a semi-circle shape it could be possibly function as a ‘ceiling slot diffuser’.

Installation Considerations

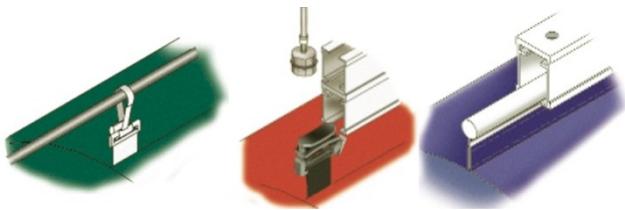
One of the primary reasons for using fabric duct is the ease of installation. It is essentially a three step process.



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1) Install Cable and Turnbuckles



2) Install Fastening Devices (Clips, hanger clamps, corded fabric)



3) Hang The Fabric Duct
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[Fabric Duct & Accessory Specifications:](#)

Fabric:

The fabric can range from the inexpensive polyethylene used in greenhouses to the high tech specialty anti-microbial and anti-static fabrics that are used in food processing or clean room areas.

Things to consider in the specifications for fabrics are such things as the material type, fabric weight, porosity, weave, fire resistance, electrostatic characteristics, resistance to aging and discoloring, UV protection, chemical resistance, etc. In some cases the fabric is porous or has vents/nozzles for air distribution; whereas in others it is non-porous where air transport is desired without diffusion.

Duct Construction and Fittings:

Fabric ducts are usually constructed in round shapes just like sheet metal ducts. However, some manufacturers offer half and quarter round fabric duct profiles to fit flat to ceilings and in corners. Also, some fabric duct manufacturers can offer radius elbows, transitions, saddle “T’s” and other fittings similar to those used in sheet metal duct systems.

The fittings used to connect sections of fabric ducts are generally made with zippers with a fabric flap that can be folded over to conceal this joint. The zippers are generally made of heavy-duty commercial quality non-metallic materials. The initial start fitting off of a fan, air handler or metal duct system is made by connecting the fabric duct with a belt or drawband fastened around the round start collar. A bead is sometimes rolled onto the metal start collar to help provide an additional point of security to fasten the drawband around to prevent the fabric air duct from working itself loose from the start collar.

Fabric Colors:

One of the major benefits of fabric duct systems is the variety of colors that are available. Manufacturers of fabric ducts generally have a stock of standard colors and can also provide custom color fabrics for those installations that need the colors to conform with the clients color schemes.

Some manufacturers also offer silk screening of letters, wording, motivational messages, corporate logos, or other advertising or signage. By using a Velcro type fastening system the signage can be changed out as needed and sold as a revenue generating technique at sporting events or in other public spaces.

Air Distribution Vents/Nozzles:

There are a variety of vent/nozzle styles available from various manufacturers. Some manufacturers have perfected techniques to punch or cut their fabrics to provide a hole or series of holes directly in the fabric without fraying of the fabric. Other manufacturers use or need



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plastic orifices inserted in the fabric. Some of the vents are continuous series of smaller holes while others are slotted openings covered with a mesh material.

In addition to the vents/nozzles the fabric itself can have a porosity that can provide additional air distribution or can be used as the only air distribution when a “draft free” effect is needed. The vents/nozzles can usually be located anywhere along the length or around the circumference of the fabric air duct in order to provide the air distribution coverage that is required for the design application.

Cleanability:

Fabric ducts are designed to be easy to clean. The whole concept of fabric ducts is centered around the ability to take the duct down easily and wash it. Generally the cleaning involves commercial laundering of the fabric air distribution material. Polyethylene materials can generally be washed or hosed down in place if the application requires this type of cleaning. Drain ports may be desired in washdown type applications to allow the water to be drained from the system; however, the polyethylene can also be dried out when the air system is re-energized if excessive water has not accumulated in the system.

Mounting Hardware & Accessories:

The mounting of fabric ducts is generally done with galvanized cabling. However, there are other mounting materials and systems that are available such as stainless steel cables, plastic coated cables and aluminum tracks.

Performance Criteria:

As with any product selection, the end result is what needs to be considered before selecting the product. This is the performance criterion that needs to be understood from the beginning of the job. These include such things as requirements for non-condensing duct surfaces, space air velocity, terminal velocity, throw distance of the air being distributed, temperature of the air during cooling and heating, ceiling heights, etc.

These are the same criteria that need to be considered when using traditional sheet metal ducts and diffusers.

Design Parameters/Units Of Measure:

It is essential to have a performance type specification that can be used for comparison of alternate products. The design parameters listed below are some of the typical parameters that are used by many fabric air distribution product manufacturers in their literature and typical specifications. Metric equivalent units can also be used if desired or required.

Weight: oz./sq. yd.

Thickness: mils

Tensile Strength: lb/in

Resistance To Tearing: lbf

Elongation: %



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Permeability: CFM/sq. ft. @ specified air pressure (inches W.G.)
Shrinkage In Wash: %
Melting Point: °F
Spontaneous Ignition Temperature: °F
Water Absorption: %
Electrostatic Resistance: Ohm/In
Operating Temperatures (Max/Min): °F

Industry Standards:

UL, ASTM, NFPA, USDA are some of the industry standards that are now part of the material specifications for fabric ducts. Such characteristics as Flame Spread/Smoke Development requirements in NFPA 90 and USDA Approval for Meat & Poultry installations are specifiable characteristics of fabric ducts. Listings as “Green Products” are also specifiable industry standards for fabric ducts.

Warranty:

Manufacturers generally provide a standard one year parts warranty with extended warranties available if specified. At least one manufacturer now has a standard warranty of 10 years on some fabrics.

Submittals:

Manufacturers of fabric ducts can provide product data sheets showing the performance and construction features of their products. Installation and O&M instructions can be provided as well as certified construction drawings and the fabric MSDS (Material Safety Data Sheet) are also available upon request.

Demonstration/Commissioning:

As with other HVAC installations, the end result is the most important aspect of the design. The design intent should be specified in a manner that provides measurable results at the actual installation. It may be found that some fabric duct products cannot provide the required level of performance when air performance is specified in a manner that requires proof of performance.

Manufacturers:

There are several manufacturers of fabric ducts. These manufacturers can be located by contacting local sales representative agencies, internet searches using common search engines, industry master specification services, industry product equipment resource guides, etc.

Conclusion

Fabric ducts can be applied to any open ceiling architectural application where there is a need to distribute air. Creativity in the application starts from the first day of design when the project functional criteria are being established. Fabric ducts provide unique solutions to HVAC



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challenges in a more cost effective and energy conscious manner than some of the traditional air distribution systems that engineers and contractors use out of habit.

Using fabric duct is often overlooked when engineers and facility owners look for solutions to these HVAC challenges. Sometimes more elaborate air distribution systems are used when a fabric duct system would provide a more cost effective solution. Engineers may find that the habit of using exposed steel ducts or other more elaborate HVAC system materials needs to be reconsidered and discover that using fabric duct is the wiser choice for many reasons.

Facility owners should insist that the professional designers at least consider and evaluate the benefits of using fabric air distribution where applicable on their projects. The facility owners and professional architects and engineers who understand the benefits of using fabric air distribution systems will be the ones who set the new benchmark for the rest of the industry for integrating engineering and architecture.