

# AIR CONDITIONING AND REFRIGERATION Journal

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## The Market for Duct Systems: What's New

Innovations in duct materials, connections, and software and advice for applying them

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Just when you thought you had seen everything the tin men could throw your way, something new is on the horizon — something new and something that does the job better. How do you improve ductwork, the lowest common denominator of the HVAC system? By looking at the latest problems facing the HVAC industry and solving them with truly “outside-the-box” approaches. Some of the best new HVAC mouse-traps in the world are out there today, waiting for application on your next HVAC project.

### **Indoor environmental quality**

Providing the healthiest and most productive working environment requires the best possible indoor environmental quality (IEQ) and the avoidance of sickbuilding syndrome.

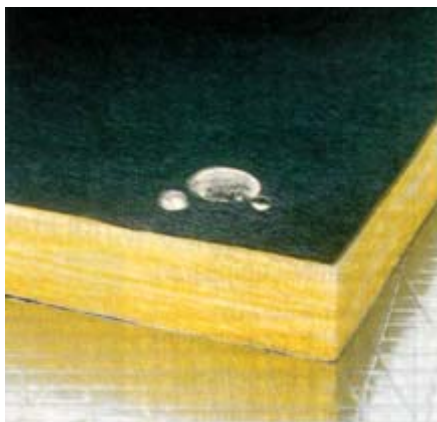
What are the hallmarks of a good indoor-air environment? A lack of infectious and allergenic microbes is one, while a quiet working space is another. But probably foremost

in the minds of many workers simply are comfortable working temperatures and humidities and gentle air movement that maintains fresh surroundings while not causing drafts.

In the rush to get designs out the door and to bidders, many engineers lose sight of the contribution ductwork can make to accomplishing these goals. Indoor air contacts ductwork more than any other part of a commercial building. This means the properties of ductwork can have a lot to do with IEQ.

High concentrations of infectious and allergenic microbes can be prevented by eliminating the sources of moisture and nutrients required for proliferation. In ductwork, this involves adding non-hygroscopic (will not absorb moisture) facings to duct liners. Many manufacturers take this one step farther by adding antimicrobial agents to the duct-liner/duct-board material. These agents also are designed to prevent erosion of the material and its subsequent entrainment into the ventilation-air supply. When specifying duct board and duct liner, ask whether the material has a specially designed surface that resists moisture and erosion, and inquire as to the anti-microbial agent used. The agent should be effective, but also certified by regulatory agencies as safe for use in ventilation-air streams.

## Metal duct

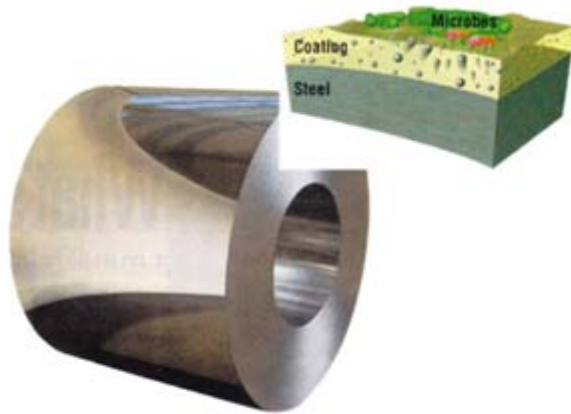


Duct board with a moisture-repelling coating

Going yet another step in the application of anti-microbial agents to duct materials, several companies are applying a silver-ion-based compound directly to metal ductwork. As air is circulated through the ductwork and work space, the microbe population is reduced continually.

In laboratory tests, silver ions have been shown to interfere with the life processes of microorganisms through a form of oxidation similar to burning, but occurring at room

temperature. A microporous zeolite material impregnated with the silver compound is blended with an epoxy bonding agent. The resulting material is applied directly to the face of sheet metal while it still is in coils. This makes the application controllable and economical.



Steel coated with a silver-ion-based compound that suppresses the growth of a broad array of microbes

As the metal is exposed to moisture, the silver ions leach out of the coating, attacking microbes on the surface. The ions either kill the microbes outright or interfere with their ability to colonize and reproduce.

This process has a proven track record, having been applied successfully for medical equipment, counter tops, fabrics, and even plastics.



A self-sealing double-lipped double-wall duct with a fiberretention system

Although long-term application data is not yet available, lab tests have shown the new silver technology to be effective, with a predicted life expectancy of decades. The silver ions bridge scratches up to 1/4 -in. wide, with the coating able to be repaired in the field. Approved by the Environmental Protection Agency and the Food and Drug Administration (FDA), the coating is suitable for stainless-steel, as well as carbon-steel, ductwork. At least two major manufacturers of ductwork and air-handling equipment have made the coating a standard part of their offerings.

## Ductwork connection

One of the most important aspects of an efficient and effective HVAC system is getting ventilation air to the right place. Leaky ducts hamstring this effort by shortcircuiting air

back into return-air plenums, decreasing the air supply and allowing contaminants into returnair ducts. To be tight and leak-free, ductwork has to be designed correctly, fabricated accurately, hung straight and true, and joined with sealed, leak-resistant fittings.

Over the years, manufacturers have reduced duct leakage by developing better and faster methods of joining ducts during installation. The most prominent of these methods utilizes a bolted flange, rather than a slip joint, to connect duct sections. The flange allows gasketing and provides good quality assurance for the field-assembled portion of ductwork. This constitutes the majority of the high-quality, long-life commercial and institutional systems installed today.

At least one manufacturer is producing a line of prefabricated, preinsulated HVAC ductwork for commercial applications. All of the fittings are manufactured in-house, reaping the inherent benefits of factory quality assurance.

Each fitting comes with its own custom-designed elastometric seal, which provides reliable and repeatable performance when assembled in the field. The seal design allows ductwork sections to be slipped inside one another like bell-and-spigot drain pipe. No liquid or mastic sealant — a source of volatile organic hydrocarbons — is required. The duct is said to meet the Sheet Metal and Air Conditioning Contractors' National Association's (SMACNA's) Class 3 integrity rating of -20 to +12 in spwg. Application-specific seal materials are available.

For a presealed duct system, always request the guaranteed leakage class. The American Society of Heating, Refrigerating and Air-Conditioning Engineers recommended sealing efficiency for sealed round duct is the SMACNA Class 3 rating above. Leakage class should be a consideration, but not a make-or-break requirement.

First cost should be another consideration. A complete life-cycle-cost analysis would paint an accurate picture, but may not be justified for many projects, especially small ones.

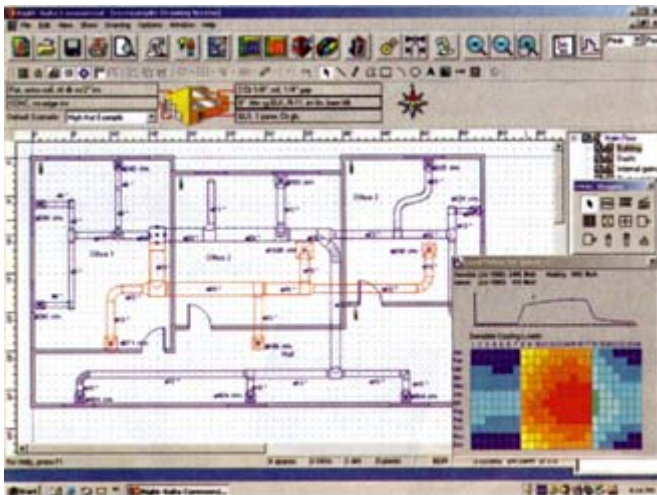
When specifying self-sealing duct, remember that not all prefabricated ductwork comes in all sizes. If large (more than 36 in. in diameter) duct is required, make sure a manufacturer provides it. When it comes to the long-term, guaranteed performance of ductwork, it is best to have single-source responsibility for sealing.

The manufacturer of prefabricated, preinsulated HVAC ductwork for commercial applications also offers a doublewall design. The inner wall can be specified perforated for better sound absorption or specified solid for contaminated air streams where containment is critical. The sound-attenuation characteristics of the duct are excellent, with ratings

approximately double that of conventional duct board and duct liners. The company also offers compact in-line duct silencers that connect directly — with the same seals — and provide attenuation of 10 to 20 dB per foot in moderate diameters.

## Duct-Design software

Use duct-design software in conjunction with the office CAD package. The software should size ducts, grilles, and registers based on room loads; calculate pressure drops; and lay out systems on CAD drawings. See if the software also can create equipment schedules, break down energy use by area, and generate reports. This is important for monitoring efforts and tracking energy efficiency.



An integrated, Windows-based software package that automates design, ASHRAE 24-hr loads, one-and two-line duct design, and parts takeoffs and proposals

Do not forget to ask how the office will get upgrades of the software. And do not forget to check hardware requirements for printers, plotters, and PCs, especially RAM size and special display cards.

One of the worst things that can happen to ductwork is to be redesigned in the field because of designer error. This invariably leads to a higher pressure drop, more noise, more leakage, and possibly an opportunity for moisture carryover from cooling coils. Good duct-design software can help get the job done right the first time, especially if it is integrated with the architectural CAD program. This integration spots interferences at the design stage, before the ductwork arrives at the construction site.



Cutaway view of a metal-core flexible duct with a metalized polyester vapor barrier

## Flex duct

Flex duct is one of the most used — and feared — materials in the HVAC field. It is irreplaceable in making short connections from sheetmetal duct to grilles and registers. Usually made of fabric or flexible plastic sheeting, it has good sound attenuation properties and is useful as a short transfer duct between occupied spaces. It also is useful in isolating noise and vibration when connecting small fans to rigid ductwork.

The downside of flex duct is that the cheaper and lighter types tend to collapse or kink and restrict airflow. Because of its corrugated surface, flex duct has a high pressure drop per unit of length, even when installed correctly. Flex duct that is installed incorrectly and collapsed or kinked can reduce supply or exhaust volume to near zero. This can be prevented through the use of a flex-duct support, a simple frame of high-strength composite material, through which flex duct is threaded as it is connected to terminal devices. The brace guides flex duct into a 90-degree angle as it turns down to a grille or diffuser. This is a great invention at a much lower price than the alternative: providing 90-degree sheetmetal elbows at terminal devices.

One type of flex duct features a double-wall design with metal inside and out and fiberglass insulation in between. The aluminum inner and outer sleeves are rated to 350 F. A stainless-steel design is good to 1,400 F. What's more, the product is available with a perforated interior surface providing sound attenuation of 6 to 8 dB per foot and air-moving capabilities to 3,000 fpm. The duct's sturdy nature prevents its collapse.

Flexible metal duct is available in rectangular, round, and oval shapes and is field-configurable for even the most irregular chases and openings. It even can be used to make transitions between different shapes of rigid ductwork and/or equipment. It is available in aluminum and stainless steel.

## Fabric duct

Fabric ductwork is an air-moving innovation that not only is attractive and flexible in application, but can serve as its own diffuser. It comes in either a non-porous material that requires outlet diffusers or a porous one that releases conditioned air itself.



Fabric duct with a linear vent diffuser providing precise directional air-throw capabilities

Fabric duct must be continuously supported from the structure — either roof or ceiling — above. It comes with sewn-in loops or a tube, through which wire is strung for support. As the duct is pressurized with supply air, it expands to its fullest shape, and air is released through either the fabric itself or openings cut into the material. These openings are engineered to provide the throw required for the conditioned air.

Light and easy to install, fabric duct is available in a variety of colors, which can make for an attractive installation in such large, high-ceiling spaces as convention centers, auditoriums, natatoriums, and light-manufacturing areas. It can be specified with an antimicrobial treatment approved for United States Department of Agriculture (USDA) and FDA applications.

Fabric duct was used extensively in the temporary structures built for the 2002 Winter Olympics in Salt Lake City. Despite the high ceilings and low ambient temperatures, this author found the conditions inside these buildings comfortable. Faced with a short construction schedule, fabric duct appears to be a good way to distribute a large volume of air.

A particularly clever idea of late is the D-shaped fabric duct. This can be mounted on the underside of any ceiling, with the flat side of the “D” up against the ceiling. Tracks are mounted on the ceiling, with the duct pulled up and into position. A high volume of air can be moved with minimal clearance below ceiling height. Add molded-in air diffusers and zipper-connected fabric fittings, and you have a fast and effective air-distribution system that adds colors, as well as ventilation, to a space.

Fabric duct should be made of the highest-quality material meeting all relevant classifications. These include Underwriters Laboratories/National Fire Protection Association testing and classification for flame spread, humidity, mold growth, temperature, pressure, and erosion. In food and dairy-processing facilities, they also

include FDA/USDA testing and certification. Make sure the duct can be cleaned in conventional large-scale industrial laundries. This kills microorganisms and preserves the air-distribution characteristics of the ductwork.

## Quality is in the details

Don't forget the details of a good duct installation, such as durable, high-quality access doors. These should be placed at every coil, fire/smoke damper, actuator, and filter, as well as all other devices that could require cleaning, repair, or replacement. Access doors can be shown on drawings, noted in schedules, or both; however, they must be specified in bid documents, or they will not be installed.

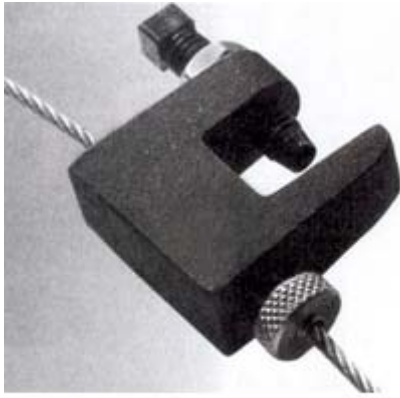


An access door

At best, missing access doors will result in change orders. At worst, they will result in dirty, clogged, and/or inefficient heating and cooling coils that fail to provide comfortable conditions and that waste energy.

Specify insulated access doors of a sandwich construction, with metal on both sides and a rigid foam center (check codes for allowable insulations). This combination results in minimal heating/cooling loss and a rigid panel that operates without binding and provides a consistently tight seal.

Lastly, a variety of adjustable clamps and cable systems is available to suspend ducts quickly and accurately. If you see an installer using an older threaded rod system, suggesting a switch to adjustable cables (with seismic bracing) might save money and earn you bargaining points with the contractor later on.



A labor-saving wire-rope beam clamp, which can be used to hang a variety of mechanical systems.

Every trick helps when it comes to pushing the envelope in state-of-the-art ductwork.

### Free information

A good source of free technical information is SMACNA's Website ([www.smacna.org](http://www.smacna.org)).