



ENERGY SERIES: What About the Ductwork?

How Does the Duct System Work?

Air distribution or duct systems are designed to supply rooms with air that is “conditioned”—that is, heated or cooled by the heating, ventilation, and air conditioning (HVAC) equipment—and to recirculate or return the same volume of air back to the HVAC equipment. Your duct system has two main air transfer systems: 1) supply, and 2) return. The supply side delivers the conditioned air to the home through individual room registers. The return draws inside air and delivers it to the air handler of your central system (e.g., air handler unit) where heat and moisture are either removed or added and then delivered to the supply side. All of the air drawn into the return duct(s) is conditioned and should be delivered back through the supply registers.

What are the Types of Ductwork?

Flex duct

Flexible duct, or more commonly, flex duct, is a round, flexible duct material. This accordion type of duct has a plastic liner surrounded by insulation, which is often bound by a reflective covering. Flex ducts are easy to install in almost any area, but can be inefficient and difficult to seal if installed incorrectly. For maximum airflow, it is important that flexible ductwork is installed correctly: pulled tightly and free of bends and pinches.

Rigid ductboard

Lined rigid ductboard is rectangular, foil covered, and lined with fiber glass. Encapsulated rigid ductboard is lined with a hard, fungicidal material. Rigid ductboard is often used around vents and air handler unit plenums.

Metal duct

Metal duct is rectangular or round bare metal. Round, galvanized steel ducts wrapped on the outside with insulation covered with a vapor barrier are preferred over other duct materials. Round metal ducts have less friction (compared to flex duct and ductboard) therefore they have better air flow. The zinc coating on galvanized metal is hostile to molds and is easier to clean.

When Building a New Home, Where Should the Ductwork be Located?

In new construction, the best option is to locate the duct system within the conditioned space. This way, even if return leaks do occur, the air sucked into the system is already conditioned. Supply leaks can still create a problem by barring even distribution of conditioned air throughout the home. Therefore, proper sealing of ductwork is vital—even when the duct system is located within the conditioned space. The 2015 Virginia Construction Code (effective 9/4/19) requires duct testing of new homes when ductwork is located outside of conditioned space.

Why is the Location of Ductwork Important?

Location is important because ducts placed in unconditioned attics, basements, garages or crawl spaces lose energy if improperly insulated. Additionally, most homes have leaks in both the return and supply sides of the duct system. Locating ductwork in conditioned spaces decreases the temperature and pressure differences *if* leaks do occur.

How Do Leaks Occur?

Homes are not static systems, and conditions change as homes age. Tape adhesive dries out and caulking erodes. Many systems have supply vents in each room, but only one centrally located return vent for the whole home. When we close doors for privacy, air in that particular room can't reach the return vent—but the supply duct is still bringing in conditioned air. It has to go somewhere, so air gets forced out any space available. Meanwhile, enough air isn't entering the return duct, so unconditioned air from the attic, basement, garage or crawl space gets sucked in through weak spots, cracks, or crevices. This situation can be avoided by having supply and return ducts in each room, or by adding vents in doors or in the space between the door frame and ceiling. Also, keep furniture clear of air registers and return air vents. Anything that interferes with air circulation will make the system less efficient.

Where Do You Look for Leaks?

Look for holes, tears, and loose joints at ductwork connections, around the air handler, and near vents. Make sure registers and vents are firmly attached to subfloors and drywall. If your home has a mechanical closet, it should also be properly sealed to prevent negative return side air leakage. The return chamber should be kept free of debris.

What Happens if There is a Leak in the Duct System?

Since most ductwork is located in non-conditioned spaces like attics, basements, garages or crawl spaces, the HVAC system becomes an open system instead of a closed one. Leaking supply ducts can lose large amounts of

cooled/heated air to these unconditioned areas. Leaking return ducts suck hot/cold unconditioned air into the conditioned space. Duct leakage significantly increases cooling and heating loads, indoor air quality risks, and creates comfort issues for occupants.

In homes with gas appliances, leaking ducts can lead to health and safety risks. Negative pressures can contribute to back drafting of a combustion appliances. Gas appliances like atmospherically vented water heaters and furnaces are particularly at risk of back drafting carbon monoxide if there is significant return side duct leakage in the home.

The increased energy cost, because the HVAC system has to work harder, isn't the only effect of leaking ducts. Indoor humidity can increase when unconditioned air is introduced, leading to mold and mildew problems. If the air handler is in the garage and improperly sealed, return or supply leaks can introduce poor quality outdoor air or hazardous vapors from the garage (from cleaning supplies, pesticides, gasoline, paints, car exhaust, etc.) into the home.

How Often Should the Duct System be Checked for Leaks?

Ductwork should be inspected once a year for leaks. Some utilities and home energy raters offer energy audits or diagnostic tools like blower door, duct blaster, and pressure pan tests to detect leaks the homeowner can't easily see. The relationship between supply and return ducts and air movement in the system is complex; and sometimes a homeowner, in fixing one problem, may inadvertently create another. Professionals can sometimes spot such potential problems before they happen.

What is the Best Way to Seal the Leaks?

It is best to have a licensed heating and air conditioning contractor repair your system's duct leaks. Return duct leaks are difficult to detect because the larger return ducts operate at a lower air pressure and air is being drawn into the system. In addition, if you only repair the supply duct leaks, even more unconditioned air may be drawn into the system. Supply duct leaks are more easily noticed because you can feel air blowing out at the connections or see nearby insulation moving.

Duct leaks can be sealed using mastic or acrylic- adhesive foil tape. Mastic adheres well to most surfaces and provides an effective long-term seal. Mastic alone may be used to seal cracks less than ¼" wide. Foil tape carries a 20-year guarantee if applied properly.

If your ductwork is not insulated, consider adding 1½" to 3" of insulation and wrapping with an exterior vapor retarder. Some building codes require that ductwork have a minimum insulation value.

If you see the contractor bringing in duct tape, hire someone else. In the past, many systems were sealed with a gray, rubber-adhesive, cloth duct tape. This tape will eventually fail due to its short-lived rubber-based glue. If you see this kind of tape in an existing home, be sure to check all areas where it is attached to the ducts.

Any sealant should carry the Underwriters Laboratory rating (UL-181) specific for that particular type of duct. Most duct manufacturers are now listing the closure products that they allow to be used with their ducts.

References and Resources

- 2015 Virginia Construction Code, Part 1: <https://www.dhcd.virginia.gov/sites/default/files/Docx/building-codes-regulations/archive-codes/2015/2015-virginia-construction-part-1-code.pdf>

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