Energy Efficient Homes: The Duct System

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Quick Facts

• Typical duct systems lose up to 40% of your heating or cooling energy.

• Leaky ducts make your HVAC work much harder—ducts leaking just 20% of the conditioned air passing through them cause your system to work 50% harder.

• Leaks in your duct system = higher utility bills.

• Duct leakage can result in mold problems and potential health and safety issues.

• Sealing leaky ducts can save you well over $300/year.

Terms to Help You Get Started

• **Duct system** Collection of tubes that distributes heated or cooled air to different room in your home

• **HVAC** Heating, Ventilation, and Air Conditioning equipment

• **Supply** Delivers the conditioned air to the home through individual room registers

• **Supply Registers** Vent-like units in wall, floor, or ceiling where you feel the conditioned air blowing from

• **Return/Return Register or Grille** Picks up inside air for reconditioning, drawing the air through a changeable filter to the air handler of your central system

• **Air handler** The indoor unit that moves the air through the heating/cooling system

• **Cooling load** The amount of energy needed to maintain comfort levels in conditioned air

• **Duct tape** Fabric based tape with a rubber adhesive used in many households for temporary fixes, but has been proven to become brittle and fail over time
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- **Aluminum/foil tape** Specialty tape with an acrylic-based adhesive that performs consistently under extreme temperatures

- **Mastic** A thick paste that provides a permanent seal at duct joints and connections; sometimes used in conjunction with a fiberglass mesh tape

**So how does a duct system work and why is it so important?**

The duct, or air distribution, system used in cooling and heating your home is a collection of tubes that distributes the heated or cooled air to the different rooms. This branching network of round or rectangular tubes—usually constructed of sheet metal, fiberglass board, or a flexible plastic-and-wire composite—is found within your home. The duct system is 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 circulate or return the same volume of air back to the HVAC equipment.

Typical duct systems lose 25 to 40% of the heating or cooling energy put out by the cooling and heating system. Leaks, one way in which conditioned air is lost, in the duct system make the HVAC system work harder, thus raising your utility bill. In addition, duct leakage can lessen comfort, and endanger your health and safety.

Your duct system has two main air transfer systems—supply and return. The supply side delivers the conditioned air to the home through individual room registers—what you feel blowing out of the registers. The return side picks up inside air and delivers it to the air handler of your central system. All of the air drawn into the return duct(s) is conditioned and should be delivered back through the supply registers.

The graphic below shows common areas where there are problems with the ducts and vents.

**What exactly happens if there is a leak in the duct system?**

Since most ductwork is located in non-conditioned space 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, sometimes beyond what the HVAC system can handle.

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 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 registers in each room, but only one centrally located return register for the whole home. When we close doors for privacy, air in that particular room can’t reach the return register—but the supply register is still bringing in conditioned air. The delivered air 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 providing an air pathway
between the room and the main body of the home.
Such a pathway can be created by adding vents in
doors or walls, or by installing a jumper duct or
transfer vent that connects vents in the ceiling of each
space. Also, keep furniture clear of air registers and
return air vents. Anything that interferes with air
circulation will make the system less efficient and
potentially lead to problems.

**Where do you look for leaks?**

Major leaks can be found around joints at
ductwork connections, around the air handler, and
near vents. Look for holes, tears, and loose joints.
Every unsealed joint is likely a small leak—even if a
gap is not visible. Make sure registers and vents are
firmly attached. 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.

**How often should the duct system be
checked for leaks?**

Ductwork should be inspected once a year for
leaks. Some utilities and 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. And 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
1/4” wide. Foil tape carries a 20-year guarantee if
applied properly.

Any sealant should carry the Underwriters
Laboratories 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.

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. If your contractor insists on
using this type of duct tape, use a different
contractor.

**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. Doing
so can reduce your heating and cooling costs and
improve your indoor air quality. When all the ducts
are inside the building envelope, even if return leaks
do occur, the air infiltrating the system is already
conditioned. Supply leaks can still be a problem in
that you won’t get even distribution of conditioned
air throughout the home. Therefore, proper sealing of
ductwork is still very important—even when the duct
system is located within the conditioned space. Note
that the Florida Building Code, among other things,
requires all duct distribution systems be sized and
designed in accordance with recognized engineering
standards such as ACCA Manual D or other standards.
(ACCA stands for Air Conditioning Contractors of
Why is the location of ductwork important?

Location is important because ducts placed in unconditioned attics, basements, garages, or crawl spaces waste energy if improperly insulated—another major cause of energy loss. Additionally, most homes have leaks in both the return and supply sides of the duct system. Locating ductwork in conditioned spaces decreases the temperature difference if leaks do occur.

Do you have any suggestions for the short-term?

Yes, there are some things you can do now to get the most out of your duct system:

• Change/clean the filters on your return register regularly to optimize airflow.
• Adjust the positioning of your home furnishings so that none of the supply registers are blocked.
• Use weather stripping on the inside edge of your registers to prevent air leaks into wall crevices.
• Contact your local utility for a home energy audit.

Summary

Evaluating the efficiency of your ductwork is just one way to save on energy costs. For more information about HVAC systems, other appliances, and additional resources for improving your homes overall energy efficiency, refer to the Sustainable Living section of SolutionsForYourLife.com.

References and Resources

• Florida Building Code
  http://www.floridabuilding.org

• U.S. Department of Energy – Better Duct Systems for Home Heating and Cooling -
  http://www.nrel.gov/docs/fy05osti/30506.pdf

• U.S. Department of Energy – Improving the Efficiency of Your Duct System -

• U.S. Department of Energy – Minimizing Energy Losses in Ducts –
  http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12730

• University of Florida - Energy Efficient Building Construction in Florida, SP 267, Gainesville, FL.