Duct Leakage in Residential Homes is a Major Problem

Gustafson Has the Solution Gustafson Brings the Round Revolution to the Residential Market

ABSTRACT

Ideally, an air duct system would have no leakage. However components, materials, and instillation techniques used for residential for residential systems have led to most having significant leakage. Not only does leakage lead to an inefficient system, but it also affects overall air quality. Unfortunately, the air duct system is something a homeowner generally does not pay much attention to until there is a problem. As always, price is a major concern for the homeowner. What a system installer needs is a product that is easy to install, airtight, long lasting and affordable. Gustafson has the solution.

DISCUSSION

A recent survey by **Contractor's Magazine** indicated that homeowners who had installed a new HVAC system within the past 12 months reported the following:
Only 55% were satisfied with their new systems Only 45% said they were comfortable. 80% of the homes needed duct repairs.

Furthermore, a study by Pacific Gas and Electric showed: 53% of homes were oversized by a ton or more. 69% of the homes had significant duct leakage 33% had disconnected ductwork. 73% of the houses surveyed had been serviced in the past 12 months.

Homes with ducts in a protected area such as a basement may lose somewhat less than this, while some other types of systems (such as attic ducts in hot, humid climates) often lose more.

Duct repairs could be the most important energy improvement measure am homeowner can do if the ducts are in the attic. If only one half the typical loss of uninsulated and unsealed ducts that are in attics or crawl spaces were saved, it would amount to $160 off the total heating and cooling bill in a typical home. This savings is based on the national average use of natural gas and electricity for central heating and cooling at national average energy cost of 70 cents per them, and 8 cents per kilowatt-hour. A 2001 article from E: Magazine reported that
"Cooling the air in the average American home consumes 2,000 kilowatt-hours of electricity and costs $1,350 a year."

Duct systems lose energy in two ways: by conduction of heat from the warm surface, and air leakage through small cracks and seams. Sometimes a leakage is from accidental holes in the ducts or poorly connected duct sections; but even if the ducts are sealed, their operation can cause the house itself to leak more air than would otherwise be the case.

An understanding of pressure differences in the duct system helps to better understand air leakage in the home. Air moves from high pressure to low pressure. To get air to move from the supply duct into the room it serves, the air in the duct has to be at a higher pressure than the air in the room. Similarly, to move air from the room into the return duct, the air in that duct has to be at a lower

pressure than the air in the room. The registers are the openings through which this air is intended to move. The duct walls provide the barriers that prevent air from moving where we don't want it to go.

The fan of the central furnace creates these pressure differences. When the fan stops, these pressures quickly equalize and the flow of air through the duct stops, too.

Conduction

One way duct systems lose energy is for the warm air inside the ducts to heat the duct walls, which in turn heat the cold air outside the ducts. If the ducts are in an attic or vented crawl space that is nearly as cold as the outdoors, this heat is completely lost. If the ducts are in a basement, some of the heat lost from the ducts may be recaptured by warming the basement ceiling enough to reduce the heat lost from the house.

Typical duct systems lose 25 to 40 percent of the heating or cooling energy put out by the central furnace, heat pump, or air conditioner.

For example, look at the average house with ductwork installed in the attic. The summer sun beating down on the roof causes increased heating on the system. If the assumption s made that at summer's peak, the attic is 120°F, a 15% return leak can reduce the effective capacity and EER of the system by 50%. A 30% return leak can completely overwhelm the capacity of the system, causing the temperature in the house to rise. The total increased electrical demand caused by duct leaks is limited by the capacity of the air conditioner. If air conditioner capacity were unlimited, the peak demand impact of duct leaks on the summer peak would be much larger.

Leaks in a duct system, whether they are in the supply or return, significantly reduces efficiency and degrades air conditioner performance and reduces the equipment's life as well. The efficiency and capacity of an air conditioner decreases in proportion to the size of the leak, plus the penalty created by drawing in the air needed to make up for the leaked supply air from the outdoors.

Another way that ducts lose energy is through air leakage.

Leaky Supply Ducts

Sometimes, the supply ducts leak, but the return ducts are air tight. Even though half the duct system is good, two bad things still happen. First, some of the air that has just been cooled by the unit is lost. Second, this air has to be replaced. If it isn't, the house theoretically would soon be pumped down to a vacuum. What does happen is that warm air from the outside is drawn into the house through cracks and small holes in the outside walls. Usually these occur around doors and windows. Some houses have more of these than others, but no house is air tight. So we've lost some of the coolest air in the house (air that just came from the AC unit), and replaced it with the hottest air around (air from the outside). In other words, a leaking supply duct is an energy loser in two ways: the energy loss that does not go to the rooms and the extra energy needed to cool hot air that leaked into the house.

Leaky Return Ducts

Suppose the supply ducts are tight but the returns leak. The return duct is at a low pressure- lower than the house or the outside -so hot air from the outside is pulled into this duct. This hot air is cooled in the furnace (along with air that came from the house through the return registers). The amount of air delivered to the house by the supply registers is greater than what the return

ducts took from the house (the difference being the hot air that leaked into the return ducts). To equalize the flows, heated room air leaks out of the house through the same holes and cracks that, in the previous example, allowed air to leak in. So hot air is pulled in and cool air leaks out. In addition to creating energy losses, leaky return ducts can create health problems. Especially problematic are leaky returns in an enclosed space such as a basement or garage that also contains the furnace. If the return ducts leak, their low pressure can pull down the pressure in the basement or garage as well, and this can suck flue gases from the furnace and radon gas from the soil surrounding the home. The flue gases can be hazardous to health if they contain carbon monoxide. Exposure to radon gas from the ground is the second leading cause of lung cancer (after smoking). Lastly, dust and fiberglass insulation may also be sucked into the ductwork and distributed throughout the house.

Although experts disagree about how common these hazards are, by upgrading the energy efficiency of the duct system the homeowner has an opportunity to avoid these potential problems.

Leaky Ductwork Can Cost Money, Even When the System Is Off

So far, the examples given occur when the system is operating, However the leaks in ductwork add to the air leaks in the rest of the house even when the system is off (which is most of the time). The cracks in duct-work typically have an area that is 10 to 20 percent of the leakage area of the house. Over the course of a cooling season, the energy losses from ducts when the fan is off can be nearly as great as when the fan is on!

Building Spaces Used as Ducts

To this point, the assumption was made that the duct system is completely separate from the other components of the home. Sometimes this is not so. To save money, builders sometimes use the building structure itself as part of the duct system. One common tactic is to use the spaces between basement or ceiling joists as ducts. (Joists are the horizontal-running boards-generally 2" x 10" or 2" x 12"-that supports the floor above.)

Although this type of construction can be made to operate efficiently, it often leads to significant energy losses. One reason is that joist-space ducts are likely to be uninsulated. Another problem is that they may have unintended leakage paths to the outside, typically through the end of the joist cavity.

With returns, it is even more common to see portions of the building structure used as part of the duct system. Some homes have no return at all; the air handling unit simply has an intake grille through which basement air is drawn in to be cooled and distributed to the home.

Other Evidence of Supply-and Return-Side Leakage

In any kind of duct system, the joints between duct sections should be sealed against leakage. Duct tape is an excellent product, with hundreds of different uses, but sealing ductwork is not one of them. The biggest problem is that it often loses adhesiveness after a few years. In such cases a visual inspection would show it falling off the ducts and it could be easily pulled away.

Another fairly common type of energy-wasting air leakage is found in systems where ducts, water pipes, or vent pipes lead between the basement and the attic. If there are openings around these pipes that allow heated air to flow out or cold air to flow in,

then the pressure difference between the basement and the attic is likely to increase air infiltration into the basement. It is usually a good idea to seal this flow path.

Leaking Ducts Can Also Be Hazardous to Your Health

These are all signs that serious duct leakage may be which over time has accumulated on the surface as the air is being pulled through the insulation.

Comfort and Sizing
Air conditioning cooling capacity is often measured in "tons". A ton of cooling represents the heat energy required to melt one ton of ice in 24 hours. Because duct systems lose energy that is supposed to heat or cool the house, they change the effective capacity of the heating and cooling equipment. For example, a three ton air conditioner connected to a duct system of 70% efficiency effectively becomes a two ton air conditioner. A duct system guaranteed to reduce duct leakage would allow the homeowner to purchase a smaller air conditioning system.

Simulation results showed that improved ducts (low leakage) and improved system installation (minimally leaking and insulated ductwork) can allow the use of a smaller nameplate capacity air conditioner without reducing the actual heating or cooling delivered at the air supply registers to the occupied space or the pulldown time. (A three ton unit can be used rather than a four ton for a typical house). If system nameplate capacity is unchanged, improving duct systems results in the pulldown being reduced by more than an hour, so the occupants become comfortable sooner.

Unfortunately, the old axiom of “out-of-sight, out-of-mind” applies to most aspects of an air conditioning system. For most homeowners, as long as the system is keeping them cool, they usually do not give it much thought. What they do not see is how much their system is costing them per year. Most duct systems are installed in attics or building cavities where they are rarely seen or inspected. The lower quality of air duct currently on the market may lead to poor seals, loose fittings and duct runs, and tears in the system that mean additional leakage, which has already been addressed at length. Not only does this mean the homeowner has an inefficient system, but a leaking ductwork is unhealthy for the occupants as well.

THE GUSTAFSON SOLUTION
Gustafson is the world leader in HVAC air duct systems, but until now has never offered an option for the residential market. The company’s G3 and HV2 self-sealing gasketed fittings provide the tightest fitting ducts available, that are easy to install and do not require the sealant that is normally required for most duct systems. Gustafson’s HV2 solution offers a true win/win situation for all parties involved. The homeowner will reduce their average cooling cost by greater than 50%. Since the HV2 gasket reduces mold and dust distribution, the homeowner’s family will have safer air distributed throughout the house. Furthermore, the HV2 gasket insures that fiberglass insulation will not be sucked into the system and distributed throughout the house. Round metal ductwork is also easier to clean than conventional ductwork, which further reduces dust distribution throughout the house. All of this may reduce illness as well as costly doctor’s visits. The Gustafson ductwork also means the homeowner can purchase a smaller air conditioning system which will use less energy. The system will run more efficiently, which means it will last longer and avoid costly repairs. On a larger level, energy consumption is reduced, along with toxic

emissions from power plants. The ease of installation means that the contractor will spend less time installing the system, thus the homeowner will save in instillation costs. Also, since the contractor is dealing with an industry leader, he can ensure that what he needs is either in stock or available for quick delivery.

Gustafson Inc. develops, manufactures and markets innovative sheet metal products for the HVAC industry. The company's G3 and HV2 line of self-sealing duct systems offers owners, engineers and contractors an easy-to install, performance guaranteed duct system. Gustafson's corporate headquarters and primary manufacturing plant is located in Portsmouth, VA, For more information about Gustafson or for the name of the Gustafson Distributor in your area, please contact Gustafson at 866-757-9414 or visit www.gustafsonduct.com

SOURCES

The Berkley Lab: http;//ducts.lbl.gov
Florida Solar Energy Center: "Duct Doctoring" pg 107-108
Contractor's Magazine Homeowners Survey
Federal Services Information Center
http://www.pueblo.gsa.gov/cic_text/housing/duct/losses.htm
California Energy Commission
CIEE Report On Residential Thermal Distribution Systems:
Distribution Effectiveness and Impacts on Equipment Sizing
Publication Number: 600-00-002 Dated: October 1999
http://www.energy.ca.gov/pier/final_project_reports/600-00-002.html