Thief in the DUCTWORK?

Air duct leakage a major source of energy waste, IAQ issues in forced air systems.

BY FRANK SPEVAK

Images courtesy of TEC.

There are more than a million miles of ductwork in U.S. homes, and industry experts estimate that more than two-thirds of them are leaky enough to justify sealing or repair. Leaky ducts can significantly increase air conditioning and heating bills, dramatically reduce equipment capacity and performance, and result in potentially dangerous indoor air quality problems. In fact, duct leakage is responsible for many of the comfort complaints experienced by homeowners today.

Why stop duct leakage?

Leaks in forced air duct systems are recognized as a major source of energy waste in both new and existing houses. Studies indicate that duct leakage can account for as much as 25% of total house energy loss, and in many cases, has a greater impact on energy use than air infiltration through the building shell.

Just as important, duct leakage can prevent heating and cooling systems from doing their job properly, resulting in hot or cold rooms, and humidity problems. Worse yet, duct leaks can create air quality problems by pulling pollutants and irritants directly into the house.

Here are just a few problems resulting from duct leakage:

→Leaks in the supply ductwork run through the attic can cause expensive conditioned air to be dumped into the attic, crawlspace or garage instead of into the house.

→Return leaks in systems placed in the attics or crawlspaces pull outside air (hot in summer, cold in winter) into the duct system, reducing efficiency and capacity. In humid climates, moist air drawn into return leaks can overwhelm the dehumidification capacity of air conditioning systems causing homes to feel clammy even when the air conditioner is running.

→Heat pumps are particularly susceptible to comfort complaints from duct leakage, especially during the heating season. Duct leaks can cause the air coming from heat pumps to feel lukewarm or even cold during the winter. In addition, leaky ductwork has been found to greatly increase the use of electric strip heaters in heat pumps during the heating season.

→Leaks in return ductwork draw air into the house from crawlspaces, garages and attics, bringing with it dust, mold spores, insulation fibers and other contaminants.

→Household depressurization from duct leaks and imbalanced duct systems can cause spillage of combustion products (from furnaces, water heaters and fireplaces) into the house.

Duct leakage measurements are used to diagnose and demonstrate leakage problems, estimate efficiency losses from duct leakage, and certify the quality of duct system installation.

IECC sets standards

Because of these and other issues, the International Code Council (ICC) created the International Energy Conservation Code (IECC). ICC makes recommendations for building construction codes. These codes are adopted by states, counties and cities.

Since 2009, the IECC portion of the building codes has included the requirement to measure and seal leaky ducts in residential new construction. Some states, such as California, started requiring duct leak measurement and sealing since 2006 for new and existing homes since the vast majority of systems are placed in the attic. Leaks in supply ducts in the attic can cause significant energy expenses, both on the homeowner and on the electric grid.

At present, there are 42 states that have adopted the IECC 2009 or better, with 20 states adopting IECC 2012 or better. While some states have not adopted the IECC, there

are a number of cities and counties around the country that have adopted the IECC requirements. Some states have delayed the adoption of duct leakage testing, but they are all looking to add it in future updates to the building codes.

Studies in California have estimates that over 60% of homes have duct leakage in excess of 40% of the rated flow of an air handler. A home with a 2 1/2 ton air conditioner generally should deliver about 1,000 cfm of air through the system; this is the rated flow. If the home has 40% duct leakage, that means 400 cfm of air that should be delivered to the bedrooms and living rooms of a home is being leaked into the attic. Why pay for a 2 1/2 ton system when 1 ton is not being used for the comfort of the occupants?

The current IECC code for maximum allowed duct leakage in a new home is 4%. The home in the above example then would only have leakage of 40 cfm. For existing homes in California, the standard is 15% maximum leakage, which would still bring the leakage amount to just 150 cfm. While that is not ideal, it is a big improvement from 40% leakage. Now, the occupants will be more comfortable and have more money in their pockets.

It is important to remember that testing commercial duct leakage follows a different set of standards and practices than residential duct leakage testing. Commercial duct systems are designed to provide more flow, capable of higher pressures, and coming from larger systems. The standards for commercial duct leakage are generally based on the Sheet Metal Air Conditioning National Association (SMACNA) standards. While the ICC debates commercial building codes, SMACNA and commercial HVAC contractors have guidelines and standards with which to work.

How to measure duct leakage

A residential duct leakage performance test involves pressurizing the duct system with a calibrated fan and simultaneously measuring the airflow through the fan and its effect on the pressure within the duct system. The tighter the duct system, the less air is needed from the fan to create a change in duct system pressure.

Testing procedures can be set up to measure only duct leaks which are connected to the outside, or to measure total duct leakage (i.e. leaks connected to the outside and inside of the house). Duct leakage measurements are used to diagnose and demonstrate leakage problems, estimate efficiency losses from duct leakage, and certify the quality of duct system installation. Using a duct leakage testing system:

→A duct leakage testing system is used to directly pressure test the duct system for air leaks, much the same way a plumber pressure tests water pipes for leaks.

→A fan is first connected to the duct system at the air handler cabinet or a return grille. After temporarily sealing all remaining registers and grilles, the fan is turned on to force air through all.

→The fan speed is increased until a standard test pressure is achieved in the duct system. A precise leakage measurement is then made using a pressure and flow gauge connected to the fan.

→Estimates of efficiency losses from duct leakage can then be made from the leakage measurements.

Improving efficiency and comfort

Duct leakage testing has been around since the late 1980s, and a test system was used in studies to understand the overall magnitude of the problem. Now, duct leakage testing systems are being used to verify tight ductwork in new and existing homes.

Frank Spevak has more than 30 years of experience in the HVACR industry with expertise in air and pressure measurement equipment. He is the Marketing and Sales Manager at The Energy Conservatory, a Minneapolis-based company known for manufacturing the Minneapolis Blower Door, the Minneapolis Duct Blaster and digital pressure gauges.