Improving Airflow in Central Air Conditioning Systems: A Quick Guide for Contractors

Studies have shown that the vast majority central air conditioning (AC) systems have inadequate airflow. Improper AC system airflow reduces both cooling capacity (the ability of the system to provide cooling) and cooling efficiency (the ability to cool without using a lot of electricity). This translates to higher electricity bills and reduced home comfort.

WHAT AFFECTS SYSTEM AIRFLOW?

Any piece of equipment in the AC system can affect airflow, including return grilles, filters, fan blades, fan motor, in-line accessories (electronic air cleaners, humidifiers, etc.), fittings, duct work, plenums, and evaporator coils. Even closing interior doors in the house can reduce airflow.

For most residential AC systems the likely cause for reduced airflow is undersized ducts. For too long, HVAC contractors sized ducts by rule of thumb, not realizing that inadequate airflow severely reduces both capacity and efficiency. Installers use smaller ducts because installation is easier and properly-sized ducts often will not fit. Architects, home builders, structural engineers and framers historically have not provided adequate space to run ducts.

HOW CAN I TELL IF AIRFLOW IS INADEQUATE?

The easiest way to check for low airflow is comparing the static pressure measurement across the air handler (furnace or fan coil unit) to the manufacturer's airflow table. Most manufacturers design furnaces that operate at 350 cubic feet per minute (CFM) per ton at approximately 0.5 inches of water column (IWC). Most systems, however, operate at static pressures well over 0.8 IWC, even though manufacturer tables rarely go up that high.

The SMUD Home Performance Program (HPP) has rebates available for 400 CFM per ton and 450 CFM per ton (based on the tonnage of the condenser). These airflow rates will have to be directly measured at the supply side or return side of the unit. The three approved measurements methods are flow hood (passive or powered), flow grid, and plenum-pressure matching. Comparing the measured static pressure against the manufacturer's airflow table is not accepted for SMUD HPP.

HOW CAN AIRFLOW BE IMPROVED WITHOUT RE-DUCTING THE ENTIRE SYSTEM?

Substantial improvements to airflow can often be made without drastic changes to the entire system.

Return grilles. There are different *quality* of return grilles that have substantially different airflow properties. The two main types are "stamped face" and "bar type." According to manufacturer's specifications, bar type registers are rated for higher and better airflow than stamped face grilles of the same dimension. When it comes to returns, bigger is better. Increasing grille area will reduce resistance to airflow, but may require more sheetrock and framing modifications. It is often easier and more cost-effective to add additional grilles. Adding a second grille of the same size alongside the original has the advantage of visual symmetry without having to buy two different filter sizes.

Filters. "High Efficiency" filters are usually *very low efficiency* when it comes to airflow. Aftermarket filters that are designed to remove smaller and smaller particles will have more resistance to airflow and clog up faster. Homeowners should not have to choose between air quality and good airflow. If dust allergens and indoor air quality are an issue, consider a different approach such as in-line electronic air cleaners or plug-in room air cleaners. New Title 24 Energy Codes mandate MERV 6 filters in all completely new systems, but also mandate proper sizing to minimize negative airflow impacts.

Return ducts. Adding another return duct or enlarging the existing return duct is usually an easy way to relieve duct system pressure and improve airflow. Because return ducts are often the main bottleneck in the duct system, relieving that pressure can have an immediate effect. Bigger is better for return ducts. Also seek out crushed or kinked ducts. Bends should be as smooth as possible. Consider turning vanes or hard elbows where there is a very sharp turn.

Return plenum. How the return duct is attached to the air handler can impact airflow. Return ducts are usually bigger across than the return side of the air handler, so some sort of transition is required. Ideally the duct should connect straight from the bottom and utilize a smoothly tapered transition. Some air handler manufacturers allow return ducts to attach to the side of the blower compartment, but specifications will show a substantially reduced airflow due to the added resistance from the air having to make a sharp turn at the blower. Some systems, such as closet-mounted upflow systems, cannot be improved, and the only option would be to relocate the system.

Blower. Updating the blower motor to a higher efficiency type ECM motor is sometimes an option, but caution is advised when static pressure is high. See the ***ECM Motor Quick Guide***. The blower fan can become dirty, negatively impacting its performance. The fan blades should be inspected and cleaned regularly.

Evaporator coil. The evaporator coil is what cools the air. Air flows between very small aluminum gaps. Dust, hair and other particles stick to these fins that dampen from condensation. The effect can mount quickly, and the evaporator coil can become as dirty as an unchanged filter. The coil should be inspected and cleaned regularly.

Supply plenum. Similar to the return plenum, how the ducts are attached can impact airflow. Typically, round ducts are attached to a rectangular box at right angles, creating a greater resistance than an angled take-off with tapered transitions.

Supply ducts. This can be where most of the resistance in a duct system occurs, but is harder to fix because there are so many ducts. If a system is being re-ducted or designed anew, the new ducts should be sized with care. Air Conditioning Contractors of America (ACCA) Manual J/S/D is the industry standard for residential HVAC design. Generally, bigger is better, but it needs to be applied evenly to the entire system. Otherwise, the system is unbalanced, resulting in unequal temperature distribution. Existing ducts should be inspected for kinks and crushed sections.

T-Wyes and elbows. A *smooth* 90 degree bend in flex duct is equivalent to 15-25 feet of straight duct in terms of resistance to airflow. Sharp bends should be avoided. Where they are unavoidable, hard elbows should be used. In general, the inside radius of the bend should be no less than half the diameter of the duct. Sheet metal T-Wyes have better airflow properties than duct board “cheese wedge” boxes.

Register boots. Register boots help the air make a turn more smoothly than a sharp bend in flex duct. Side entry register boots (e.g., PH-3, PH-2) should be used in confined spaces. Smooth transitions are always better than sharp angles.

Supply registers. Like return grilles, supply registers come in two basic types: “stamped face” and “bar type.” Bar type registers rated for twice as much air flow as a stamped face register of the exact same dimensions. Unlike return grilles, bigger is not necessarily better. If a supply register is too big, it will not have adequate throw. Replacing stamped face grilles with bar type grilles is easy, relatively cheap, and will result in improved airflow. There is also a good trick for getting more air to the first floor of a two story house with the furnace in the attic: Replace the supply registers on the first floor.

FOR MORE INFORMATION

For more information about energy efficiency incentives available through SMUD, visit: ***http://hpp.smud.org/*** or email Jim Mills at: ***james.mills@smud.org***

For more information about improving airflow and duct sizing:

http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

http://www.acca.org/standards/technical-manuals