

Get Your Ducts in a Row

by Harvey Black & Pat Keegan

What is a DUCT BLASTER?

Experts measure duct leakage with a machine called a “duct blaster”.



Photo courtesy of Invisible Energy

A recent test of 38 new homes in Fort Collins found that the ducts leaked, on average, 12 times more air than would be leaked in a “good” ductwork system.

Sources:
Consumer Guide to Home Energy Savings, 8th edition, ©2003, American Council for an Energy-Efficient Economy, aceee.org/consumerguide

Residential Energy, Krigger and Dorsi, 2004, www.residential-energy.com

US Department of Energy, www.energy.gov

Steve Andrews, consultant, Fort Collins, CO

John Merrill, University of Wisconsin-Extension

Max Sherman, Lawrence Berkeley Lab

Everyone wants their home to be comfortable. In most homes, the primary system to deliver this comfort is the ductwork that distributes warm air in the winter and, with central air conditioning, cool air in the summer. Comfort has a price — heating is typically the largest home energy expense, accounting for nearly half of home energy costs in colder areas like Colorado. Ductwork is a key component of any heating and cooling system.

Most homes in Colorado have furnaces. Some older homes may still have a very inefficient gravity furnace, which relies on the simple principle of hot air rising to distribute warm air. Far more common is the forced air furnace, in which warm air is distributed through ductwork to each room. Natural gas, the typical fuel in Colorado, is burned in the combustion chamber. The exhaust gases, including carbon dioxide and carbon monoxide, are vented out of the building via a flue pipe. The flames heat a metal box called a heat exchanger which transfers heat to the air which is sent on its way through the supply ducts in the house. Another set of ducts return room air back to the furnace.

When it comes to heating, the furnace and thermostat have often received the most attention. But in the last decade more and more attention has been paid to the distribution system. According to Department of Energy (DOE) experts, a typical duct system loses between 25 and 40 percent of the energy put out by your furnace. In Colorado, the situation may be even worse than that. A recent test of 38 new homes in Fort Collins found that the ducts leaked, on average, 12 times more air than would be leaked in a good ductwork system. Experts measure duct leakage with a machine called a duct blaster. This test, which uses a strong fan to pressurize the ductwork, can cost between \$150 and \$350.

“When concerns about energy efficiency first surfaced in the 70s,” says Max Sherman

of Lawrence Berkeley Laboratory in California, “people were most concerned about windows, walls, and furnaces. Nobody was much thinking about the ducts,” he says. “It was only in the early 90s that concerns began to focus on these carriers of comfort.”

Inefficient duct work is like having the blood from your heart go into leaky arteries, with much of it never reaching the cells it was supposed to nourish. While much of the duct work is hidden from view, the part that is visible can be easily sealed with an adhesive compound called mastic, which can be put on duct joints, cracks and holes. It can be applied with a glove, brush, trowel or caulking gun. Duct tape, ironically, should not be used to seal ducts because it dries out in a few years and won’t adhere.

If ducts are inaccessible a different approach is needed. “One of the things we did in the early 90s was to develop a novel way to seal ductwork called AeroSeal,” explains Sherman. “It is an aerosolized sticky polymer that is blown through the duct work by a machine. When the air is blown out through the holes the particles stick. It can seal holes up to 1/4” in diameter. A few companies are beginning to offer this in the Front Range,” says Sherman.

Properly insulating ducts that pass through unheated or unconditioned space is important. Such spaces include attics, crawl spaces, and garages. “Fiberglass is the material of choice,” says Rana Belshe, a consultant from Fairchild, Wisconsin. “The insulation should be at least R-5, though R-8 is preferred.”

Sealing and insulating ductwork is an important step, but may not be enough to ensure adequate airflow throughout the house. Rooms that are hard to heat are often a symptom of inadequate ductwork or registers. Rooms far from the furnace are especially prone to this problem. An expert can quantify airflow to and from each room using a

device called a flow hood, which measures the amount of air going through a supply or return air register. Sometimes airflow can be improved by cutting the bottom of a door to allow air to return out of room without a return register. A creative and experienced heating contractor can usually come up with ways to reconfigure ductwork to provide better airflow.

Last, but not least, is a critical component of the ductwork that you, the homeowner, controls: the air filter. A dirty filter restricts air supply and reduces the airflow to every room. The

filter may need to be replaced as often as once each month, depending upon the amount of dirt in the air and how often the furnace is on. Knowing that a dirty filter can affect your utility bill and comfort helps you remember this important monthly maintenance task – just check your air filter each time you pay your utility bill (refer to pg. 34 for details).

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Types of Efficiency

Efficiency is an important yardstick for evaluating heating systems because the fuel buyer pays for the portion of heat wasted in addition to the portion used.

Heating specialists express heating efficiency in four different ways

- ✓ Fuel burning efficiency
- ✓ Steady-state efficiency (also called combustion efficiency)
- ✓ Annual fuel utilization efficiency (AFUE)
- ✓ Delivered heating efficiency (also called seasonal efficiency)

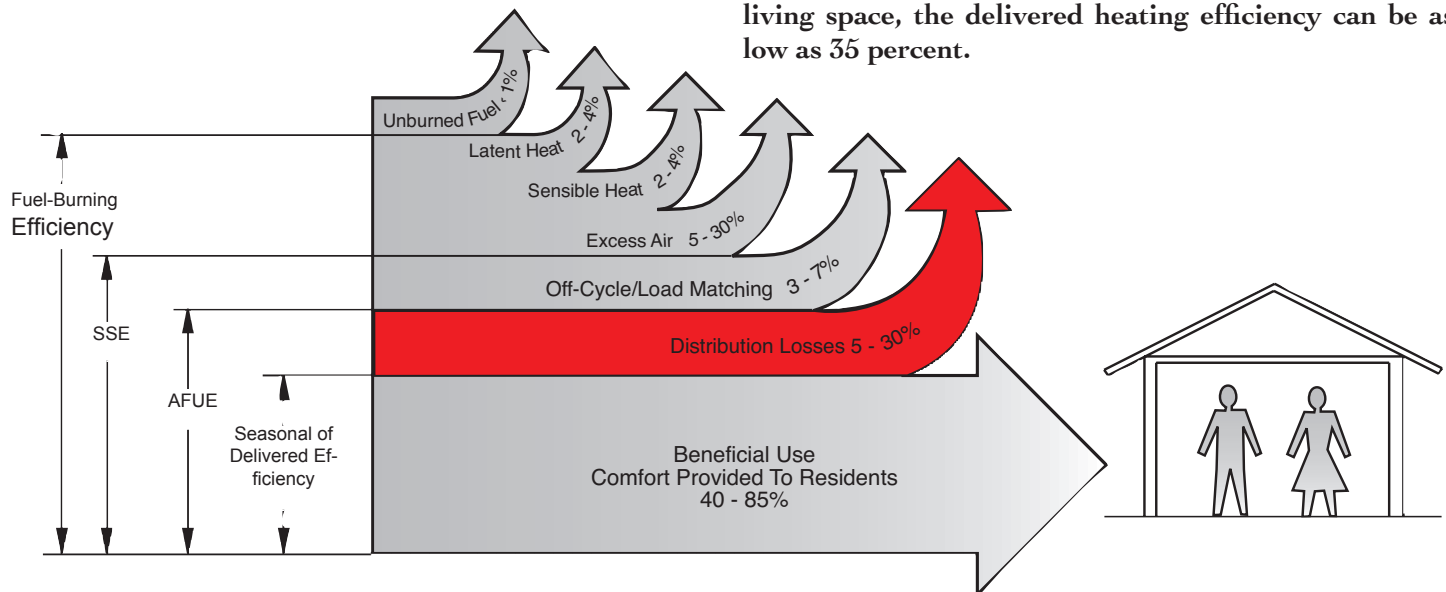
The four types of efficiencies to be discussed account for the succession of losses as heat travels from the burner through the heat exchanger and distribution system.

Fuel-burning efficiency is the percentage of the fuel's potential energy converted to heat at the flame. It is also sometimes called burn efficiency or combustion efficiency. Most modern, oil-fired heaters and gas heaters have a fuel-burning efficiency of over 99 percent.

Steady-state efficiency (SSE) is the percentage of heat captured by heating fluids: air, water, or steam. It accounts for fuel-burning losses and chimney losses. The SSE can be measured with CO₂-sensing or oxygen-sensing devices and thermometers.

All combustion furnaces, boilers, and room heaters must leave the factory with an energy guide label listing the AFUE. AFUE is the laboratory-tested efficiency that accounts for: fuel-burning losses, chimney losses, cycling losses, and heat loss through a central heater's cabinet. **AFUE does not account for distribution losses through ducts or pipes.** The AFUE tells what percentage of the potential energy in the fuel makes it into the heating distribution ducts or pipes on a seasonal basis.

Delivered heating efficiency is the most difficult type of heating efficiency to measure, because it includes distribution losses. Delivered efficiency is the percentage of the fuel's potential energy that actually heats the living space. **With all the ways to lost heat between the flame and the living space, the delivered heating efficiency can be as low as 35 percent.**



Source: Residential Energy, Krigger and Dorsi, 2004. www.residential-energy.com