Blower Door Basics

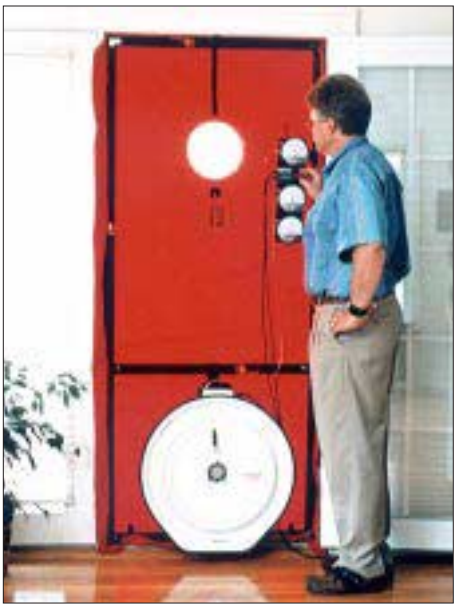
by Tim Maker

I'm having a difference of opinion with one of my favorite hvac contractors, a plumber named Herb. The subject of our disagreement is whether the 20-year-old electrically heated apartment buildings we are modernizing are too tight. A too-tight house can lead to a buildup of airborne toxins, causing health problems for the occupants and liability for the contractor. It can also result in mildew and condensation problems.

I believe these buildings are so tight that they need central ventilation systems to prevent these problems; Herb thinks I'm out to lunch. Who's right? The answer, I think, depends on just how tight the house is. And to find that out, you need a blower door.

What It Is

A blower door measures air leakage through a building shell. It consists of a fan mounted in an adjustable frame that fits tightly into an exterior door opening (see photo, next page). The fan blows air into or out of the building. Sensors in the blower door measure the air flow through the fan, as well as the air pressure difference between inside and outside. This data is fed to a small computer, which uses it to estimate the building's air leakage rate.



A technician uses a blower door to check a home's air infiltration rate.

Blower doors have been around since the early 1980s. They made their debut with weatherization programs, whose energy auditors use them to find air leaks in old buildings. (Air leakage can make up 30% to 50% of the heat loss of some homes.) Within a short time, however, they were embraced by energy-minded builders of new homes as well. These builders used the blower door to estimate how much air-sealing was needed to make a home tighter and less drafty and to locate the air leaks.

Finding Leaks

A blower door test begins with the operator setting the fan to pull air out of the house and then going from room to room in search of air leaks. Because the fan puts the house under a negative pressure, outside air is pulled in through any cracks in the building shell. The operator finds leaks by feeling around for air flows, or by using a device called a smoke pencil — a pencil-like device that produces a puff of smoke that is easily moved by small air currents.

This part of the test can bring some surprises. I remember one test where the blower door's instruments showed a high leakage rate, but where we couldn't spot anything unusual. Then, while standing in the kitchen with the blower door's fan turned on, I felt a breeze on my face. I followed the breeze to a corner where two sets of upper cabinets met, and found a torrent of cold air dumping onto the counter. When I looked at the top cabinets from below, I saw that they had been screwed directly to the wall studs (with no drywall or vapor barrier), and that the insulation between the studs had been installed with a number of gaps.

After leaks have been mapped out, the operator then measures air flow and house pressure at several different fan speeds. The measurements are fed to a computer, which estimates the building's average natural air-leakage rate over the heating season. This is the rate at which the home's inside air is replaced with fresh air by natural infiltration; it's expressed in air changes per hour or ACH. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) recommends mechanical ventilation in homes with air exchange rates of .35 ACH or less. Put differently, if the ventilation systems you are putting in your new homes consist only of typical bathroom and kitchen exhaust fans, you better be sure you aren't building tighter than .35 ACH.

Lessons From The Blower Door

Unfortunately, many new homes with inadequate mechanical ventilation test at .1 to .2 ACH, a level that could spell problems down the road for the unsuspecting builders. In fact, people who use the blower door on a regular basis say that it's getting easier and easier to build a very tight home without knowing it. Carol Boyd has done hundreds of blower door tests on new homes and condominiums for Energy Rated Homes (ERH) of Vermont. (ERH is a national home energy rating program that works with builders to upgrade the efficiency of new homes.) Boyd says that new construction has gotten dramatically tighter in the last five years. The reasons are the widespread use of housewrap, better windows and doors, and more attention to draft-stopping by builders. Says Boyd, "I see lots of new houses with inadequate ventilation that are so tight I wouldn't live in them."

But Boyd's conclusion isn't that homes shouldn't be built tight. Instead, it's that a tight home needs a well-designed mechanical ventilation system. This is echoed by Gary Nelson of the Energy Conservatory, in South Minneapolis, Minn., which manufacturers blower doors. Nelson cites a study of airtightness in Minnesota showing that 70% to 80% of new homes built in the state are underventilated by the standards of state code.

Getting a Test Done

So how do you get a home tested? One tactic is to hire an energy consultant. A simple test to measure air-

tightness might cost as little as $75 to $100. A more detailed test, including a written report showing where the leaks are, typically costs $200 to $250. But it's becoming less common to use the blower door simply as a diagnostic tool than to use it in "blower-door directed air sealing." This is where a specialized air-sealing contractor uses the door to identify leakage areas and fixes them on the spot. The contractor can also use the door as an aid in lowering the home's air exchange rate up to a predetermined maximum.

Another strategy is to participate in an energy program sponsored by electric utilities, state energy office, or other energy-rating program. These often use a blower door to determine whether a new home meets their air-tightness standards. Energy ratings, which include an airtightness measurement, can be a powerful marketing tool for builders of energy-efficient homes.

The End of the Story

Unfortunately, the blower door hasn't resolved my disagreement with Herb. Blower door tests estimated a natural air change rate of .36 ACH for the buildings, just a hair above ASHRAE's required minimum. While Herb concedes that the buildings are tighter than they look, he believes that natural air movement around the old windows and doors, coupled with the normal opening and closing of doors, will keep air quality acceptable. He sees an upgrade of the ventilation system as an unnecessary expense.

But because the building is so close to the minimum recommended tightness, I maintain that the ventilation upgrade is a prudent investment that will protect the tenants' health and reduce the owners' liability. The owners are adopting a "wait and see" attitude: They'll see what happens this winter, then decide whether they need ventilation. ■

Tim Maker is the principal of Energy Efficiency Associates, an energy consulting and project management firm in Calais, Vt.

Sources

There are three major blower door manufacturers in North America. A basic model with instrumentation and a wood frame costs $1,350 to $1,550. Aluminum frame models and extra accessories are also available.

Infiltec
P.O. Box 8007
Falls Church, VA 22041
703/820-7696

Minneapolis Blower Door
The Energy Conservatory
5158 Bloomington Ave.
South Minneapolis, MN 55417
612/827-1117

Retrotec Inc.
2200 Queen St., Unit 12
Bellingham, WA 98226
800/933-5656