Blower Door and Duct Pressure Testing for Duct & Envelope Tightness Verification

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Fact Sheet

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Diagnostics for an energy efficient house

Measuring house air leakage with a blower door

Air leakage can increase heating and cooling costs over 30% and contribute to comfort, health and safety problems. Finding hidden air leakage sites, called *bypasses*, can be difficult without the use of a blower door. This diagnostic equipment uses a fan to pressurize (force air into) or depressurize (force air out of) a building. When the fan operates, it is easy to feel the effects of *infiltration* – air leaking through cracks in the building envelope. Blower doors have gauges which can measure the relative leakiness of a building.

One measure of a home's leakage rate is air changes per hour (ACH), which estimates how many times in one hour the entire volume of air inside the building leaks to the outside. Leakier houses have higher ACH's, therefore higher heating and cooling costs, and greater potential for moisture, comfort, and health problems.

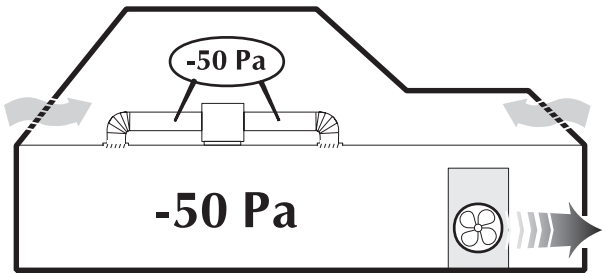
To determine ACH_{50}, the blower door creates a pressure difference of 50 Pascals between inside and outside. Fifty Pascals is approximately equivalent to a 20 m.p.h. wind blowing against all surfaces of a building. The leakier the house, the harder the fan must work to maintain the pressure. The amount of air the fan blows, measured in cubic feet per minute (CFM), is used to determine ACH.

Measuring duct leakage with a duct pressure test

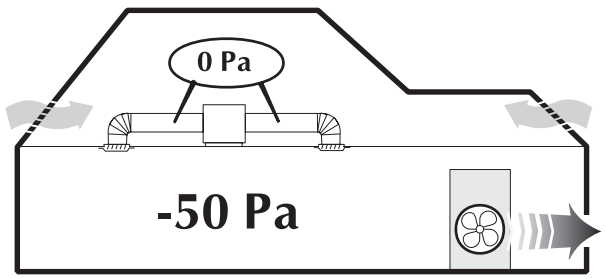
A duct pressure test machine combines a small fan and a pressure gauge to pressurize a house's duct system and accurately measure air leakage of the ductwork. This test is similiar to a pressure test of a plumbing system. Duct leakage can increase heating and cooling costs over 30% and contribute to comfort, health and safety problems.

House set-up

Consistent test methods are used throughout and include: Not taping over the dryer vent hookup if no dryer is present, turning combustion appliances in conditioned space to "off" or "pilot", closing and locking all windows and exterior doors, including storms, turning off all fans or mechanical blowers and opening interior doors.



Blower door - ***untaped*** - Depressurize house and ducts



Blower door - ***taped*** - Depressurize house only

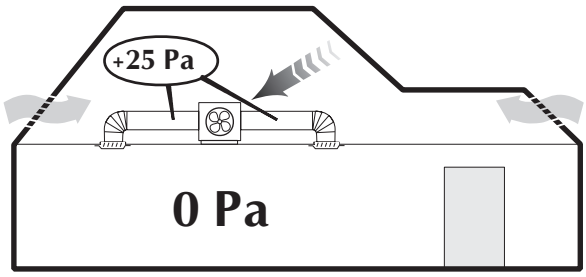
Blower door - untaped

The blower door measures the airflow (CFM_{50}) required to de-pressurize the house to -50 Pascals (~0.2 inches w.c.). This test condition is known as ***Untaped*** and is the basis for the Air Changes per Hour calculation, $ACH_{50} = CFM_{50} \times 60$ / conditioned house volume.

Blower door - taped

After taping over all the supply and return duct grills, a second blower door test can be performed to determine the ***Taped*** CFM_{50} measurement. This number indicates how much air leakage is through the building envelope only, because any duct loss is blocked out.

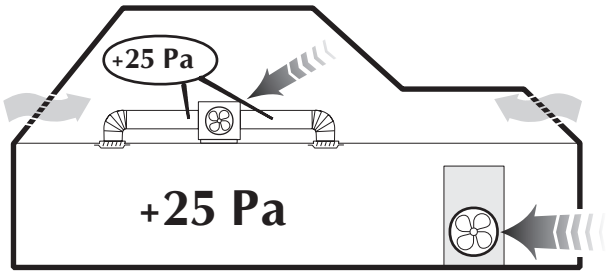
Subtracting the ***Taped*** measurement test value from the ***Untaped*** value and adjusting the figure with the subtraction correction factor (SCF) gives a rough estimate of the total duct leakage. Several tests use this technique—the ***modified blower door subtraction*** (MBDS) and the more accurate ***automated multi-point blower door*** (AMBD) methods. While these tests are approved for duct tightness verification, the duct pressure test machine is the preferred tool, as it provides a more direct measurement of leakage with a smaller margin of error.



Duct pressure test - *total* - Pressurize ducts only

Duct pressure test - *total leakage*

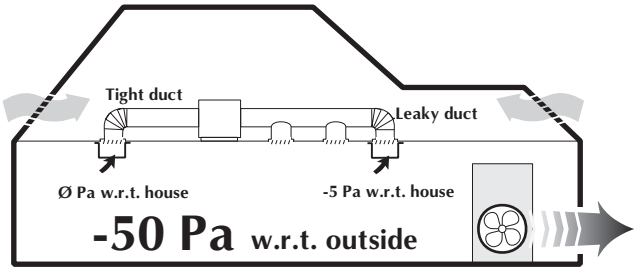
The duct pressure test machine is connected to the air handler to pressurize (or depressurize) the taped-over duct system to 25 Pascals. This is about the pressure that an HVAsC system normally experiences. The blower door is not used for this test. The ***Total*** CFM_{25} amount of duct leakage is determined.



Duct pressure test & blower door - *to outside* - Pressurize ducts and house

Duct pressure test - *leakage to outside*

Since some duct leakage may occur within the conditioned space and is not necessarily bad from an energy standpoint, an additional duct test is performed to measure ***Leakage To Outside***. For this test, the blower door is used to pressurize the house to 25 Pascals and the duct pressure test pressurizes the ductwork to the same level. All duct leakage that is measured is lost to the outside, or unconditioned space, and represents heating or cooling energy that is directly wasted.



Blower door - *pressure pan* - Depressurize house

Blower door - *pressure pan*

The blower door can be a useful diagnostic tool in determining the relative amount of leakage in a particular duct run. For the ***Pressure Pan*** test, the duct system and blower door are set-up as in the ***Untaped*** test - no masking tape on any registers, house de-pressurized to -50 Pascals w.r.t. (with reference to) the outside. A highly accurate pressure gauge connected with a tube to a covering pan is placed over a single register and the pressure inside of that register is measured. If the particular duct run is fairly tight, the pressure inside the register will read close to the house pressure (say, -49 Pascals w.r.t. the outside, or -1 Pascal w.r.t. the house). If the duct run is excessively leaky or partially disconnected, the pressure inside the register will vary considerably from the rest of the house (say, -45 Pascals w.r.t. the outside, or -5 Pascals w.r.t. the house). A quick test of all registers will tell which have the leakiest duct runs. This method cannot be used to determine or quantify the duct leakage of a system.

Blower door — *test results - building tightness*

Newly constructed homes should test at less than 7 ACH at 50 Pascals pressure (7 ACH_{50}). Reasonable air-sealing efforts that are required by the Georgia Energy Code, usually will yield a range of 5 to 7 ACH_{50} or better. Older houses tend to be between 10 and 20+ ACH_{50} but there is broad variation. Energy efficient homes with controlled ventilation often have tightness levels of 1 to 5 ACH_{50}.

Duct pressure test — *test results - ductwork and mechanical*

Ductwork for mechanical systems should be sealed tightly with mastic and at least pass a leakage to outside level of duct tightness of 8% of the floor area; e.g., a 1,000 square foot house could have up to 80 cfm of leakage in the ductwork. These levels are easily achievable with a moderate sealing effort. The Georgia Energy Code requires all joints and seams in ductwork to be sealed with mastic and to be insulated to R-6 or better when located in unconditioned spaces, such as a crawlspace, and R-8 when located in an attic. Duct tape is not allowed as a sealant.