Since November 2015, blower door testing has been mandatory for all new residential construction, both within and outside local code enforcement jurisdictions in Montana.

**Why is a Tight Building Envelope Important?**

Current building science is based on the adage “Build it tight, ventilate it right.” It has been demonstrated that natural ventilation provides too much outside air sometimes and too little outside air at other times. To provide the right amount of outside air it is important to limit unintentional or accidental envelope air leakage and to provide adequate outside air with mechanical ventilation. A tight house will have lower heating bills due to less heat loss and fewer drafts to decrease comfort. A tight house reduces the chance of mold and rot because moisture is less likely to enter and become trapped in building cavities. Tight homes have better-performing ventilation systems and potentially require smaller heating and cooling equipment capacities.

**House Tightness (Blower Door) Test**

House tightness is measured by a blower door test. In a blower door test, an exterior door is fitted with a nylon skirt with an opening for a large fan. For new construction, it is most common to perform a depressurization blower door test. The blower door exhausts air from the house until the home has a negative pressure of 50 Pascals (Pa) with reference to the outside. The amount of air that flows out of a house is equal to the amount of air that leaks into the house through the envelope and ducts located outside the conditioned space. A digital manometer is used to measure the pressure difference and the air flow out of the fan.

Pressurization blower door tests are performed most often in existing homes when there is a possibility that asbestos or other unwanted dust or particles may be present in the building cavities. A pressurization blower door test usually takes longer to perform since the exhaust backdraft dampers must be sealed before testing occurs.

The blower door fan includes the fan housing and several rings to adjust the size of the fan opening. The nylon skirt is held in the doorway by a metal frame. The motor speed controller allows the technician to control the speed of the fan. The knob on the fan controller is turned until the manometer displays the pressure in the house as 50 Pa with reference to outside. The air flow at this pressure is equal to envelope leakage.

Air Changes per Hour at 50 Pascals (ACH50) – The number of times in an hour that the total air volume of a home is exchanged for outside air with the house depressurized or pressurized by a blower door to 50 Pascals with reference to the outside.

Pascals – A measurement of air pressure. One inch of water column is equal to 249 Pascals.

The blower door test procedure includes closing all exterior doors and windows and disabling all combustion appliances and exhaust fans. The air-flow measurement at 50 Pa is then used to calculate the air change rate for
the house. While the blower door testing process is not complex, it takes care to properly set up the house and configure the digital manometer.

**Blower Door Test Procedures**

The energy code states that the blower door testing shall be performed at *any time after creation of all penetrations of the building thermal envelope*. The code goes on to identify several conditions that must be met during testing.

Backdraft dampers must be installed. Continuously operating exhaust fans must be sealed. Other envelope penetrations should not be sealed. The code does not designate whether the house is to be depressurized or pressurized for the blower door test but the requirements noted appear to assume that the blower door test will depressurize the house. Since these provisions would not yield an accurate result for a pressurized blower door test it can be reasonably assumed that a depressurized test is intended.

All interior doors should be open so that the entire house volume will be at the same pressure. The exhaust fans and ventilators must be deactivated for the test.

Shutting down the heating and cooling systems will help equalize pressure throughout the house. More importantly, if a combustion appliance such as a gas furnace or gas water heater is allowed to fire while the house is depressurized, the flames could be sucked out of the appliance potentially starting the house on fire.

The house tightness test is intended to include any air leaks associated with the duct system regardless of the location of the ducts. By leaving the supply and return registers unsealed, the entire duct system will be at the same pressure as the rest of the house.

Special care must be taken when dealing with wood fireplaces. If there is ash in the fireplace when the house is depressurized, that ash could be sucked into the house. All ash or dust should be removed from the fireplace prior to depressurizing the house.

The exact nature of the blower door test report is not specified in the energy code and is therefore determined by the local code official. It is good practice for the code official to require detailed test information along with the final test result in the report submitted to the building department. An example of such a report is included later in this article.
Blower Door Test Building Preparation Common Configuration
Who May Conduct a Blower Door Test?

In Montana the building code official may require that the test be conducted by an “approved party.” Check with the local code official regarding their requirements for house tightness testers. For houses built in the self-certification areas of the state, since there are no applicable code officials, there no requirements for testers.

Air Barrier and Insulation Installation Table

In the 2009 IECC, a home was required to either be tested for envelope tightness (maximum leakage being four air changes at 50 Pascals) or to comply with the Air Barrier and Insulation Installation Table 402.4.1.1. This table is often referred to as the visual checklist. In the current Montana energy code, a home must pass a blower door test and comply with the visual checklist.

Typical Depressurization Configuration with Manometer and Tubes

Plan Review

There are no plan review requirements for building tightness testing but it should be noted that in addition to the building tightness test, the building must comply with Table R402.4.1.1 Air Barrier and Insulation Installation Table. Building designers may specify a building tightness tighter than required by the energy code. The plan reviewer should note this value for reference when the written test report is submitted.

Inspection

The primary responsibility of the code official is to review the written report that is signed and submitted by the technician conducting the test. The local code official determines who is qualified to conduct the test so the technician’s qualifications should also be verified. There is no information about the character of the written report provided by the IECC but asking for basic information such as house identification, technician identification, test conditions, equipment used, and results will help determine the test’s validity. An example test recording form is shown on the next page.
Montana Blower Door Test Results – Standard Form

Test: Date______________ Time________________

Tester Information
Name (Printed)_________________________ Phone_________________________
Company____________________________________________________________
Tester Email________________________________________________________
Tester Signature______________________________________________________
Manometer: Manufacturer & Model________ Serial #______ Date Last Calibrated____
Fan: Manufacturer & Model________ Serial #________ Visible Damage____Yes ___ No

House Information
House Address________________________ City______________________________
Builder Name_________________________ Phone___________________________
Builder Email__________________________ Phone___________________________
House Floor Area (Include all conditioned floor areas measured to the outside of exterior walls; do not include unvented crawl space areas)
Above Grade Conditioned Floor Area ____________ (Ft²)
Basement Conditioned Floor Area ____________ (Ft²)
Total Conditioned Floor Area ______________ (Ft²)
House Volume (include all conditioned house volume including basements and unvented crawl spaces; includes volumes created by cathedral ceilings; includes floor framing volume between conditioned spaces as well as exterior walls)
Above Grade Conditioned Volume ______________ (Ft³)
Basement Conditioned Volume ______________ (Ft³)
Crawlspace Conditioned Volume ______________ (Ft³)

Test Record
Fan Location ______________________ Flow Ring Installed _________________
Measured Air Flow at 50 Pascals (CFM50) _________________________________

Air Changes at 50 Pascals \[ ACH50 = (\text{CFM50} \times 60) / \text{Volume} \]: [ ] ACH50

Code Required Procedures
The energy code states that the blower door testing shall be performed at any time after creation of all penetrations of the building thermal envelope. The code goes on to identify several conditions that must be met during testing.

☐ Exterior windows and doors, fireplace and stove doors closed, but not sealed.
☐ Dampers including exhaust, intake, makeup air, backdraft and flue dampers closed, but not sealed.
☐ Interior doors, if installed at the time of the test, shall be open.
☐ Exterior doors (dampers) for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
☐ Heating and cooling systems, if installed at the time of the test, shall be turned off.
☐ Supply and return registers, if installed at the time of the test, shall be fully open.
**Code Reference**

**R402.4.1.2 Testing.** The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 3 air changes per hour in Climate Zone 5. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weather stripping or other infiltration control measures;
2. Dampers, including exhaust, intake, makeup air, backdraft and flue dampers, shall be closed, but not sealed beyond intended infiltration control measures;
3. Interior doors, if installed at the time of the test, shall be open;
4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and
6. Supply and return registers, if installed at the time of the test, shall be fully open.

**Resources**


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