Energy Code Compliance

Montana

Best Practices Newsletter

Fall 2017

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"Trust but verify."

Ronald Reagan

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House Tightness Testing

President Ronald Reagan used an old Russian proverb, in speaking to Soviet President Mikhail Gorbachev about an arms control treaty. Although it was a very old adage, Reagan quoted the phrase in Russian to Gorbachev, to underline his meaning. "Trust but verify" can be applied to almost all aspects of the building and energy codes. Prior to the 2012 edition of the International Energy Conservation Code (IECC) there was more trust than verification regarding building tightness. But with greater use of blower doors, testing building tightness has become commonplace. Since November 2015, blower door testing has been mandatory for all new residential construction, both within and outside local code enforcement jurisdictions.

Why is a Tight Building Envelope Important?

Current building science is based on the adage "Build it tight, ventilate it right." It has be 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 cavities. Tight homes have better-performing ventilation systems and potentially require smaller heating and cooling equipment capacities.

Home Energy Rater Training

Based on RESNET HERS and ENERGY STAR

December 4 -11, 2017 Missoula, Montana

Reduced Registration Fee for NorthWestern Energy Residents

For more information about this training contact Dale Horton (daleh@ncat.org) 406-494-8653. To register go to www.ncat.org/events/. **For general information about HERS Ratings:** www.resnet.us/professional/rater/what-is-a-hers.

Blower Door Test

Code Citation: 2012 IECC, R402.4.1.2 Testing

The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding 4 air changes per hour. Testing shall be conducted with a blower door at the pressure of 50 Pascals.

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 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 exterior ducts. 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.

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 Math

To calculate air changes per hour at 50 Pascals

$$ACH50 = \frac{CFM50 \times 60}{\text{House Volume}}$$

House volume is cubic feet enclosed by the thermal envelope including exterior walls.

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.

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.

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed. Beyond the intended weatherstripping or other infiltration control measures;

Remarks: Special care must be taken when dealing with wood fireplaces. If there is ash in the fireplace when the house is depressurized to 50 Pascals, that ash could be sucked into the house if there are any leaks in the required gasketed doors. All ash or dust should be removed from the fireplace prior to depressurizing the house.

2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;

Dampers obviously must be installed in order to be closed. Other than the operation of the backdraft dampers, these envelope penetrations should not be sealed. These requirements assume that the blower door test will depressurize the house. The code does not designate whether the house is to be depressurized or pressurized for the required blower door test. Since this provision would not yield an accurate result for a pressurized blower door test it can be reasonably assumed that a depressurized test is intended.

3. Interior doors, if installed at the time of the test, shall be open;

All interior doors should be open so that the entire house volume will be at the same pressure.

4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;

The use of the term *doors* in this provision can be confusing. The intent is that the dampers and exterior openings shall be sealed if an exhaust fan or a heat recovery ventilator will be operating continuously. The fan should be deactivated for the test.

5. Heating and cooling systems, if installed at the time of the test, shall be turned off; and

Shutting down the heating and cooling systems will help create 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 to 50 Pascals, the flames could be sucked out of the appliance starting the house on fire.

6. Supply and return registers, if installed at the time of the test, shall be fully open.

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.

Note: The current energy code has limited information about how to conduct and report a blower door test. Subsequent editions of the IECC list three different standards that may be used when conducting a blower door test. The most user friendly of the standards is RESNET/ICC 380.

Blower Door Test Results Reporting

Code Citation: 2012 IECC, R402.4.1.2 Testing
A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

The exact nature of the blower door test report is not specified in the energy code and is therefore decided by the local code official. Good practice is to require relevant test information along with the final test result in the report submitted to the building department as a confirmation of the procedure employed by the tester. Below is an example of such a report. If you would like an electronic copy of this report form, email NCAT at daleh@ncat.org and request the standard blower door test report form.

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 _____

House Floor Area (Include all conditioned floor areas measured to the outside of exterior walls; do not included unvented crawlspace areas)

Above Grade Conditioned Floor Area _____ (Ft^2)

Basement Conditioned Floor Area _____ (Ft^2)

Total Conditioned Floor Area _____ (Ft^2)

House Volume (Include all conditioned house volume including basements and unvented crawlspaces; includes volumes created by cathedral ceilings; includes floor framing volume between conditioned spaces as well as exterior walls)

Above Grade Conditioned Volume_____ (Ft^3)

Basement Conditioned Volume _____ (Ft^3)

Crawlspace Conditioned Volume _____ (Ft^3)

Test Record

Fan Location _____ Flow Ring Installed _____

Measured Air Flow at 50 Pascals (CFM50) _____

Air Changes at 50 Pascals **[ACH50 = (CFM50 x 60)/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 turn off.

☐ Supply and return registers, if installed at the time of the test, shall be fully open.

Multifamily Building Tightness Testing

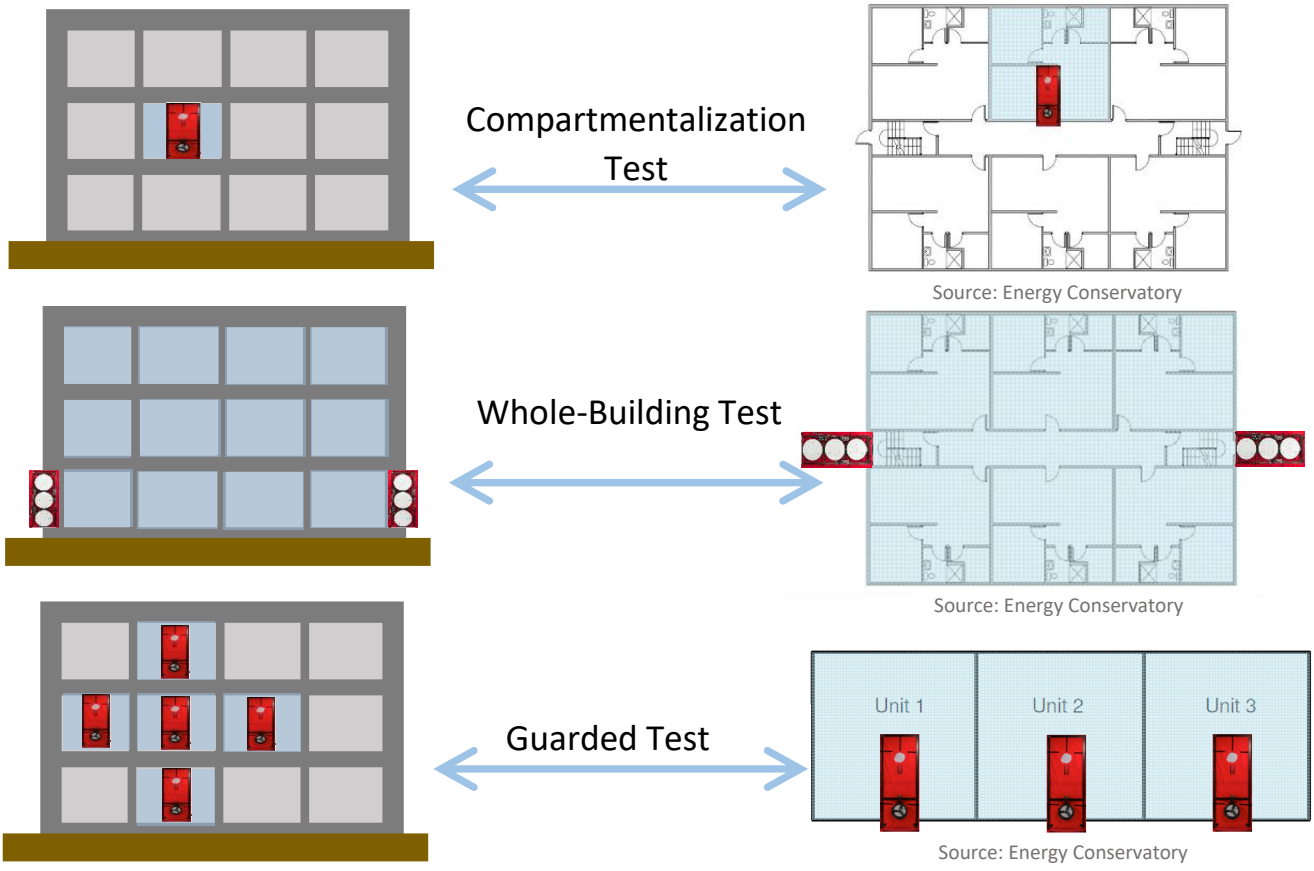
The simplest blower door test on a single family home measures only the leakage of the exterior envelope, which is all leakage to the outside. In multifamily buildings a blower door test on a single unit will measure some leakage to the outside and some leakage to the adjacent spaces. It is leakage to the outside that relates most directly to energy consumption.

There are several methods used to measure air leakage from multifamily buildings. The *compartmentalization* test is similar to a single-family home test. A single blower door is used to test one unit and the result will include air leakage to adjacent spaces. This is the simplest and most commonly used method.

Another option is the *whole-building* test. This test measures only leakage to the outside but usually requires multiple blower door fans and multiple operators. On very large buildings this can be prohibitive. Because all spaces in the building are under the same pressure, inter-unit leakage is negated. Factors such as building height, design, stage of construction, and especially weather on the testing day can make a whole-building test a challenge.

Another method is *guarded* blower door testing, which also requires multiple blower doors and experienced technicians to perform. It also aims to measure exterior envelope leakage by manipulating inter-compartment pressures with multiple fans. It's called guarded testing because it uses secondary “guard” blower doors placed in the spaces adjacent to the target unit. These are maintained at the same test pressure as the target unit, which neutralizes any inter-unit leakage. The result is that only exterior leakage is recorded from the target unit. By moving the doors around a building like a tic-tac-toe board, the exterior leakage of all the spaces can be isolated and recorded.

Refer to RESNET Guidelines for Multifamily Ratings for more information.
http://www.resnet.us/professional/standards/Adopted_RESNET_Guidlines_for_Multifamily_Ratings_8-29-14.pdf



Who May Conduct a Blower Door Test?

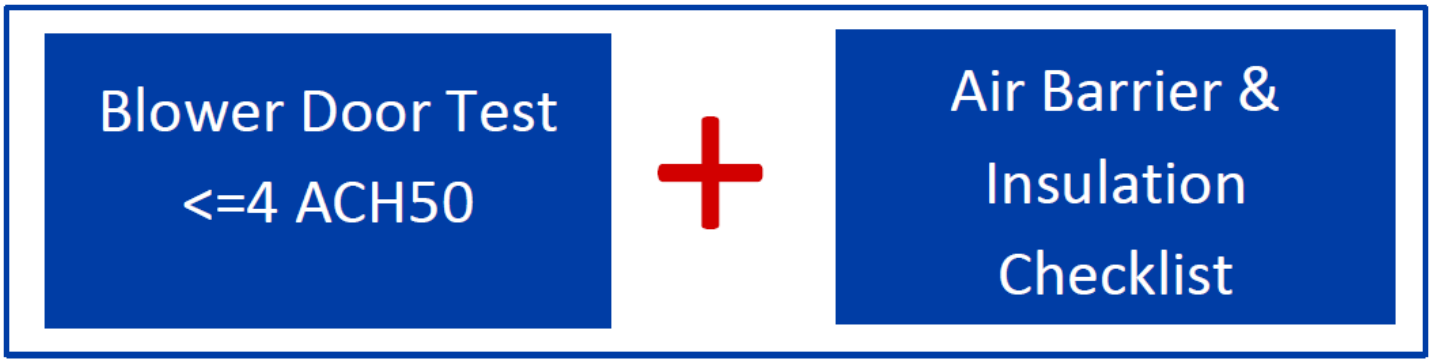
Code Citation: 2012 IECC, R402.4.1.2 Testing
Where required by the code official, testing shall be conducted by an approved party.

This provision in the IECC was amended by Montana. The original IECC language read "Where required by the code official, testing shall be conducted by an approved *third* party." The Montana amendment removed the word "third" because the homebuilders argued that builders should be able to test their own houses.

Air Barrier and Insulation Installation Table

Code Citation: 2012 IECC, R402.4.1 Building Thermal Envelope
The building thermal envelope shall comply with Sections R402.4.1.1 (installation per *Air Barrier and Insulation Installation Table*) and R402.4.1.2 (blower door test).

In the previous edition of the energy code, 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 v*isual checklist*. In the current code, a home must pass a blower door test **as well as** comply with the visual checklist.



DEQ
Montana Department of Environmental Quality

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Energize Montana Energy Code Website:

http://deq.mt.gov/Energy/EnergizeMT/EnergyCode