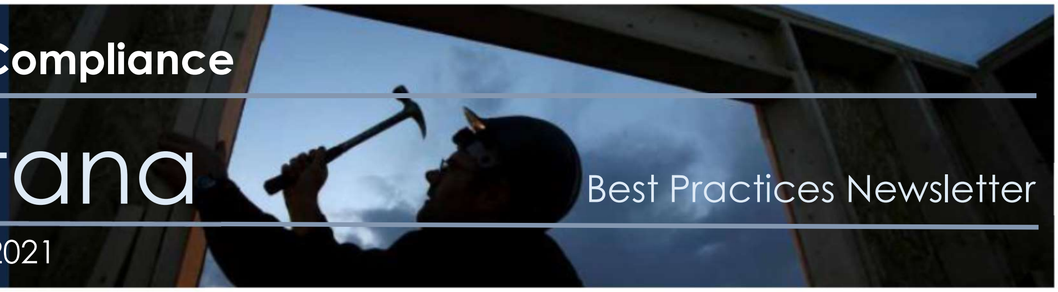
Energy Code Compliance

Montana

Best Practices Newsletter

Spring 2021

Published by MTDEQ and NCAT with funding from NEEA



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Blower Doors—More than a Verification Tool

The 2018 International Energy Conservation Code (IECC) requires that new homes pass a building airtightness test, commonly known as a ***blower door test***. The standard in Montana under the newly enacted 2018 IECC is four air changes per hour or less when tested at 50 Pascals. This is noted as 4 ACH50. Often, this is the only time a builder will ever utilize a blower door. The mantra among the building industry is "build it tight and ventilate right." Using a blower door throughout the building process will let the builder know whether he is on the right track to "building it tight," alleviating guesswork and the stress of a failed blower door test at the end of the construction process.

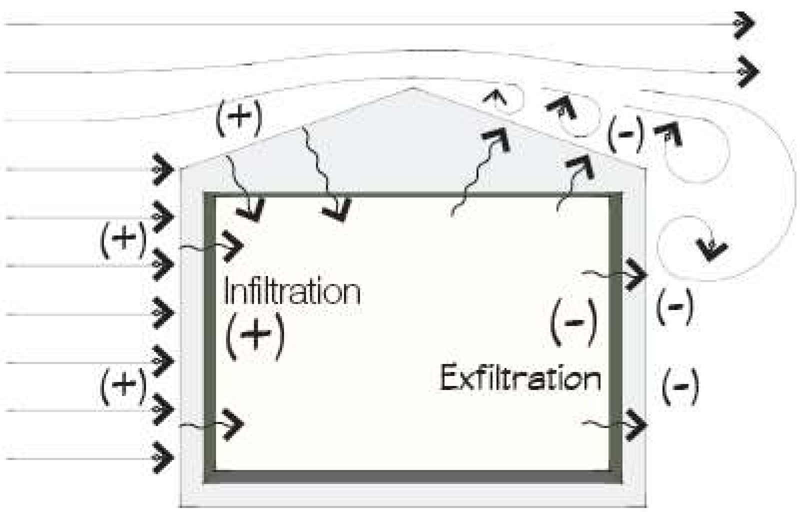
Before we discuss the milestones where a blower door can help, let's review why building tightness with proper ventilation is important. In the past, when heating was inexpensive relative to the increased costs to build tight, natural ventilation provided enough outside air circulation to dry out the structure and provide fresh air to the home. However, a leaky house pulls air through building cavities that may contain dirt, mold, or other unhealthy conditions, and inside air quality suffers as a result. In the energy crises of the 1970s and 1980s, designers began experimenting with building tighter, better insulated homes to counteract high heating fuel prices. What these designers discovered was that homes built tight and not properly ventilated developed problems with moisture, mold, appliance venting, and unhealthy air quality. Over the years, building and energy codes have tightened these standards to ensure that these problems do not occur and to provide a number of benefits to the homes' occupants, including lower heating and cooling bills, reduced chances of mold and rot, smaller healing and cooling equipment requirements (which often means lower initial costs), improved indoor air quality, and overall greater occupant comfort.

Blower door installed and ready for testing.

How the Blower Door Test Works

The blower door is a simple tool that consists of a door made of air-impermeable fabric that fits into a frame that can be adjusted to make an airtight seal in an exterior door, a powerful fan, and a manometer. This tool operates on the simple rule that air leaving a building must be replaced by air entering the building (or the opposite for a positive-pressure test).

The blower door creates either negative or positive pressure in the building, and the manometer measures the pressure change in the building and the volume of air entering or leaving the building to maintain a constant pressure in the building. In the case of testing for code compliance, the standard is 50 Pascals. A Pascal is a unit of pressure equivalent to 1 newton per square meter. The variable-speed fan is adjusted to maintain 50 Pascals and the volume of air being replaced in cubic feet per minute (CFM) is noted and used in the formula ***(CFMx60) / Building conditioned space volume = ACH50***.

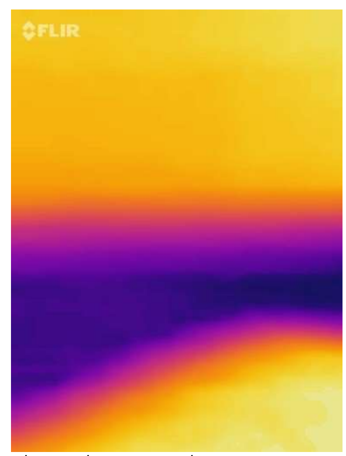


As previously mentioned, the blower door test is usually performed upon completion of construction to satisfy Montana energy code requirement and the local building official that the house has been properly constructed for airtightness. What happens if the building fails? The contractor is now left to figure out where his system for air sealing failed and how to correct it. Depending on the percentage of failure, this may involve extensive and expensive testing of the building envelope. However, utilizing the blower door test at several stages in the construction process would have allowed the builder to test systems along the way, ensuring that the final test is successful and without stress.

Stages of Construction

Stage 1: Sheathing and Attic Sealing

Once a building has been sheathed and taped—and, if possible, before windows and doors are cut out—a builder should utilize the blower door to test the effectiveness of initial air sealing and the quality of the sheathing itself. At this point, the contractor can either depressurize or pressurize at a level higher than 50 ACH and then use one of several techniques to test for air leaks in the building envelope. Common techniques include thermal imaging, theater smoke, or even spraying water on the outside of the building. The only downside of this method is that the drywall crew will have to come in twice—once to install a monolithic ceiling to seal off the attic area if it is an unconditioned, vented attic, and a second time to finish the walls. However, an added benefit of this method is that, since leakage from the attic area occurs more often at wall joints, building the ceiling first helps to seal this problematic area.



Thermal imaging showing an air leak (cold blue) where a floor meets an outside wall.

Stage 2: Windows and Doors

Once the initial building envelope is verified as tight, a second test is conducted after window and door installation, and before drywall is installed, to ensure that any problems with windows and doors can be easily rectified. This test can be run at 50 Pascals and again, thermal imaging and theater smoke or a fogging machine can be used identify problem areas that need to be corrected.

Stage 3: After Mechanical Plumbing, and Electric

A contractor will often run into problems—even after using best practices for air sealing—when subcontractors start making necessary openings for mechanical, electric, and plumbing. And while it seems that finding these problems would be straightforward, it can sometimes actually be counterintuitive. A builder setting aside an hour for a blower door test will then be confident that the final verification test will be smooth and successful. Subcontractors should be instructed on proper sealing and assume responsibility for sealing any penetrations they make.

Stage 4: Final Verification

The final verification, depending on the jurisdiction, may be conducted by a verified third-party tester. Builders should check with their local building official to understand the requirements in your jurisdiction for verification. If you have been working all along with the same tester, or if you do your own tests, you will have developed a complete understanding of how your building works as a system, how the building responds to different weather conditions, and your ability to answer your client's questions about operating the building.

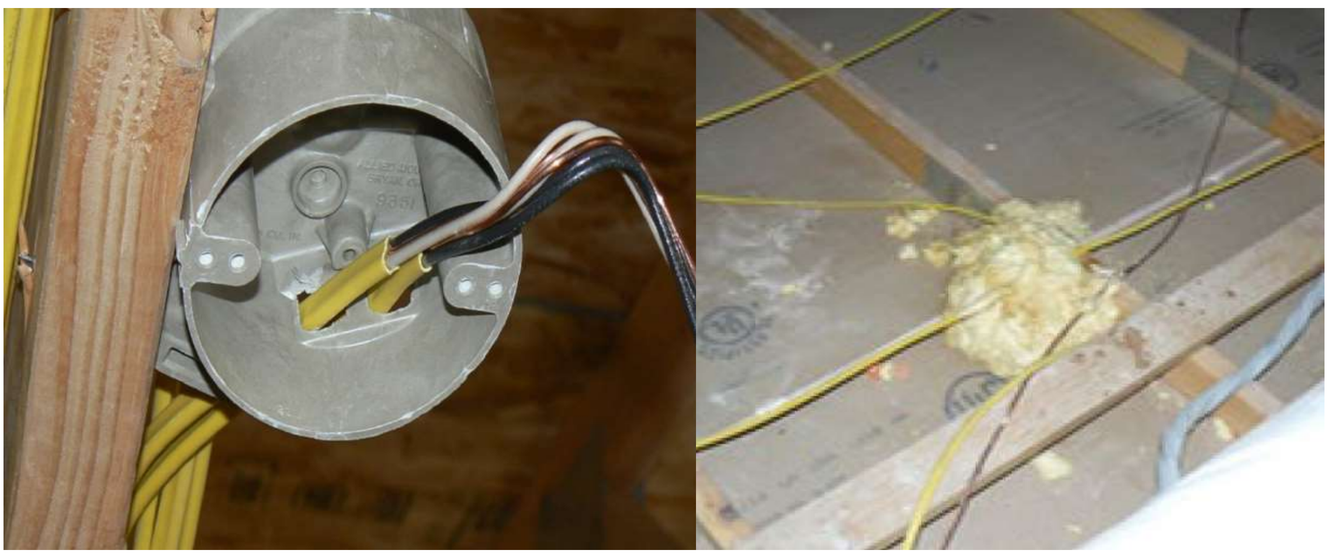
Cost and Inconvenience

Builders may object to the added cost of both the blower door test and increased labor to chase down air leaks, but the benefits far outweigh these costs, and airtightness is required by code. Initially, investment in testing will allow builders to develop their own practices and procedures for achieving airtightness that they know have been tested and work. Once they have developed confidence in these practices, they may choose to drop a test or two. Reduced callbacks, increased customer satisfaction, and increased referrals that can result will also improve a builder's bottom line.

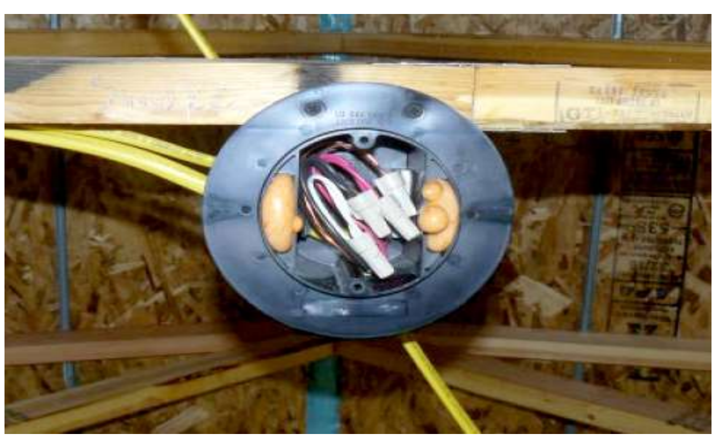
Conclusion

The National Center for Appropriate Technology (NCAT) trains and verifies people to conduct blower door tests in Montana. There should be someone in your community that conducts these tests. If you would like training on blower door testing, or if you have questions about where to obtain testing or equipment, you may contact NCAT for more information. If you are a builder interested in developing a quality-assurance program for air sealing, we would be happy to work with you to develop a program to meet your needs. We are available to assist you on-site.

Left: air leakage at a ceiling fan. Right: IR picture of air leakage taken with blower door operating.



Standard ceiling electrical box with openings at wires and gaps between box and sheetrock (left). Fix: standard electrical box sealed with spray foam from attic (above right).



Fix: wide flange box with optional seal vapor barrier to box flange or use foam gasket on the flange. Note: wire openings are sealed with foam.

Recessed lights and unsealed wall ceiling junction.

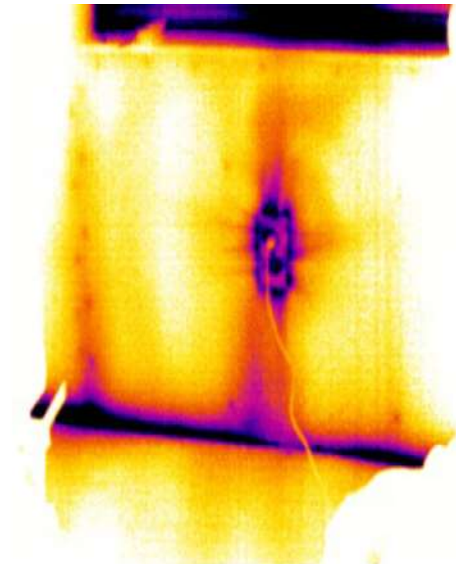
Fix: seal standard box from the attic or install air tight boxes and LED lights. LED surface mounted light fixture with an air sealed electrical box.

Rim/band joist of crawl spaces, basements and between floor. Note: fiberglass is not an air barrier, it does not stop air flow.

Fix: spray foam or foam block sealed in place. Note: the energy code requires rim/band joist must have an air barrier.

Air leakage at the exterior wall floor junction.

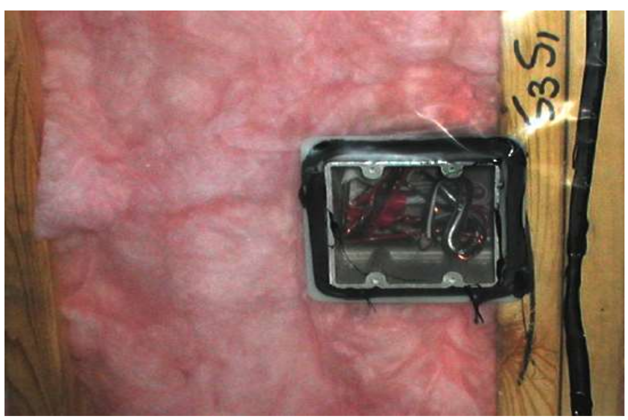
Exterior wall/junction – gap between bottom plate and floor indicates inadequate caulking (left). Fix – seal the wallboard to the floor (right).



Air leakage at exterior wall electrical outlet.

Fix: seal openings in standard box.

Fix: seal (caulk) sides of electrical box to sheetrock (above left and center). Fix: wide flange, with sealed (foamed in place) wiring opening boxes, compressed foam gasket seals box to wall board (above right).



Top plate air leakage (hot attic).

Fix: spray foam opening from the attic (left). Fix: top plate gasket sealing gap between sheetrock and top plate (right).

Additional Resources

BSI: Just Right and Airtight, www.buildingscience.com/documents/insights/bsi-053-just-right-and-airtight

How to Find Air Leaks in Your House, www.finehomebuilding.com/2020/11/20/how-to-find-air-leaks-in-your-house

Pinpointing Leaks With a Fog Machine, www.greenbuildingadvisor.com/article/pinpointing-leaks-with-a-fog-machine

Sources of Commercial Blower Doors

The Energy Conservatory, www.energyconservatory.com

Retrotec, www.retrotec.com

Photos for this publication courtesy of Paul Tschida, Montana DEQ.

DEQ Montana Department of Environmental Quality

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Energize Montana Energy Code Website:

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