Building Science Bootcamp

Air-Tightness and Energy Codes

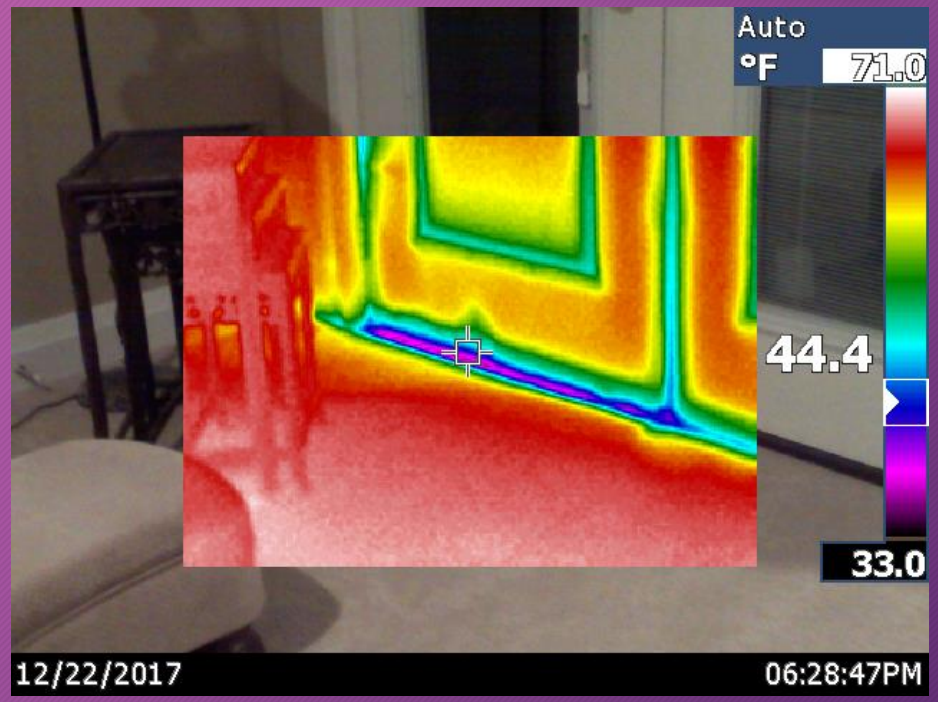
Reducing Air-Leakage in Residential Buildings

How to Pass the Blower-Door Test the First Time

Reducing Air-Leakage
A Good Return on Investment!

Advantages of Tighter Construction:

- More comfortable and less expensive to heat and cool,
- HVAC equipment can be downsized, saving on construction costs.
- Larger homes will save more,
- Homes located at higher elevation and/or windy settings will save more,
- Propane and electric heated homes will save much more!



Don't forget to adjust those thresholds, a great return on investment!

Reducing Air-Leakage
Building Code & Blower Door Testing

Current Building Code Requires:

- The **target is 3.0 ACH50 or less***,
- This is about **twice as tight** as homes built from the 1980's until 2010,
- An **independent inspector** must be hired to test and confirm that your new home meets the air-tightness requirements of the building code,
- Check with building department for a list of approved blower door testing agencies,

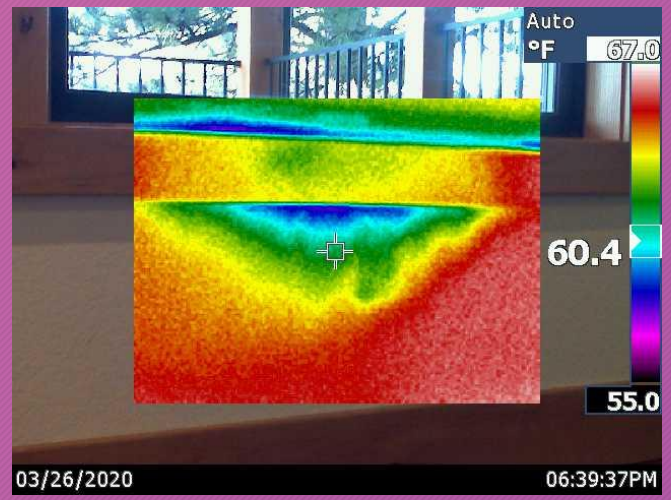
*(*air changes per hour at -50 pascals pressure)*

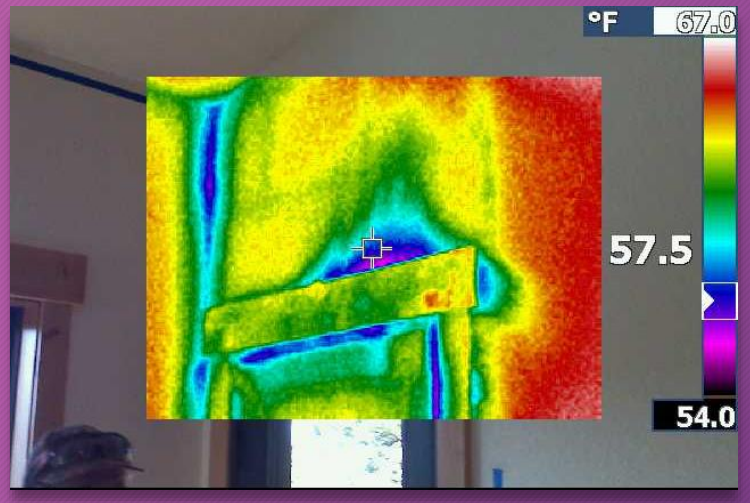
A blower-door test, and infrared camera ready to help confirm air-sealing work, and find leaks when necessary.

Reducing Air-Leakage
Building Code & Blower Door Testing

Have a Building-Tightness Plan for Air-sealing:

- Pay attention to air-sealing early on and as you go,
- It is very hard to fail a blower door test, then circle back to air-sealing and pass the test later (*and much more expensive)*.

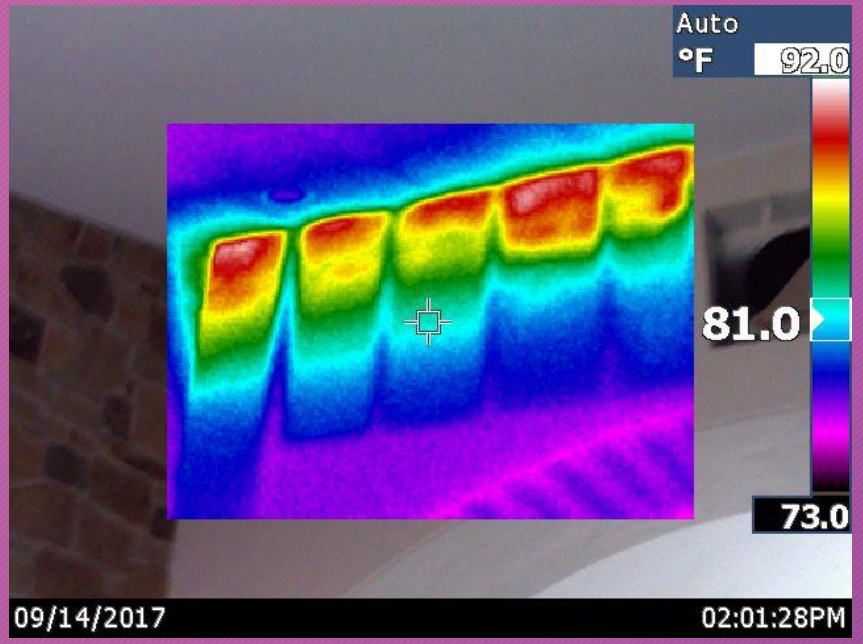




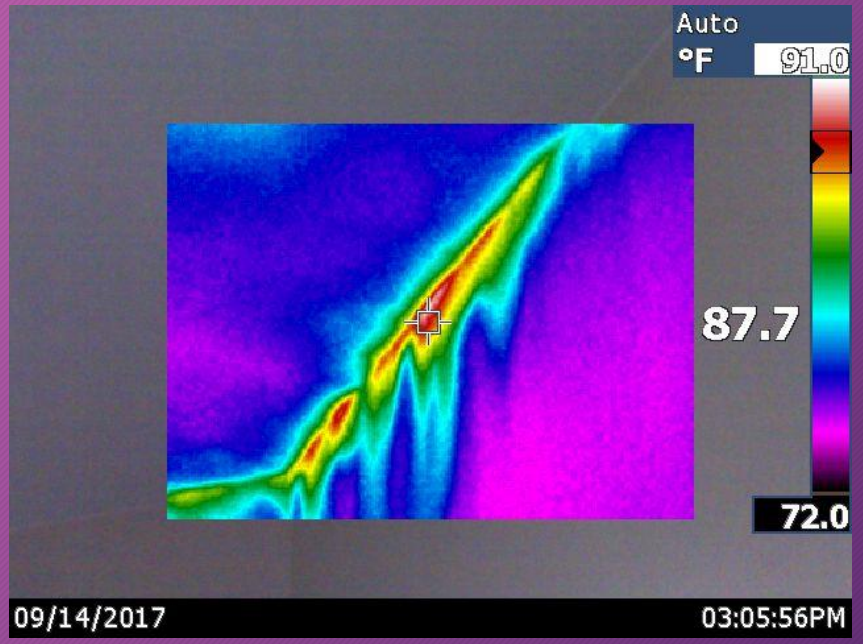
"Begin with the End in Mind"
Steven Covey

Reducing Air-Leakage
Find Leaks w/Blower Door & Infrared Camera

A large open attic chase leaking heat into the home by archway:



Leaky top-plates at unsealed interior and exterior walls:



Reducing Air-Leakage
Start at the Top – Seal Attic Floor

Reasons for Missed Air-sealing:

- Lack of training or supervision,
- Wasn't in the original estimate,
- More common w/homeowners serving as general contractors,
- A few of our not so favorite quotes from over the years:

"That's not our responsibility"

"I wasn't asked to bid that"

"We didn't have any working foam guns (or foam) on the truck"

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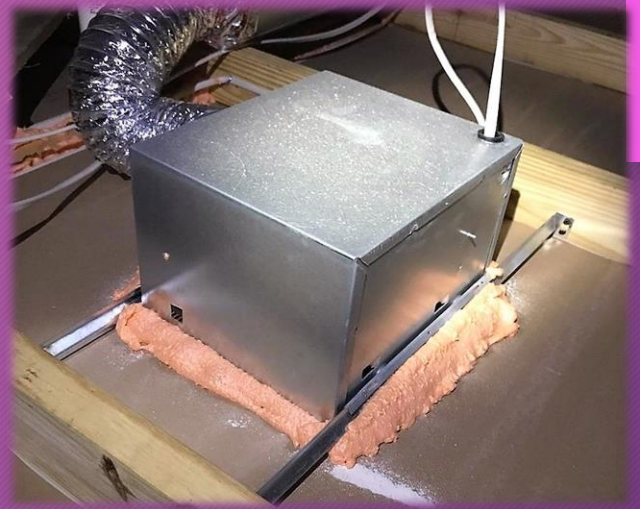
Reducing Air-Leakage
Start at the Top – Seal the Attic Floor

Signs of infiltration from the days before air-sealing:

Air-sealing is a low-cost step towards comfort and efficiency.

Start at the Top – Leaks in the Attic Floor

Start at the Top – Sealing the Attic Floor



Reducing Air-Leakage
Start at the Top – Seal Attic Floor

Expensive Mistake: When insulation contractors neglect to air-seal before blowing-in insulation, air-leakage reduction mitigation costs are significantly higher than air-sealing before insulating.

"When we fail to plan…we plan to fail."

Reducing Air-Leakage
Air-Sealing Training Tips

Set Them Up for Success:

Warm up foam-can to 80-90 degrees on dashboard or w/space heater,

Shake foam-can 30-times prior to use,

Keep can inverted to Save Materials,

Use gun-cleaner in between every new can of foam, and change cans quickly,

Store foam guns with can attached, up to 2 weeks, and store in warm place.

"Take good care of your $50 foam-gun and it will take care of you"

Reducing Air-Leakage
Traditional Wall Assemblies

Building Code Bare Minimum:

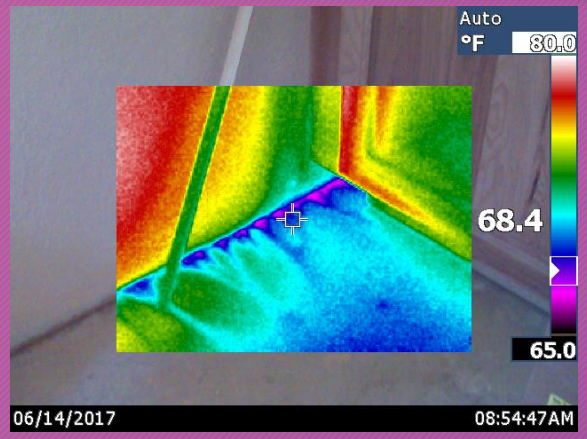
- R20 fiberglass batt in 2x6 wall cavity,
- OSB sheathing and interior drywall,
- Interior poly vapor barrier or craft facing,

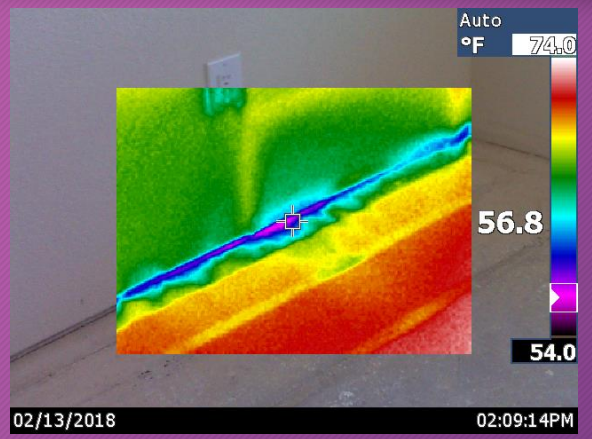
Generally speaking…

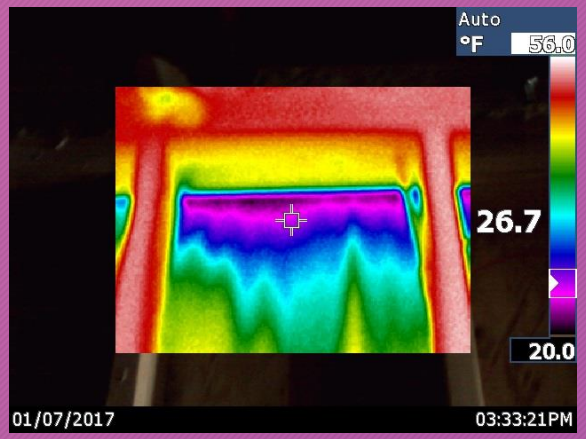
This wall assembly will NOT pass a blower-door test without extensive air-sealing.

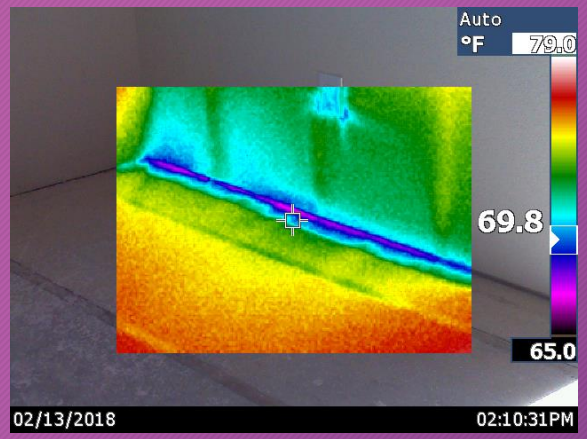
Reducing Air-Leakage Traditional Wall Assemblies

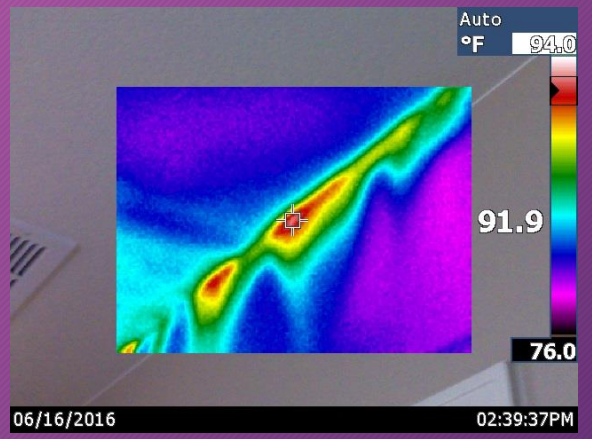
These walls are leaky: bottom & top-plates, exterior sheeting, window & door frames, and *house-to-garage*.

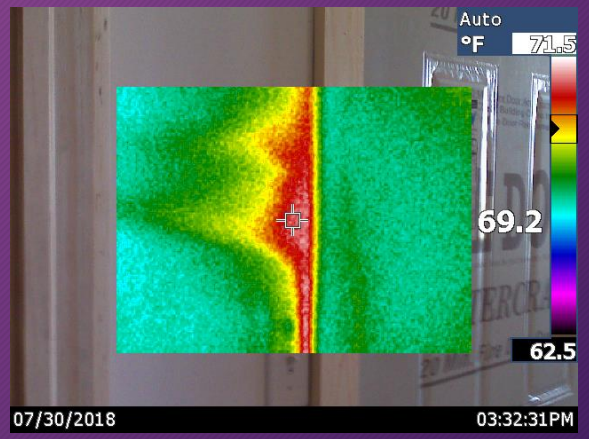












Reducing Air-Leakage in Walls
Building Code & Blower Door Testing

Early Steps to Ensure Success:

- Be sure your insulation contractor includes **“air-sealing”** in their estimates,
- You can include a **“seal-to-pass”** requirement in your bid/contract,
- Have all trades like plumbers, electricians and HVAC seal the penetrations they make along the way,
- **Practice *“You drill it, you fill it!”***

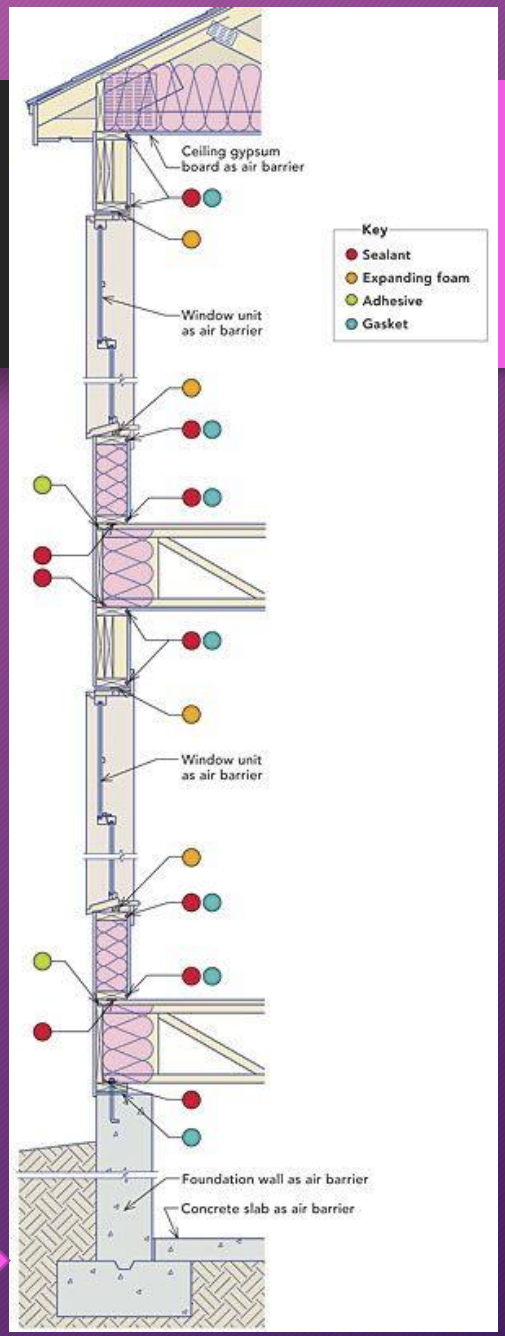
Blow-In-Blanket Wall Insulation is tighter than traditional fiberglass batts.

Building Code & Blower Door Testing Reducing Air-Leakage in Walls & Floors

Exterior Air-Barrier and Water-Resistant Sheathing:

- Pros: OSB wood-chips are individually water-proofed before laminated into sheets,
- Exterior air-barrier enhances R-value of wall-cavity insulation.
- Eliminates sealing almost all of the leak-points at far right >
- Cons: About twice the cost in materials and labor of OSB!

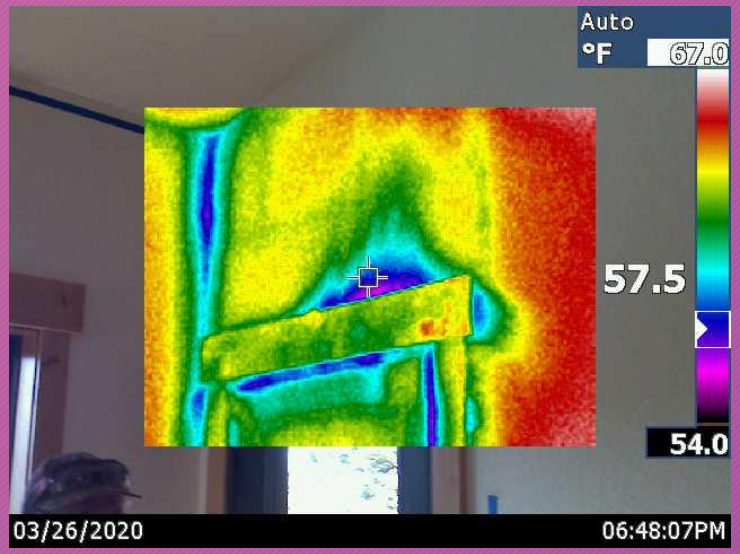
Exterior wall sealing is less complicated than sealing the house from the inside:

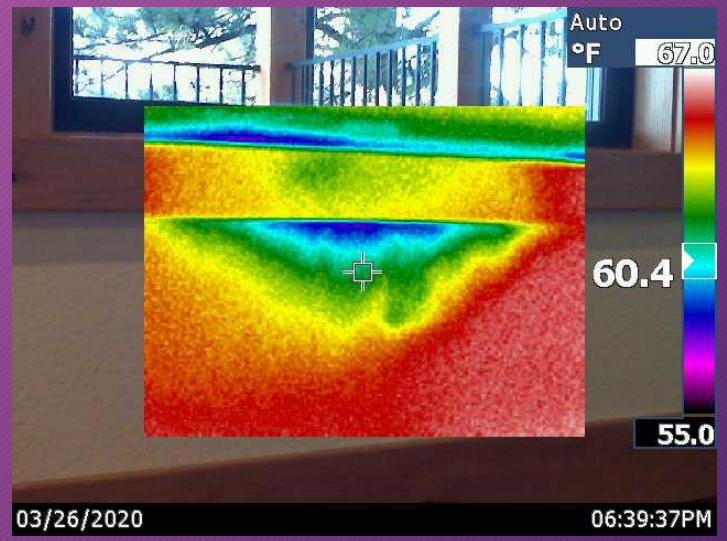


Reducing Air-Leakage
Sealing Window and Door Frames

Back to Basics:

- Packing fiberglass insulation around frames is ***outdated and ineffective***,
- Missed sealing before installing trim is a costly, and time consuming mistake.





Reducing Air-Leakage
Sealing Window and Door Frames

Back to Basics:

- Use ***"low expansion" or "no warp"*** spray foam to avoid deforming window frames, which can make them difficult to open and close later, especially vinyl,
- Fill the entire cavity for best results, use multiple passes for good expansion,
- Don't overfill onto finished surfaces,
- It pays to be careful and meticulous.

Windows and Air-Leakage
Air-Tightness Varies by Style

Leakiest: *Tilt-to-Clean*

Air-leakage: ~ 0.3

Average: Sliders and double-hung

Air-leakage: 0.1–0.2

Best: Casement

Air-leakage: 0.01-0.05

Sliding windows which operate either vertically or horizontally, generally allow the most air-exchange. This is due to design trade-offs that allow them to open and close using reasonable effort. They also leak more when it's windy.

Windows and Air-Leakage
Air-Tightness Varies by Style

The Case for Casements and Tighter Windows:

Multiple latches compress seals,

Wind pressure actually make them seal tighter during windy storms,

Examples;

Gerkin Windows: = 0.04 cfm per sf

Alpen Windows: = 0.01 cfm per sf

Reducing Air-Leakage
Be Ready for Your Blower-Door Test

CHECKLIST:

- Windows and exterior doors installed,
- Exterior door hardware installed,
- Weatherstripping and thresholds installed,
- Latches and thresholds adjusted to snug,
- Hatches to unconditioned attics and crawlspaces installed and gasketed,
- Fireplace dampers and doors installed,
- Plumbing drain traps installed, and filled with water,
- Conduits leading to outside sealed,
- HVAC air-handlers and ductwork complete,
- Attic-based HVAC systems meticulously sealed, including capped, sealed chases,
- Attic duct-boots sealed to drywall,
- Light fixtures installed,
- Plate covers installed,
- Any other gap, crack or hole between inside and outside that you can find,
- Clothes dryer, bath fans, range hoods, heat recovery ventilators installed with dampers operating as designed.

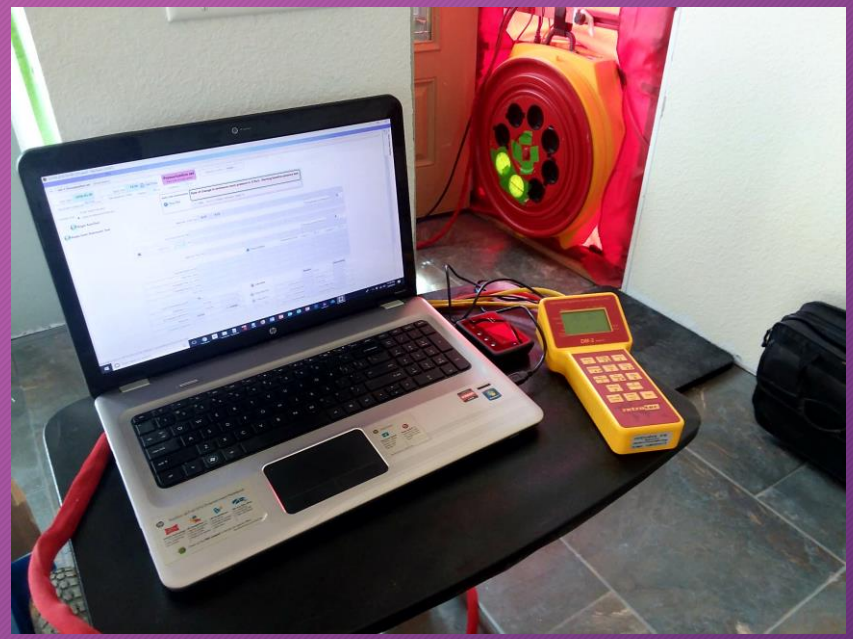
Reducing Air-Leakage Building Set-Up On Test Day:

- Exterior windows and doors, shall be closed, latched (and locked), but not sealed with tape,
- Dampers shall be closed, but not sealed; including exhaust, intake, makeup air, back draft, and flue dampers,
- All interior doors shall be open, including door to basement,
- Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed,
- Heating and cooling system(s) shall be turned off,
- HVAC supply and return registers shall not be sealed.
- Everybody in-or-out during test.

Reducing Air-Leakage
Building Code & Blower Door Testing

Accuracy and Documentation:

- Compliance testing with semi-automated software, paired with blower-door test, provides verified, accurate results,
- Such as Fan-testic® or TECTITE®,
- Approved inspectors are expected to submit results to the building department in a timely manner.



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Air-Tightness and Energy Codes

To Learn More about Energy Codes or Green Building, please contact:

Community Development

https://www.larimer.org/building

Building: 970-498-7700 or

Planning: 970-498-7683

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