



VERIFIEDGREEN

Helping You Build Green

Assessment and Strategy Development

Duluth 2010



Learning Objectives

- Name energy efficiency tests for existing and learn how to understand their results
- Understand a worst case spillage test and how to avoid creating back-draft problems
- Explore ways to develop rehabilitation strategies based on test results
- Review practical assessments for common problems in attics
- Review practical assessments for common problems in basements

Understanding Testing

- Energy Audits
- Home Performance Analysts
- HERS Raters (Home Energy Rating System)
- Radon Testing
- Lead Testing
- Mold, Mildew, Moisture testing

Understanding Testing

- What are the measurable values of know systems or materials in the home
 - Windows
 - Doors
 - Walls
 - Roof coverings
 - Insulation (where visible)
 - Mechanical systems (appliances)

Understanding Testing

- Model the home
- Data is compared to a new built to code (100)
- Energy Star requires 20% better than code (80)
- Zero Energy home is one that produces as much as it consumes (0)

Understanding Testing

- Unseen conditions
- Air leaks
- Missing / compressed insulation
- Back drafting

Understanding Testing

- What can be done to improve the score
 - Wall systems (OVE, T-mass, ICF, Durisol, Persist)
 - Insulation levels (Add insulation, insulation type)
 - Window type and specification (replacement, modified existing)
 - Impact of natural features on the home (trees)
 - Mechanical systems (efficiency, size)

Understanding Testing

- The blometer test
 - Measuring cfm of exhaust
 - Impact on durability to remove moisture
 - Get what you paid for
 - Causes: Kinks, obstructions, faulty motors, to much restriction



Understanding Testing

What does not impact the HERS score

- Location of ductwork
- Location of Mechanicals
- Passive Solar and Passive cooling are minimally accounted for other than the absence of AC, smaller heating appliance
- Newer wall systems not in the program
- Water saving systems
- IEQ materials
- Water management, erosion measures, plantings

Understanding Testing

The blower door test

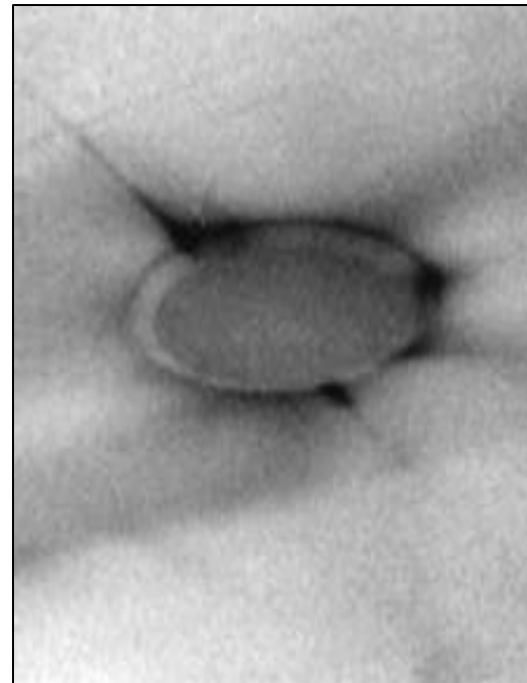
- Depressurize the home to -50 Pascals
- Equal pressure on all sides of the home
- Air exchange is measured in ACH, CFM or CFM per SF

The infrared scan

- Shows thermal differential in a wall/ceiling
- Helps find source of air leaks
- Helps find missing or improperly installed insulation

Process: Preconstruction Plan Review

Energy modeling or testing



Understanding Testing

Requirements

- The house is tested as it exists
- Fireplaces cannot be sealed
- Make-up air cannot be sealed
- Bath fans cannot be sealed

- Windows and Doors should be locked
- Dampers should be closed

Blower Door Test



Depressurization levels

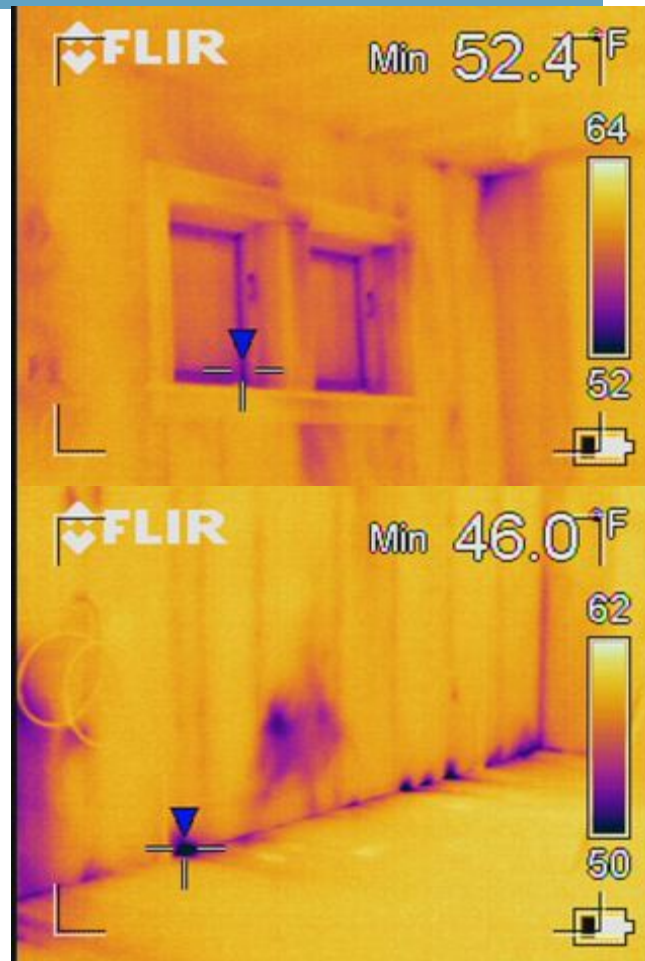
Air infiltration rate

Understanding Testing

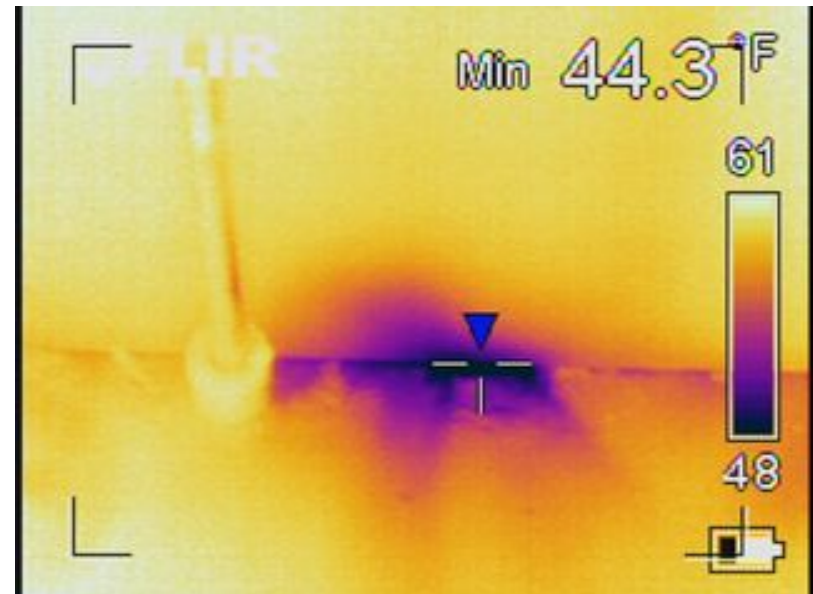
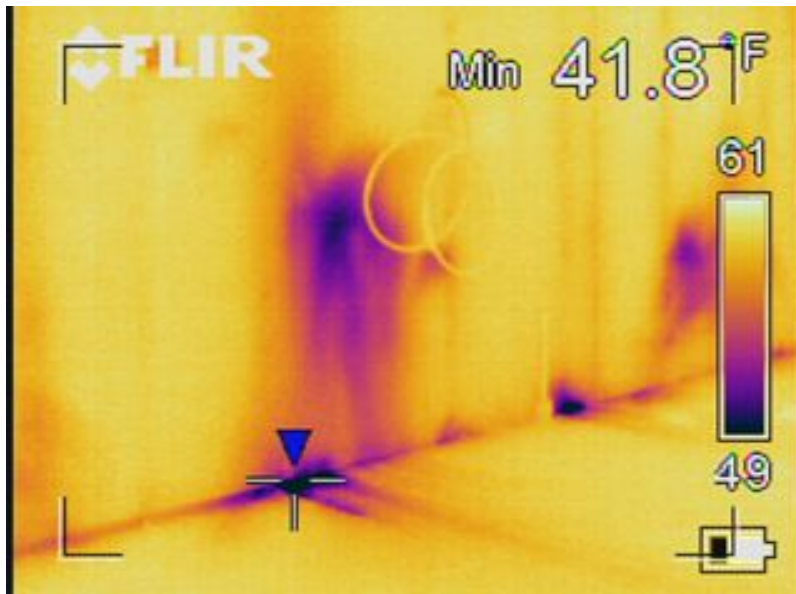
What can you expect?

- CFM 4500 – reduce by 30% or more
 - Reduction in air infiltration by 20%-50% on a 1950's or earlier home that has not been insulated or had window replacement
- CFM at 3500
 - Reduction in air infiltration by 5-20% in a home built between 1950 and 2006
- CFM at 1500
 - Reduction in air infiltration will be difficult

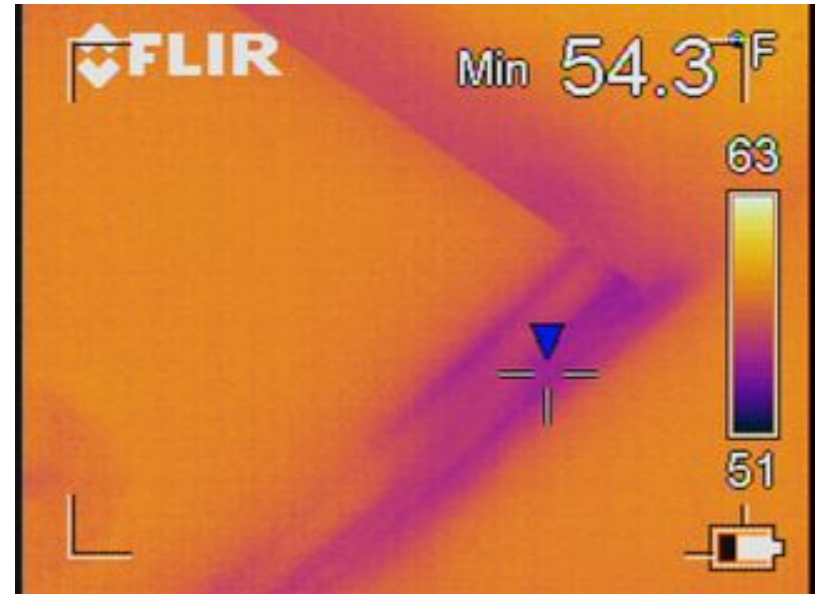
Importance of Testing



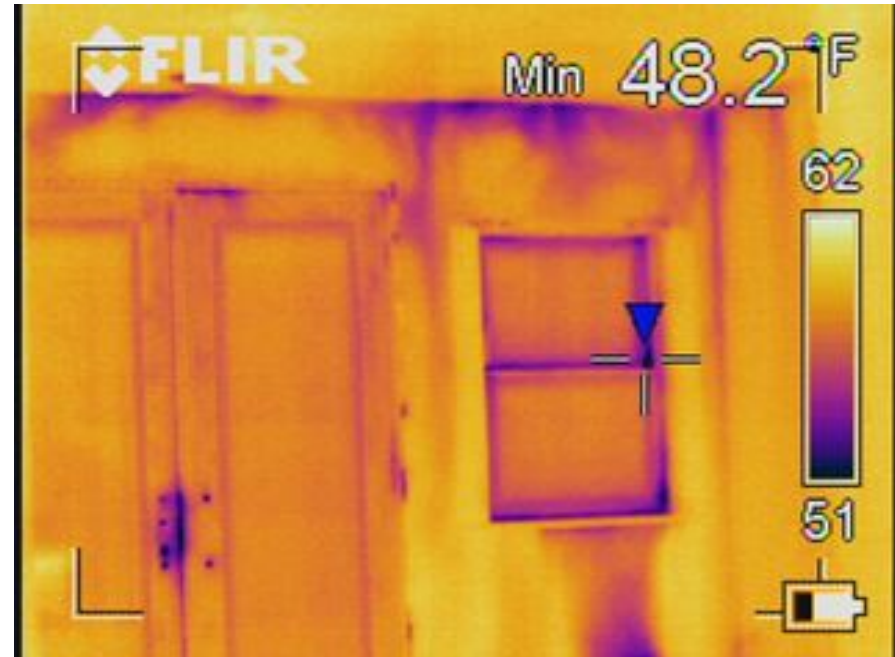
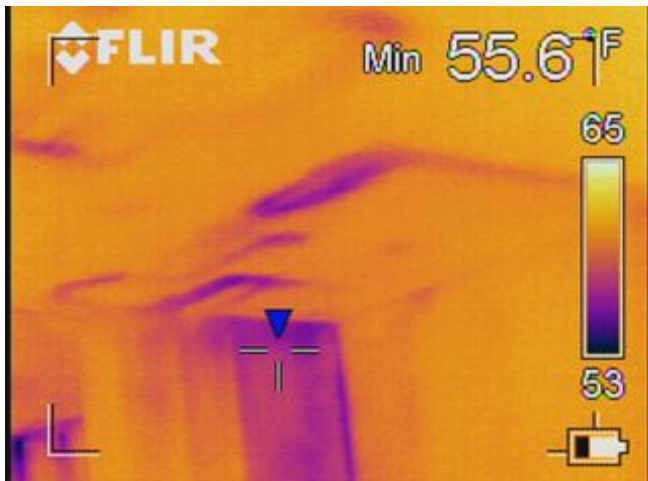
Importance of Testing



Importance of Testing



Importance of Testing







Tightening the home

- Air sealing
- Window replacement
- Building paper replacement
- Improved insulation

Problems with tightening a home

Pre-war homes were not designed to be tight

- No flashings on windows
- No insulation
- Un-finished basements
- Un-finished attics
- Chimneys (ceramic liner)
- Atmospherically vented appliances

Problems with tightening a home

Post-war homes were insulated but still not designed to be tight

- Batt insulation
- Vapor retarder (maybe)
- Un-finished basements
- Un-finished attics
- Chimneys
- Atmospherically vented appliances

Problems with tightening a home

- Moisture migration into wall cavities
- Moisture retention with insulating materials
- Unbalanced home
- Condensation and durability concerns with windows
- Mold and mildew conditions in basements
- Rot and insect infestation in wall cavities
- Backdrafting of flue gasses

Worst Case Combustion Spillage



Combustion Spillage

Methods of depressurizing a home

- Bath fan
- Range Hood
- Dryer
- Fireplace
- Anything that exhaust air from the home

Depressurization Limits

CAZ Depressurization Limits

Venting Condition	Limit (Pascals)
Orphan natural draft water heater (including outside chimneys)	-2
Natural draft boiler or furnace commonly vented with water heater	-3
Natural draft boiler or furnace with vent damper commonly vented with water heater	-5
Individual natural draft boiler or furnace	-5
Mechanically assisted draft boiler or furnace commonly vented with water heater	-5
Mechanically assisted draft boiler or furnace alone, or fan assisted DHW alone	-15
Exhausto chimney-top draft inducer (fan at chimney top); High static pressure flame retention head oil burner; Sealed combustion appliances;	-50

Combustion Spillage

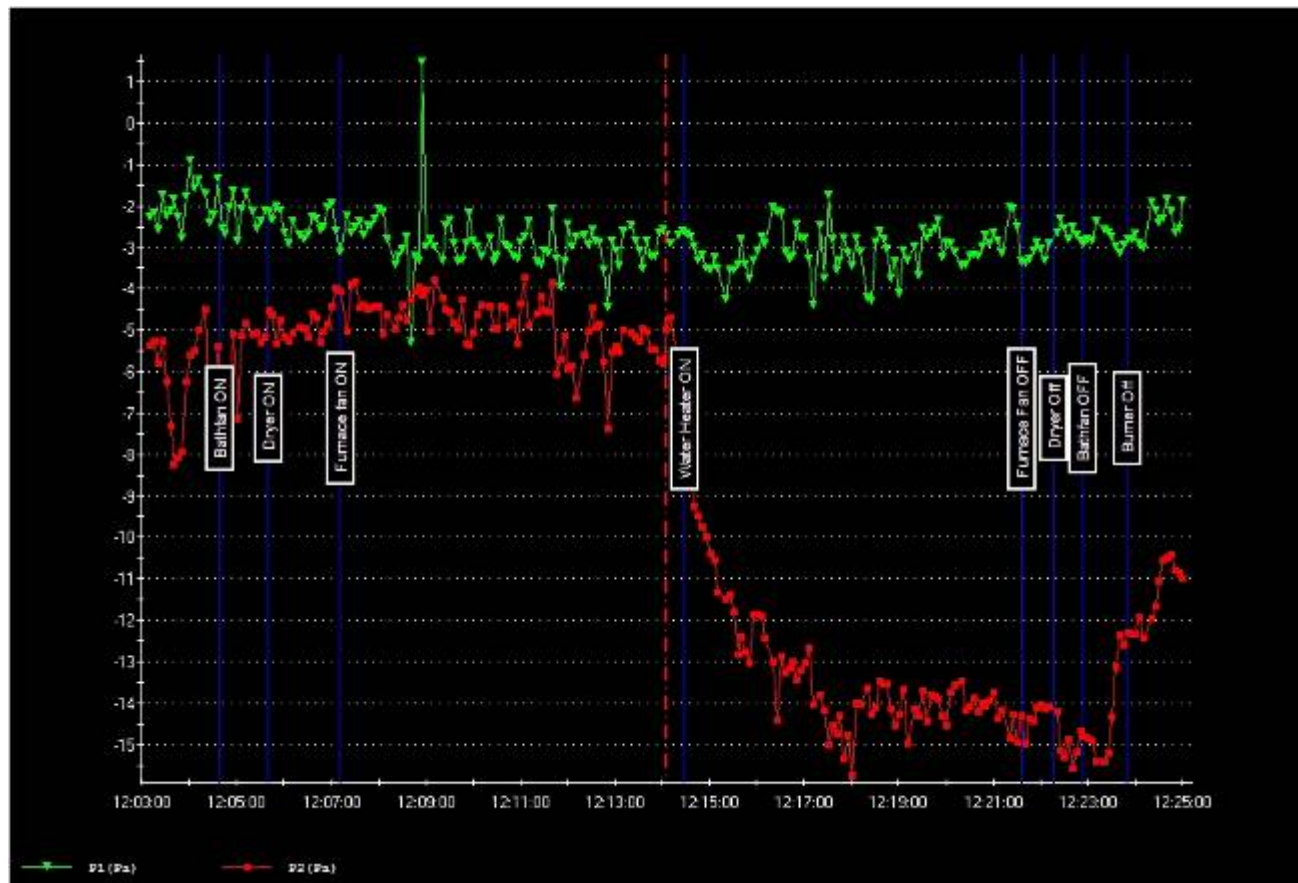
Common caused for backdrafting

- Improperly run venting ductwork
- Too much resistance
- Runs backwards
- Wrong size
- Too many appliances sharing one access to the chimney
- Improperly tied into chimney liner
- No chimney liner

Combustion Spillage

- How is it tested
 - Creating a worst case scenario with exhaust devices
 - Measuring the flow of flue gas before during and during worst-case event
 - Flow of flu-gas must remain positive throughout the test
 - Levels lower than 2 pascals suggest a risk for backdrafting

Spillage Test results



Combustion Spillage

Understanding combustion make-up air's role

- Combustion air requirements are minimal. Fresh air to maintain “draft” are large
- The make-up air “hole” cannot keep up with exhaust air
- Large loss in energy efficiency with added make-up air
- Heated make-up air wired to large range hoods is typically balanced

Combustion Spillage

- Implications for occupants and contractor
 - Creation of unhealthy indoor environment
 - Risk of CO poisoning
 - Liability for creating dangerous condition in the home

Solutions

- How to resolve back-drafting if it exists
 - Venting solutions
 - Size, run, angle
 - Power venting solutions
 - Appliance replacement
 - Water Heater (primary culprit)
 - Direct vent vs sealed combustion

Solutions

Avoid creating a problem

- Be mindful of the tightness of the home
 - Pre-test and post test
- Avoid Installation of oversized exhaust equipment
- Homeowner education
 - Help the homeowner understand the potential issues created when operating multiple exhaust devices

Solutions

- Best practices
 - Test the home prior to construction
 - Replace liner, ducting, angle
- Replace equipment
 - 96%+ AFUE furnaces
 - 85%+ direct vent boiler
 - 60% power-vent/direct vent water heater
 - 98%+ tankless direct vent water heater

Developing Strategies

- Test Results
 - Critical failures
 - Combustion spillage
 - Air exchange greater than 2/3
 - Air sealing and insulating to remove bypasses
 - Options for improvements to existing systems

Developing Strategies

- Lots of information
 - what do you do with it?
 - how do you apply it?

Developing Strategies

- Prioritizing options based on test results
 - Create a road-map for additional improvements
 - Planning with contingencies
 - Analysis of the structure suggests a potential issue.
 - Build the potential actions and costs into the road-map to eliminate “scramble”
- Prioritizing options based on impact and ease
 - Lightbulb replacement
 - Flashing replacement

Developing Strategies

Design document as a tool for expanding the scope of work as feasible

- Expanded options and flexibility during construction
- Clear expectations for plan B and plan C
- Clear indicators for activating alternate plans

Developing Strategies

Example:

Testing shows the water heater just barely passes worst combustion spillage prior to improvements

1. Improve the draw of the furnace with initial vent ducting and connection with liner
2. Replace flue liner
3. Upgrade unit to side-wall vented unit

Developing Strategies

- Alternatives to installing AC
 1. Install whole home de-humidification system
 2. Install ceiling fans (Energy Star & properly supported)
 3. Repair screens
 4. Replace Sash-cords
 5. Free the upper-sash

Practical Assessments

- Attics
 - Initial indicators
 - Sagging soffit or deformed gutter
 - Visible melting pattern on roof
 - Visible Ice-dams
 - Staining off window sill corners
 - Cracking off window sill corners

Practical Assessments

- Attics
 - Initial indicators
 - Curling shingles in spots (not uniform)
 - Review utility bills or blower door test
 - Unusually high cooling costs
 - Excessively hot in the summer and temperate in winter
 - Frost on rafters
 - Drip marks, water stains, tannin stains on rafters, floor, or ceiling below

Practical Assessments

- Inspect the system
 - Ductwork
 - Inspect joints, seams, connections, and all flex duct
 - Air handles located in unconditioned space
 - Non-sealed units in draw air into ductwork
 - Large bypass for moisture
 - Risk of freezing pipes
 - Risk of mold/mildew/rot
 - Risk of poor IEQ

Simple Solutions

- Insulate bath fan ductwork (add if missing)
- Eliminate bypasses
- Air seal and insulate between joists where sub-floor is missing
- Seal ductwork
- Create conditioned room for air-handler

Larger Solution

- Remove improperly installed insulation
- Remove knob and tube if present
- Convert to hot roof assembly or add proper sized venting

Practical Assessments

- Basements
 - Initial indicators
 - Damp
 - Musty odor
 - Vertical cracks in CMU
 - Traveling cracks in CMU
 - Missing mortar in limestone
 - Soft sand excessive exposure of limestone

Practical Assessments

- Basements
 - Initial indicators
 - Excessive efflorescence
 - Dry rot on joists
 - Beam-fill
 - Exposed soil

Practical Assessments

- Basements
 - Inspecting the surroundings
 - Undersized joists
 - Cracks in the upper or lower thirds
 - Traveling cracks
 - Undersized posts
 - Twisting
 - Checking

Practical Assessments

- Basements
 - Rotted posts
 - Set into slab
 - Punky at the base
 - White at the base
 - Checking in the post
 - Calcium chloride test to determine moisture levels
 - Moisture tests on previously finished basements

Energy Efficiency



Simple Solutions

- Don't finish an un-finished basement
- Remove carpeting from finished basement and replace with VCT or other durable hard surface
- Insulate rim joists
- Pour raised footings for posts
- Install hangers, plates, gussets as needed



THANKS

QUESTIONS?



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