




VERIFIEDGREEN

Helping You Build Green



# Assessment and Strategy Development

May 21<sup>st</sup>, 2008



# 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

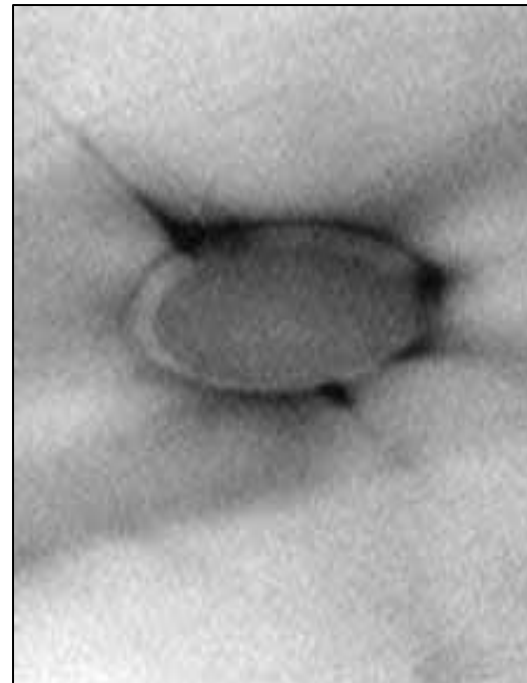
- Depressurize the home to -50 Pascals
- Equal pressure on all sides of the home
- Air exchange is measured in ACH, CFM or CFM per SF

## 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

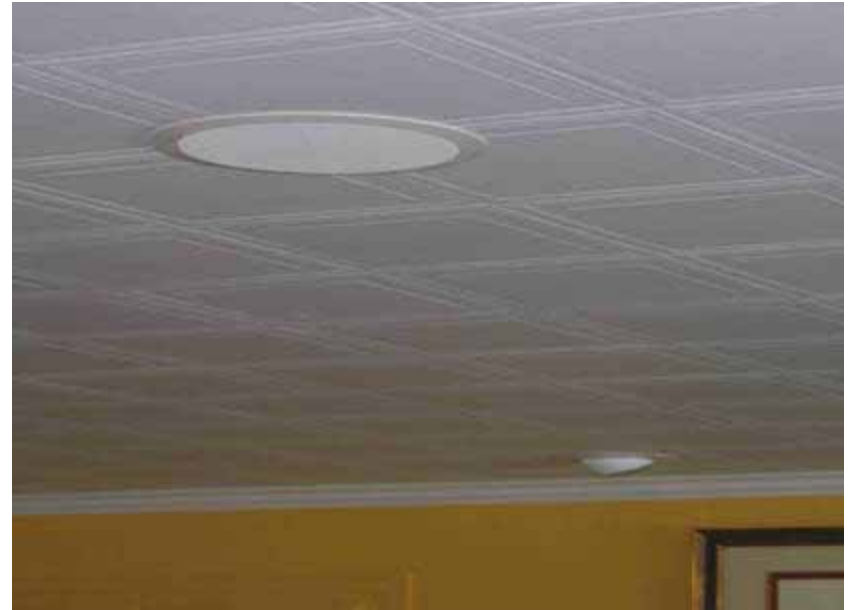
## Requirements

- 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

# Understanding Testing

What can you expect?

- ACH 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
- ACH at 3500
  - Reduction in air infiltration by 5-20% in a home built between 1950 and 2006
- ACH at 1500
  - Reduction in air infiltration will be difficult





# 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

# 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

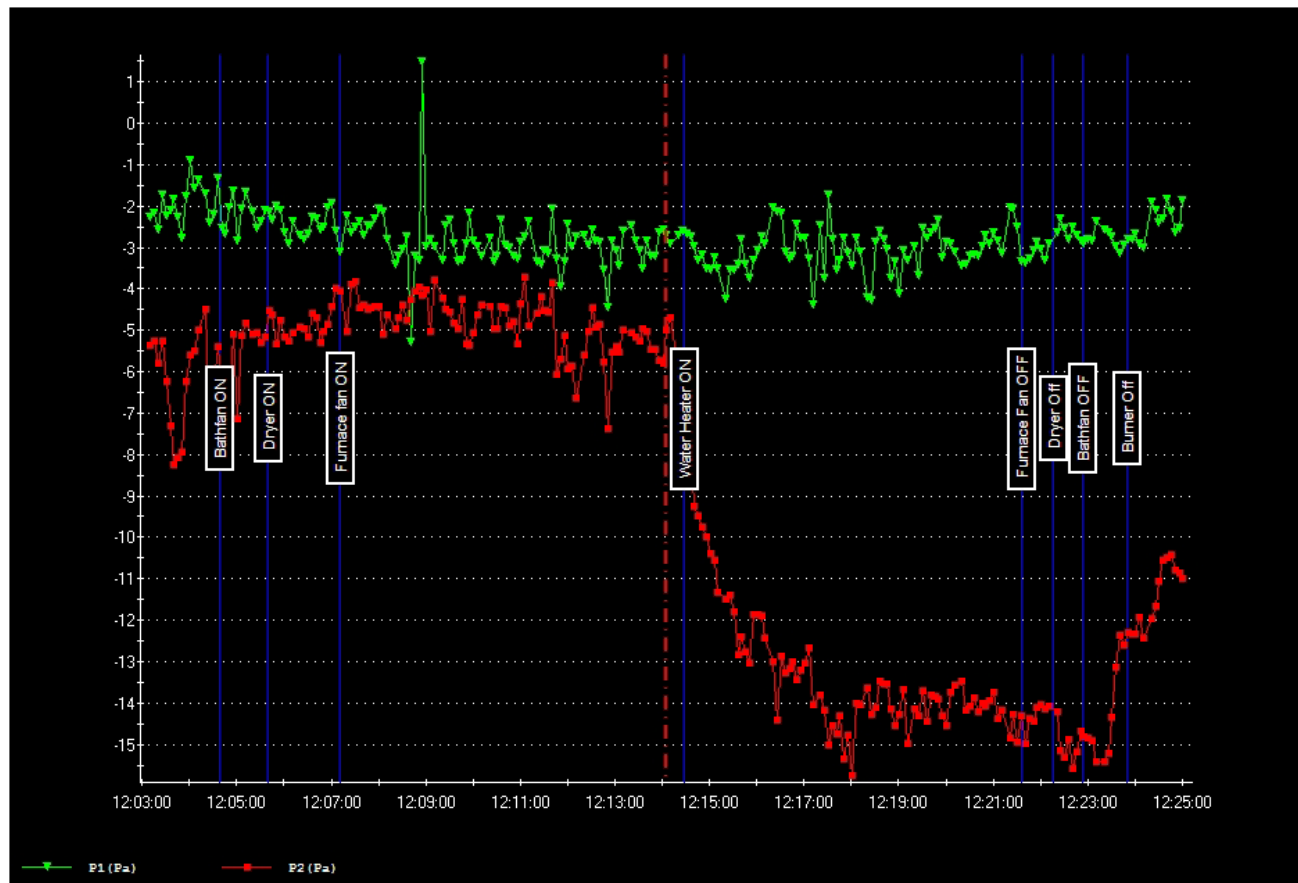
## Common caused for backdrafting

- 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
  - 90%+ AFUE furnaces
  - 85%+ direct vent boiler
  - 60% power-vent/direct vent water heater
  - 80%+ 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

- 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

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

# Developing Strategies

- Install whole home de-humidification system rather than an AC system
- Install ceiling fans (Energy Star & properly supported)
- Repair screens
- Replace Sash-cords
- 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



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