

## Advanced Blower Door Diagnostics



ENERGY 2008  
*Out West*



## Intro Questions

- How many are Doing Zonal Pressure Diagnostics
- Where are you testing Zonal Pressures
  - Attic, Garages, Crawlspace, Wall/Floor Cavities...
- How are you testing
  - Direct Pressure
  - Charts
  - Calculators

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## Use Your Blower Door to do more

- Where the air barrier (PRESSURE BOUNDARY) is so we can determine where to air seal
- If the Pressure Boundary and insulation (THERMAL BOUNDARY) line up
- Are zones with poor air quality such as Garages connected to the indoors
- Is warm moist air getting into the cold Attic

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## Zone Testing

- What are Zones?
  - Spaces that might be better connected to *Inside* or *Outside*
- Zone Types
  - Primary
  - Secondary

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## ZONE TYPES

can you tell what determines type?

Primary Zones	Secondary Zones
Attic	Cantilevers
Basement	Floor Cavity b/w Floors
Garage	Soffits
Crawlspace	Porch Ceiling
Attached Porch	Interior Wall

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## Zone Types

- Primary Zones
  - Are zones that have an opening in one of the surfaces
    - House to Zone or Zone to Outside
    - This is an advantage for testing
- Secondary Zones
  - Do not have an access in either surface
    - Only Direct Pressure measurements can be taken

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## Levels of Zone Testing

- Level 1 – Direct Pressure Measurement
- Level 2 – Charts and Graphs
- Level 3 – ZPD Calculators

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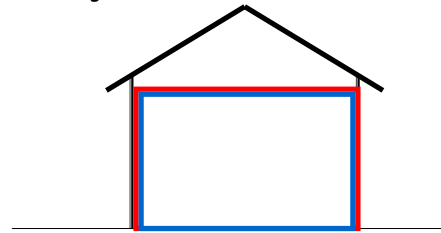
## Level 1 Pressure Only

- Is the zone more *indoors* or more *outdoors*?
- Do *Pressure* and *Thermal* Boundaries line up?

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## Pressure and Thermal Boundaries

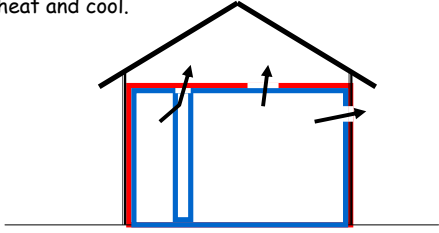
- The *Pressure Boundary* and *Thermal Boundary* must be together and continuous.



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## Pressure and Thermal Boundaries

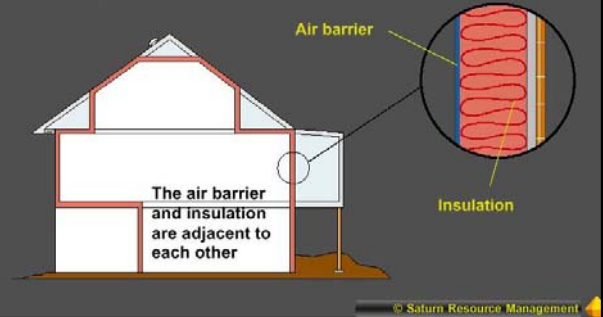
- If the boundaries are misaligned or If there are holes, voids or gaps this will make the building difficult to heat and cool.



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## The ideal thermal boundary

An ideal thermal boundary consists of an effective air barrier and an optimal level of insulation



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## Outside Zones and Inside Zones Measured with Reference to House

We want Zones Outside the House  
(Unheated Areas) to be closer to 50

We want Zones Inside the House  
(Heated Areas) be closer to 0

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## Outside Zones and Inside Zones

Unheated zones **OUTSIDE** the house should be closer to **50 pascals**.

Heated zones **INSIDE** the house should be closer to **0 pascals**.

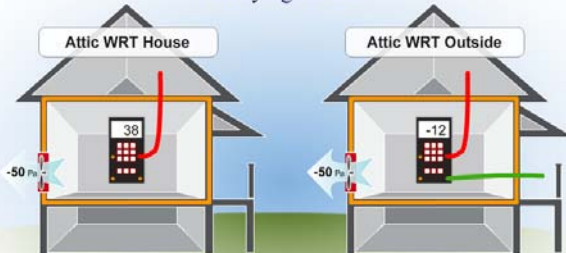
### Outside Zones (Unheated)

- Attics
- Garage
- Porches (sometimes)
- Crawlspace (sometimes)
- Basement (sometimes)

### Inside Zones (Heated)

- Interior walls
- Floors between stories
- Porches (sometimes)
- Crawlspace (sometimes)
- Basement (sometimes)

## Verifying Zonals



The attic WRT to outside measurement confirms the attic WRT house measurement because their absolute values add up to 50 pascals.

## WRT With Reference To

- Zone WRT House = 40PA
- Zone WRT Outside = \_\_\_PA
- Zone WRT House = 15PA
- Zone WRT Outside = \_\_\_PA
- Zone WRT House = 25PA
- Zone WRT Outside = \_\_\_\_\_PA

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Let's Do Some Level 1!



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TRAINING AIDES

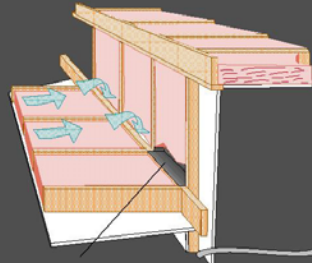
## ZPD Trainer (Program)

Demo Direct Pressure Measurements

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2-level attic in split-level or tri-level homes

*Common wall is a possible air-leakage conduit*



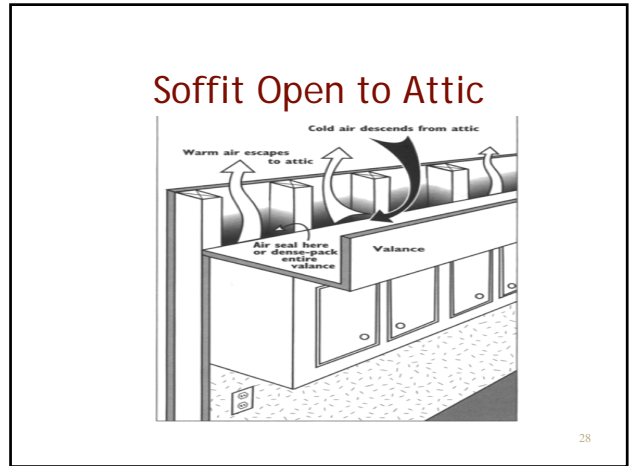
Air leaks between ventilated attic and uninsulated interior wall cavity

Plug retrofitted for air leakage reduction.

Manometer indicates outdoor connection.

© Saturn Resource Management

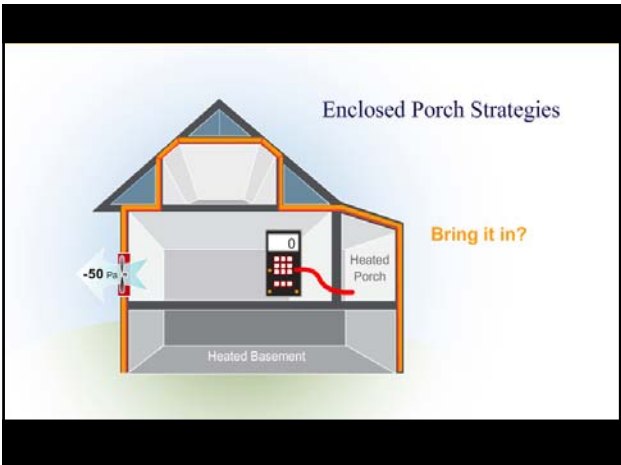


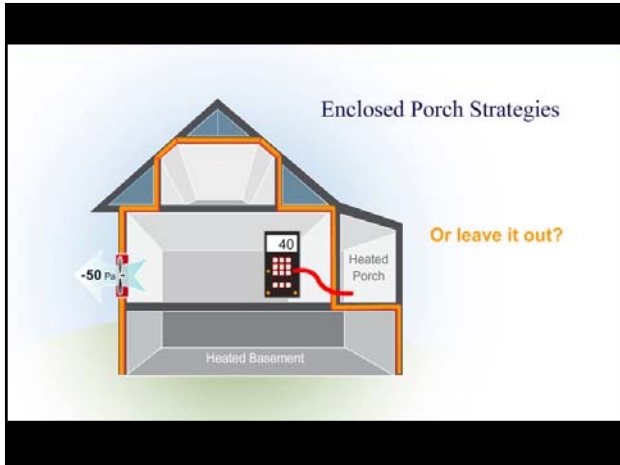


Kitchen Soffit and Base Cabinet  
were open to attic



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- ## Interconnection
- Depressurize house to 50 Pa
  - Measure pressure to one zone
  - Open a door to the other zone, readjust blower door to read 50 again
  - If the zones are connected, the pressure in the first zone will change, If not, it won't
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## Pressures and Leakage

### Attic Zonal Reading of 25pa

Means hole between Attic and House is Same size as Hole Between Attic and Outdoors

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## Pressures and Leakage

### Attic Zonal Reading of 48pa

Means hole between Attic and House is 1/8<sup>th</sup> size of Hole Between Attic and Outdoors

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## Ratios of Pressures to Leakage

Zone Pressures		Relative Size of Leaks	
Zone-House	Zone-Out	Zone-House	Zone-Out
12	38	2	1
25	25	1	1
37	13	1/2	1
41	9	1/3	1
45	5	1/4	1
48	2	1/8	1
49	1	1/13	1

Sources: Michael Blasnik and Jim Fitzgerald

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## TRAINING AIDES

### ZPD Trainer (Program)

Demo Pressure Ratios from  
Attic Venting

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## Level 2 Charts and Graphs

- Zone with an opening
- Can calculate square inches leakage of both barriers
- Can calculate the leakage through the zone (available CFM50 reduction) Total Path Leakage

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## Total Path Leakage

- The CFM50 that describes how much air will go through the two barriers
- Always less than the tightest barrier
- Identifies potential for reduction in house CFM50

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## Add a Hole

- Depressurize house to 50 Pa, measure house-zone and zone-out
- Make a hole in one of the barriers
- Adjust fan to keep 50 Pa, measure pressures
- Use Chart or software to get CFM50 of either barrier

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## Open a Door (Flow Method)

- Depressurize house to 50 Pa, measure house CFM50,
- Open a door with highest pressure difference across it (tightest air barrier)
- Measure new house CFM50 and new house-zone and/or zone-out

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## New Charts for In-Field

- Garage Chart
  - You can always open a DOOR H/G or G/O (makes this easier)
- Attic Chart
  - You can only open the hatch that is there (a bit more tricky)

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## Let's Do Some Level 2!



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## Give the Charts a Try!

(Hand them out!)

- Attached garages
  - Quick
  - Easy
  - Important
- Attics
  - Sometimes Quick and Easy
  - Also Important

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### *TRAINING AIDES*

ZPD Training Sheet  
ZPD Trainer Program  
The Garage Connection Files

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## *Level 3 Software*

- More Detailed calculations using Software or Handheld Calculator
- Test Can be automated with laptop computer and equipment

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## Level 3 Programs

- Zip Test Pro and Zip Test Pro2
  - Rick Karg ([www.karg.com](http://www.karg.com))
- ZPD Calculation Utility Calculator
  - [www.energyconservatory.com](http://www.energyconservatory.com)

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## Remeasure When You Think You're Done

- Outside zones (attic, garage) should be much closer to 50 than when you started
- Inside zones (interior walls, chases, ducts) should be much closer to zero than when you started
- Zones that haven't changed much in the right direction are opportunities for further improvement

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## Limitations/Cautions

- Don't attribute much meaning to measurements between 47 & 50
  - Small errors in measuring may generate large errors in the result
  - Don't assume attic is OK because pressure is 48
  - Can seal zone-exterior (attic vents) to get numbers into a better range
  - Read small pressure

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## Limitations/Cautions

- Re-check unusual measurements
  - "If a number is unbelievable, don't believe it!"
  - Disconnected, misplaced or pinched hoses
  - Unknown fans
  - Mis-read gauges
- Its best to be able to get 50 Pascal before and after adding a hole
- Zone Connections can give exaggerated numbers in doing advanced on several zones, especially kneewalls

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## Improving Accuracy

- Take Baseline Measurements
- Measure pressures directly; don't subtract
- Try to measure the smallest pressure difference carefully
- Do it again
- For add-a-hole, try to add the hole to the barrier with the largest pressure difference

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## The End



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