Notes from the Field

AeroBarrier - one year in

Gord Cooke

Construction Instruction

AEROBARRIER™

Breakthrough Envelope Sealing Technology

Ci

BUILDING KNOWLEDGE CANADA INC

Our Team

Construction Instruction Inc.
Denver, CO - Phoenix, AZ- Toronto, ON



Principals:

Mark LaLiberte: President
Justin Wilson: Vice President
Gord Cooke: Partner

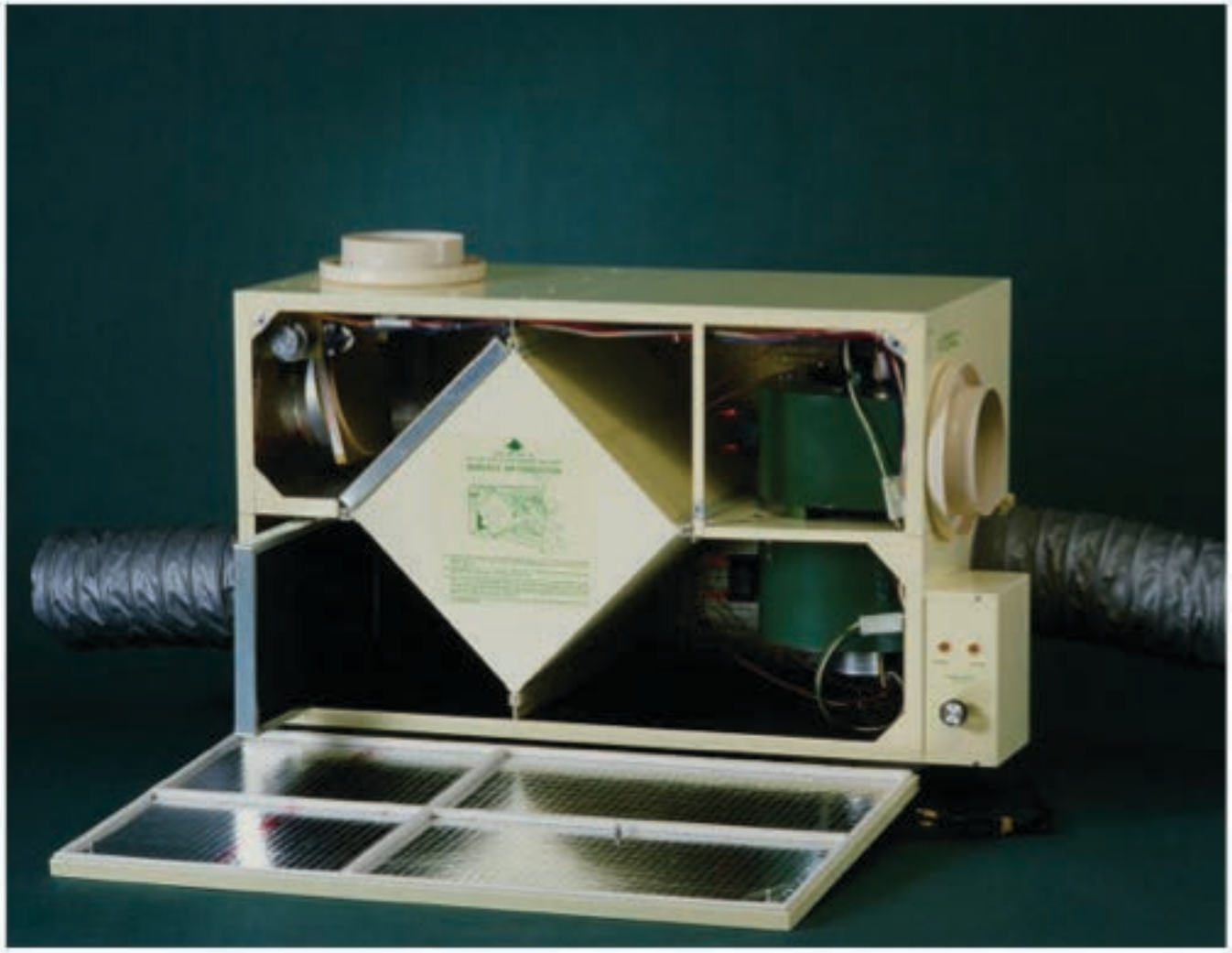
Primary focus:

Industry education, research, product development, consultation to manufacturers, App support

Audience personally reached: +15,000/yr
Audience reached via App: +150,000

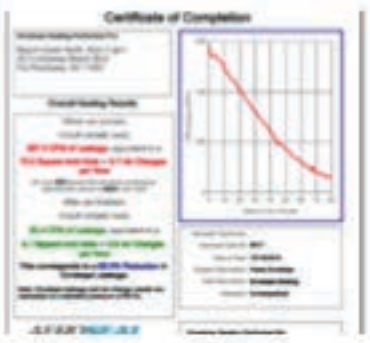
My Background

1984



Today's Agenda

- Where did this come from?
- How does it work?
- Does it work?
- Is it safe?
- Will it last?
- What impact will it have?



Company History

AEROSEAL
Duct Sealing From the Inside

1994
Patent awarded to Lawrence Berkeley National Laboratory

1997
Aeroseal Founded

1999
Carrier acquires Aeroseal

2010
JMD acquires Aeroseal

2011
3 million sq. ft. of commercial space sealed

2014
Aeroseal acquires Comfort Institute Home Performance training organization

2015
Ducts in over 100,000 homes sealed / 30 million sq. ft. of commercial space sealed

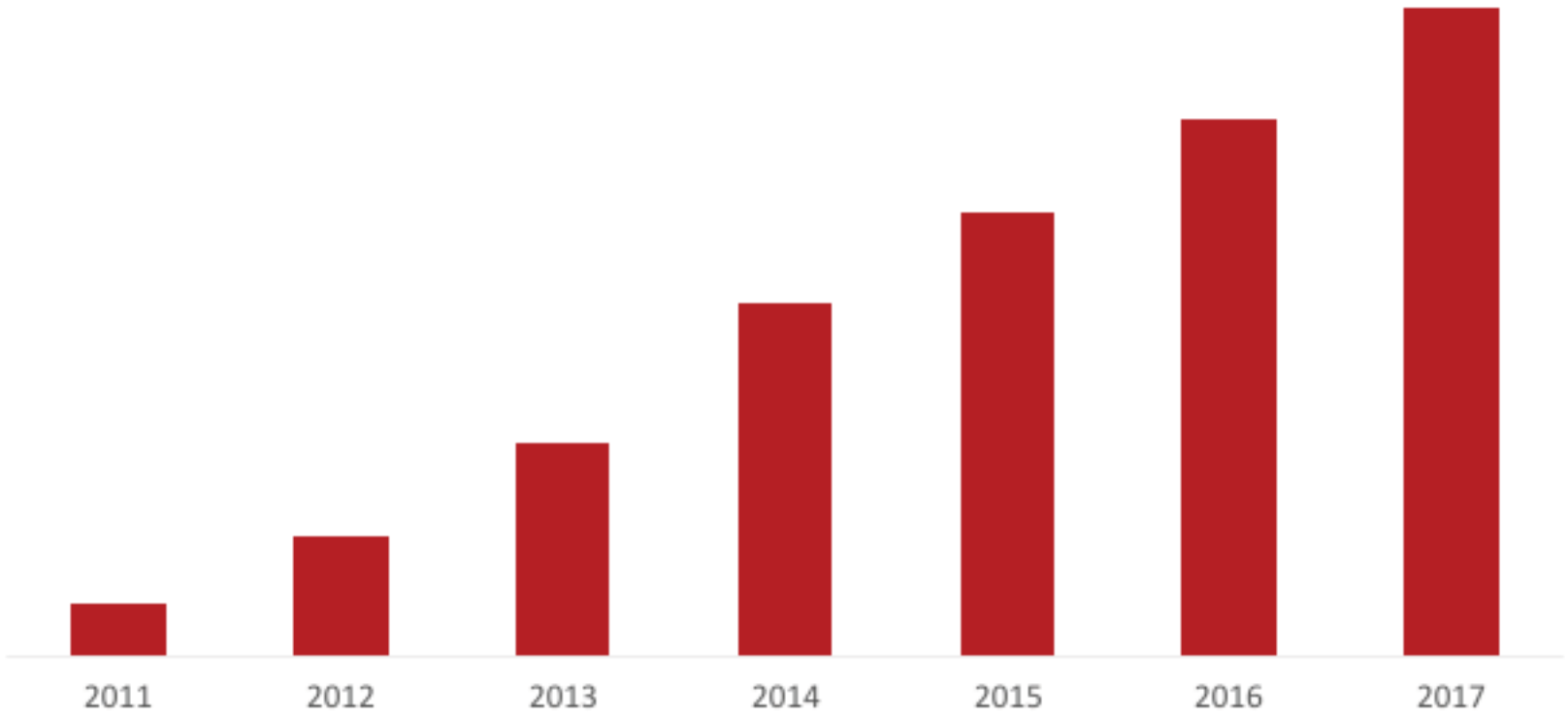
2016
Aeroseal wins AHR Expo "Product of the Year"

2017
20th Anniversary of Aeroseal technology

700 systems operating worldwide

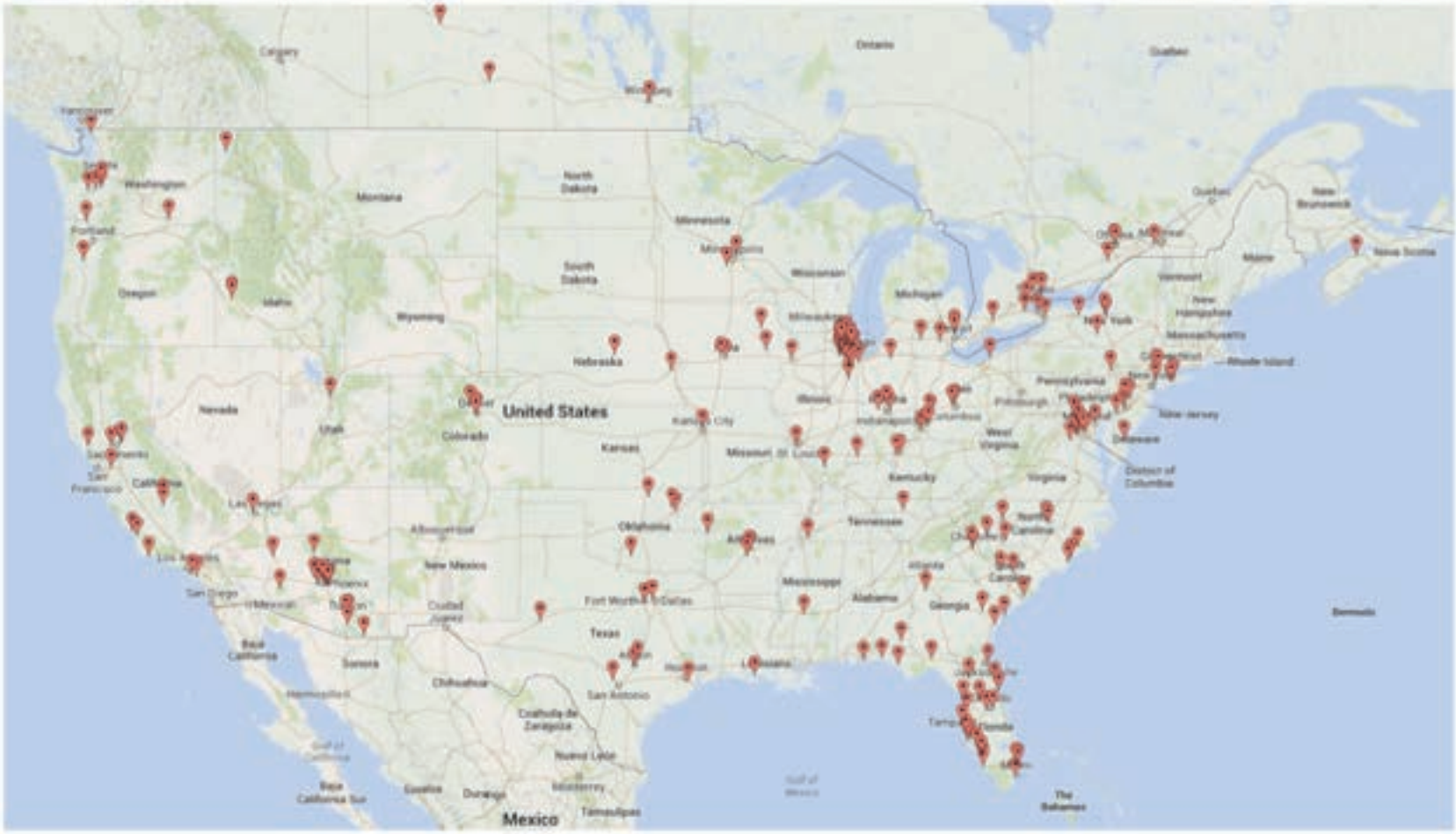
Aeroseal – number of machines

Over 1,000 machines sold



Aeroseal – making buildings better around the world

Over 750 dealers in 17 countries



Wynn Hotel – Las Vegas

Building Overview

- 45 stories – 2,716 guest suites
- Casino, Convention Center and Retail
- Air quality concerns

Aeroseal Results

- Seal 504 ventilation shafts
  - Average Pre-leakage: 411 cfm
  - Average Post-Leakage: 31 cfm
- Sealing the ventilation shafts resolved all air quality issues.

MetLife Building – New York City

Building Overview

- 56 stories – 3.2 million sq ft
- Significant air quality concerns and severe odor issues.

Aeroseal Results

- Seal 4 large ventilation shafts
  - Pre-leakage: ~8,000 cfm
  - Post-Leakage: 850 cfm
- Sealing the ventilation shafts resolved all air quality and odor related issues.

Nemours Children Hospital – Jacksonville

Building Overview

- 630,000 sq ft – 137 inpatient rooms
- General exhaust leakage contributing to nosocomial infection rates.

Aeroseal Results

- 85% Reduction in leakage

"After sealing the leaks with Aeroseal, all floors are getting the ventilation that they need. As an additional benefit, we were able to dramatically reduce the speed of the exhaust fan which has resulted in energy savings for the clinic..."

- Chuck Boynton, Carrier Corp

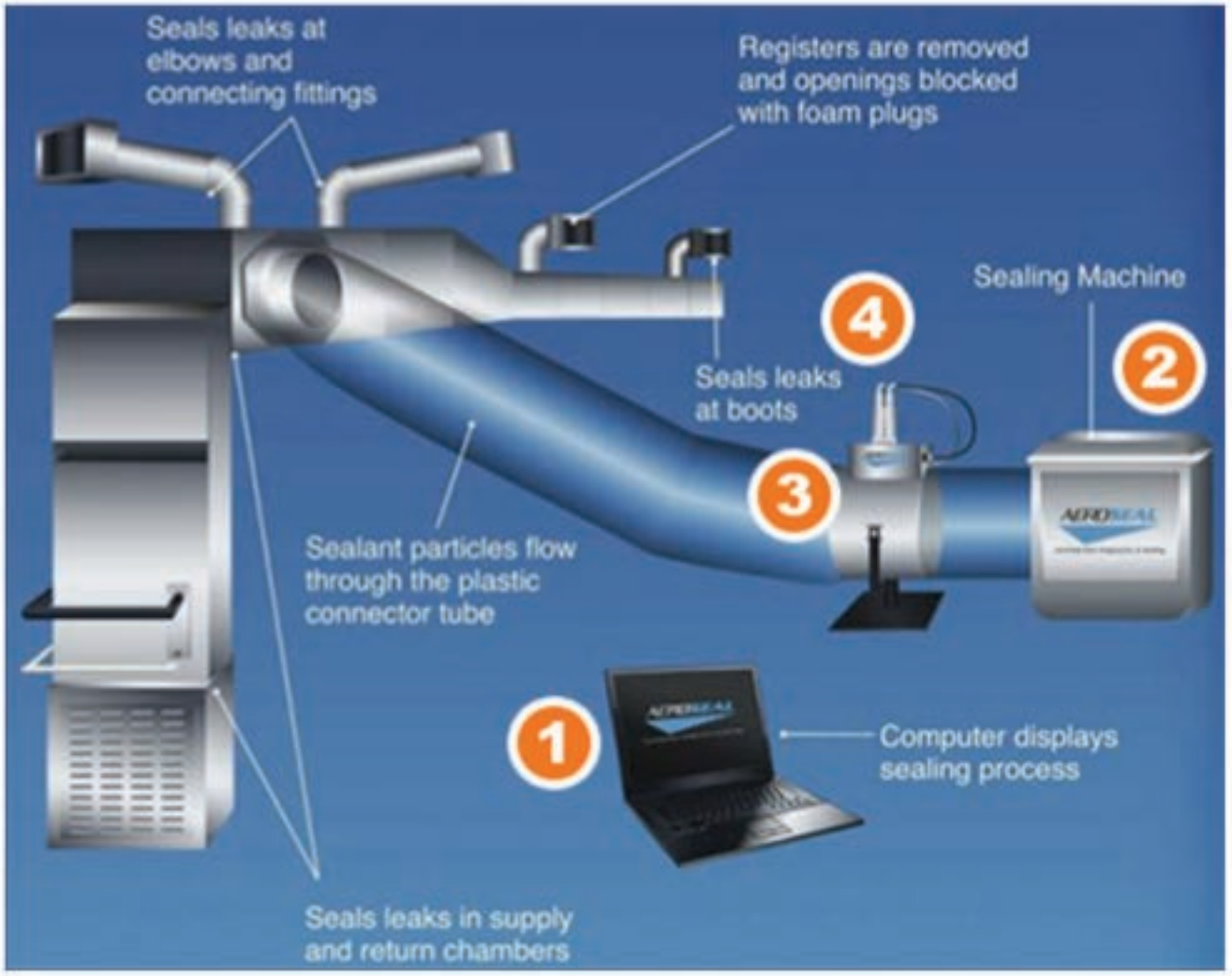
Great awards

2018 Environmental Leader Magazine Product of the Year
2016 AHR Product of the Year-AHR Expo
2016 AHR Innovation
2015 Innovation Awards Gold Metal-Interclima+Elec Trade Fair
U.S. Department of Energy (DOE)

AHR EXPO
INNOVATION AWARDS
2016

AEROSEAL®
Duct Sealing From The Inside

Duct Sealing Process



Certificate of Completion

Duct Sealing Results

Duct Sealing Performed for:

Overall Sealing Results

When we arrived,
YOUR DUCTS HAD:

494 CFM of Leakage, equivalent to a
94 **Square Inch Hole**

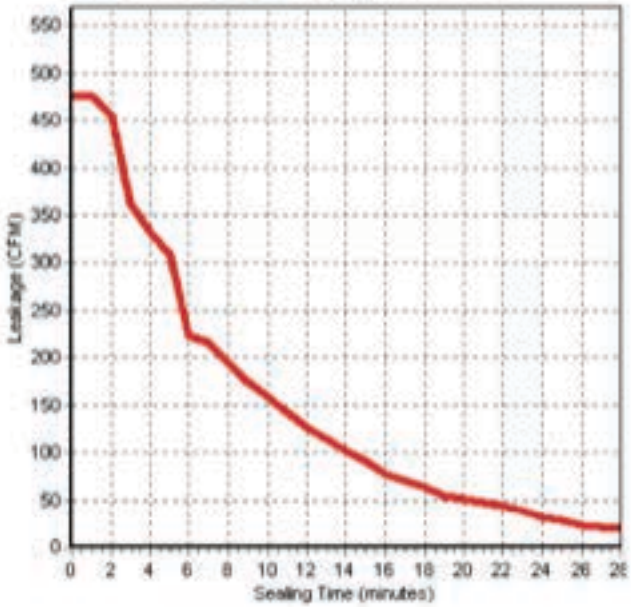
After we finished,
YOUR DUCTS HAVE:

25 CFM of Leakage, equivalent to a
5 **Square Inch Hole**

This corresponds to a **95%**
Reduction in Duct Leakage

Note: Duct leakage results are calculated in cubic feet per minute (CFM) measured at a standard OPERATING PRESSURE of 25 Pa (0.10 in. water).

Aerosol Sealing Profile



Your Heating and Cooling Capacity Improvement for Duct Sealing is
29%
based upon measured leakage reduction and original register flow

AEROBARRIER™

Breakthrough Envelope Sealing Technology By Aeroseal

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2016
AeroBarrier envelope sealing technology invented and patented.

2016
Aeroseal wins AHR Expo "Product of the Year"

2017
20th Anniversary of Aeroseal technology

700 systems operating worldwide

2018
AeroBarrier wins IBS Best In Show and Most Innovative Building Product

AeroBarrier is Nominated for an Edison Award

A breakthrough in building envelope sealing

AERO**BARRIER**

"This is a transformative technology that will assuredly change the way homes and buildings are constructed – as well as the expectations we all have regarding the overall performance of our buildings."

- Western Cooling Efficiency Center

UC DAVIS
UNIVERSITY OF CALIFORNIA

WCEC
WESTERN COOLING EFFICIENCY CENTER

Department of Energy – Building America Study

Goal of the Study:

Determine the best stage(s) of construction to apply AeroBarrier sealing and any current sealing methods that can be eliminated when AeroBarrier is used.

"The [AeroBarrier] process has the potential to be more effective and convenient than conventional sealing methods because it requires less time/effort, and can seal a larger portion of a leakage area more quickly."

Building AMERICA
U.S. Department of Energy

73%
Tighter than baseline homes

79%
Average leakage reduction

56%
Greater building tightness using Aerosols versus open-cell spray foam

Awards

IBS MOST INNOVATIVE BUILDING PRODUCT 2018

Most Innovative Building Product of the Year

IBS BEST IN SHOW 2018

EDISON AWARDS GOLD 2018 WINNER

FAST COMPANY WORLD CHANGING IDEAS

EQ AWARDS

2018 HIVE50 Pushing Boundaries

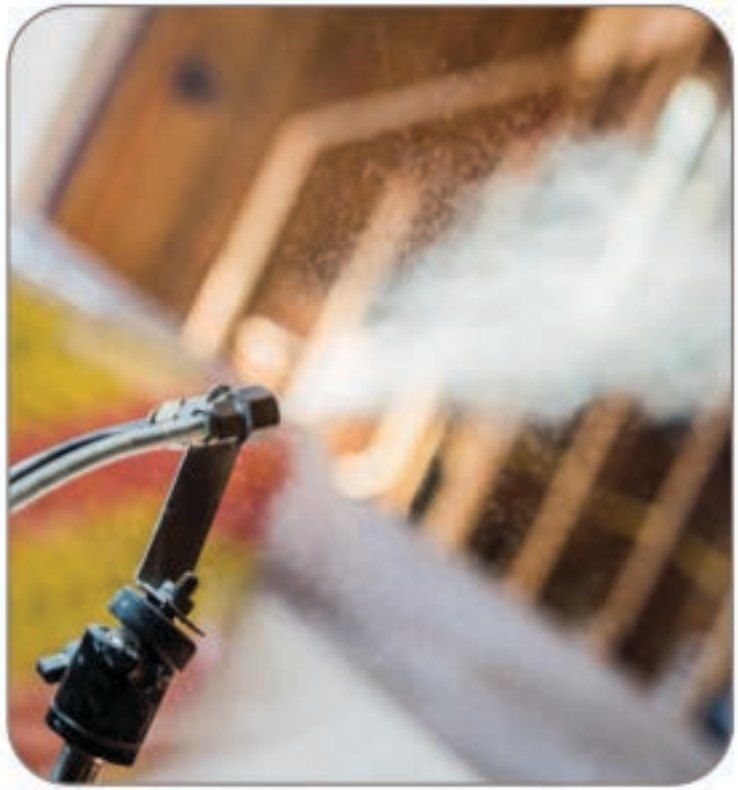
GREEN BUILDER Sustainability Awards 2019

A game changing solution

AeroBarrier is a convenient, cost effective approach that seals homes in less than 3 hours and provides verification that the air-tightness requirement has been achieved.

Changing the Way Homes are Built with:

- Consistently tighter building envelopes
- Verified and documented results
- A single process
- Time saving

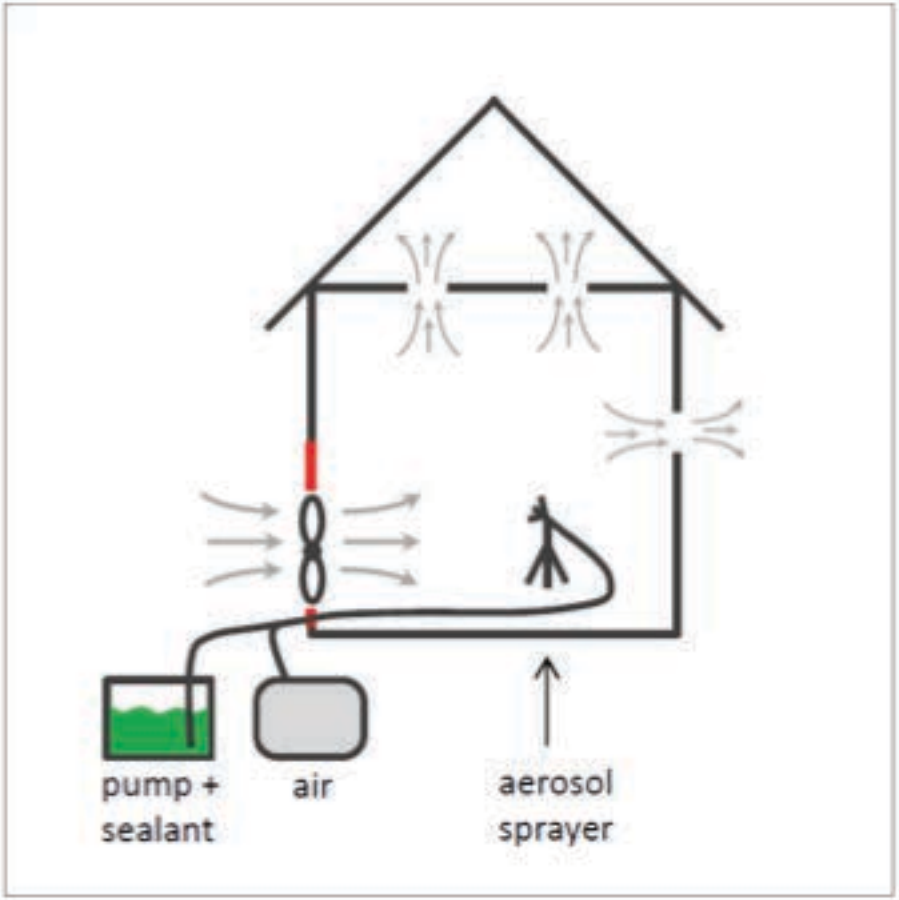


The AeroBarrier process

STEP 1:

Prepare house for sealing. Cover all intentional openings (drains, bathroom vents, etc.) and horizontal surfaces, set up sealing equipment, and pressurize the building / home.

Typically 100 Pascal



The Rig

The production challenge

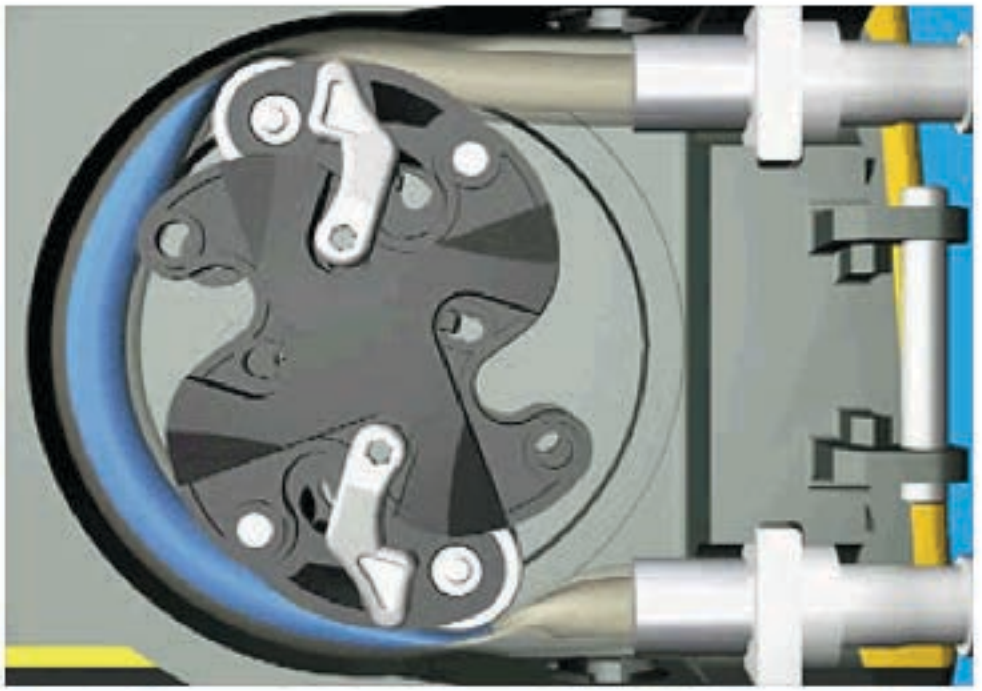
The Rig

A well thought out, self sufficient trailer

- Generator
- Compressor
- Control module
- Fluid pump
- **"Just add water"**

The Rig

At the house



By Njmcca - Own workPreviously published: http://www.watson-marlow.com/

The Peristaltic Pump

Meanwhile….

Prep inside the house:

- What holes, gaps don't you want it to seal?
- What surfaces don't you want it "falling" on?

Intentional holes to be sealed

Surfaces you don't want to have to clean sticky stuff off of

Just horizontal surfaces

… and do the big holes too

The Control Center

- Blower door in Pressurization mode
- A pail or two of sealant
- Fluid lines
- Pump module
- Sensors
- Computer control

Deploy the nozzles

Up to 8 tripods

2 nozzles each

Air and sealant to each

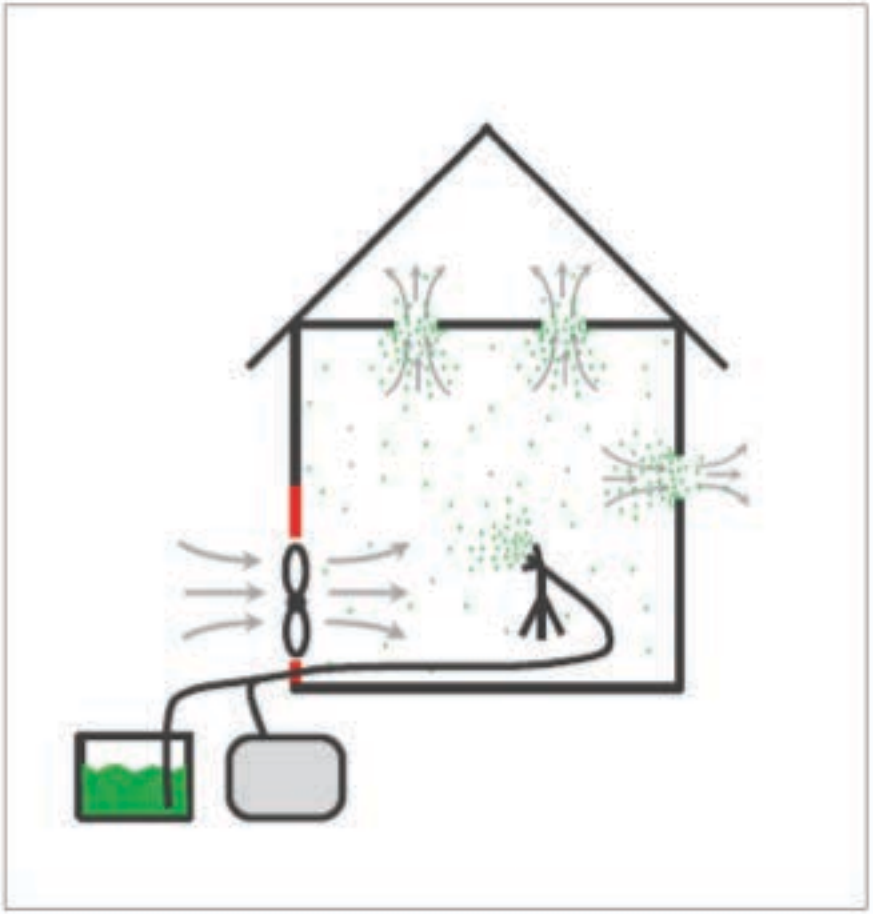
The AeroBarrier process

STEP 2:

Start the sealing process and begin to aerosolize the sealant. Air currents will transport & deposit sealant particles along the leaks throughout the space.

Fog the building

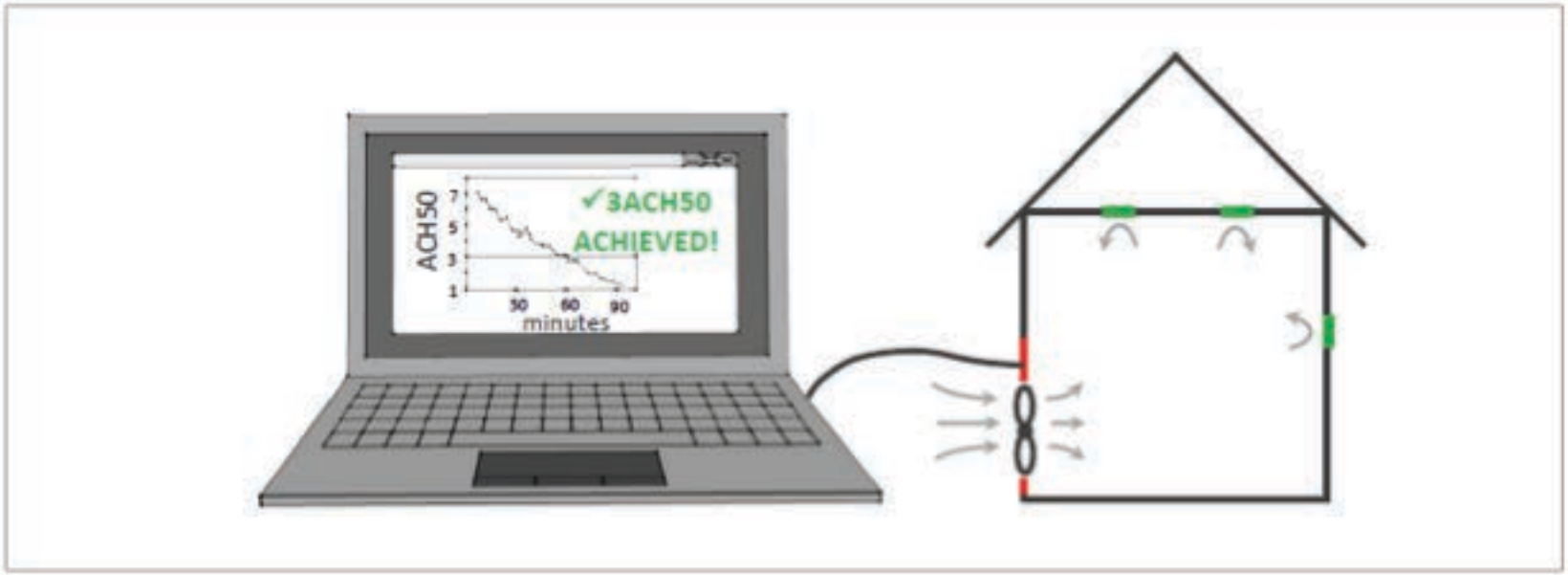
… and wait



The AeroBarrier process

STEP 3:

The software regulates the entire process; controlling all parameters, monitoring the sealing, recording all data, and verifying air-tightness target is achieved.



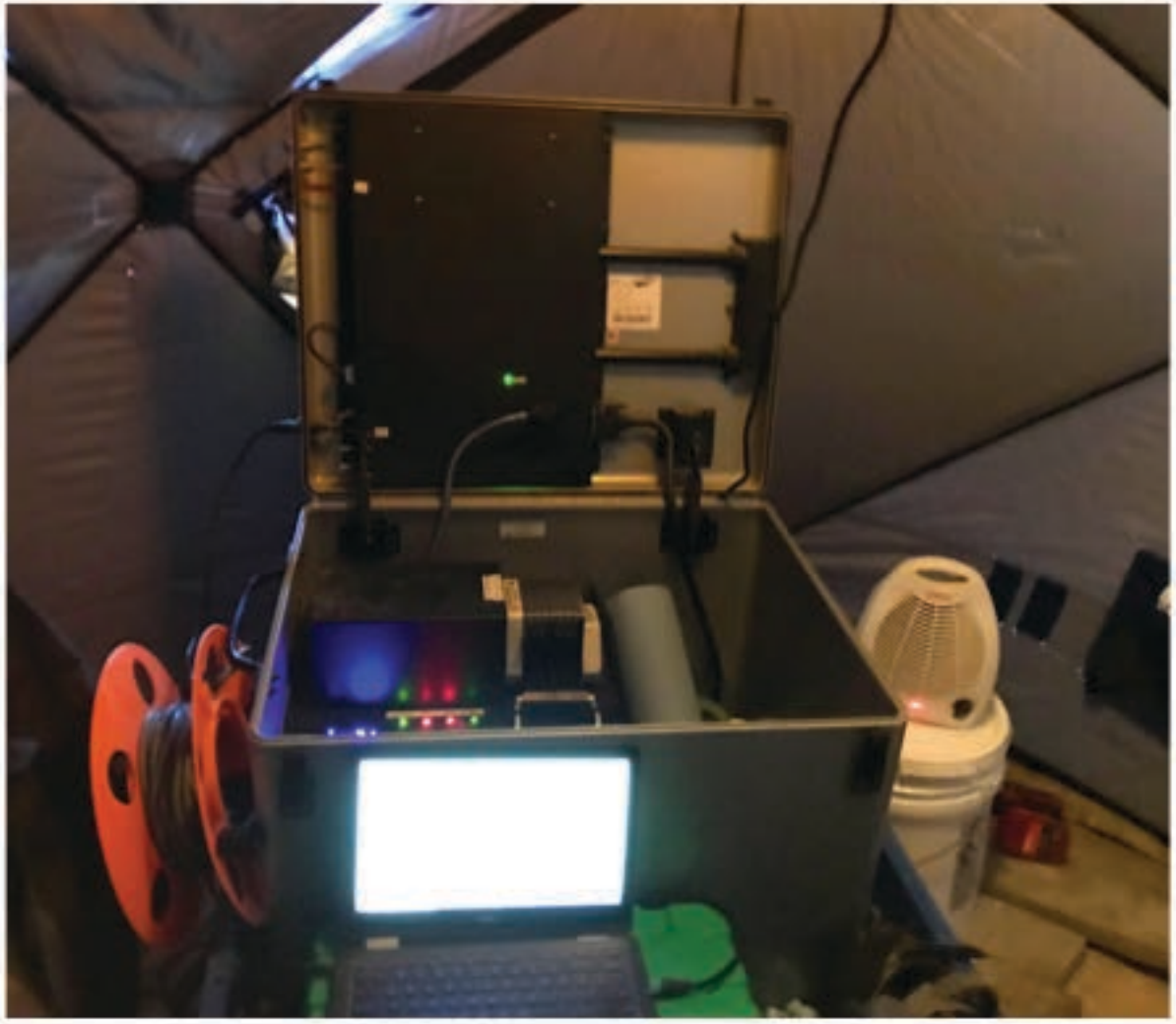
The Control Center

Measuring and controlling:

- Indoor temp. and RH
- Fan speed
- Fluid pump speed
- House pressure

Calculating and reporting:

- Leakage rate
- Time
- Sealant used

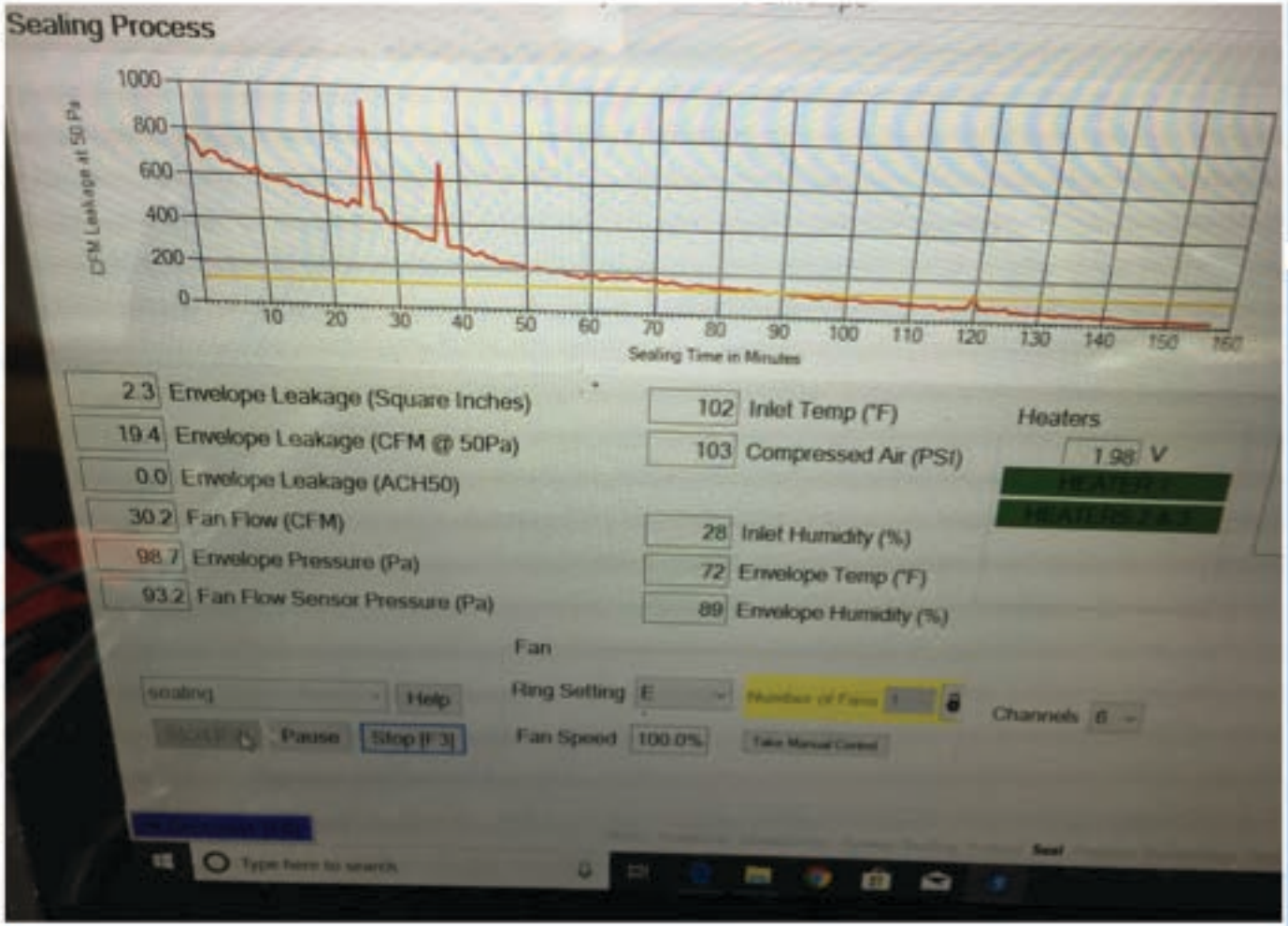


Monitor the Screen

Hints to change fan rings

Hints to check nozzles

Hints to adjust external heat



That worked great until October

We needed more heat

How much heat?

DESIRED AIR TEMP		Heat Required (kW) to boost supply air to 50 F									
50							BTUs/hr Required per CFM				
		200	400	600	800	1000	1200	1400	1600	1800	2000
Outdoor Temp F	40	2200	4400	6600	8800	11000	13200	15400	17600	19800	22000
	32	3960	7920	11880	15840	19800	23760	27720	31680	35640	39600
	20	6600	13200	19800	26400	33000	39600	46200	52800	59400	**66000**
	15	7700	15400	23100	30800	38500	46200	53900	61600	69300	77000
	5	9900	19800	29700	39600	49500	59400	69300	79200	89100	99000
	-5	12100	24200	36300	48400	60500	72600	84700	96800	108900	121000

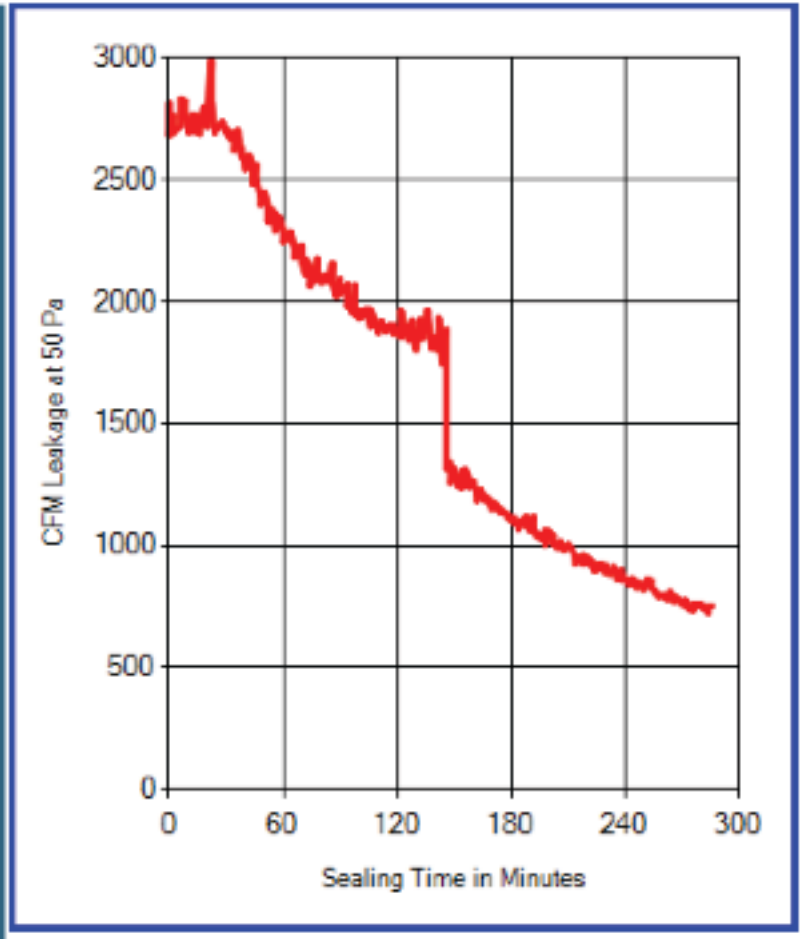
A 3000 ft2 house, 10" ceiling has a volume of 30,000 ft3
If it has an initial air tightness of 4 ACH50, that would require 2000 CFM

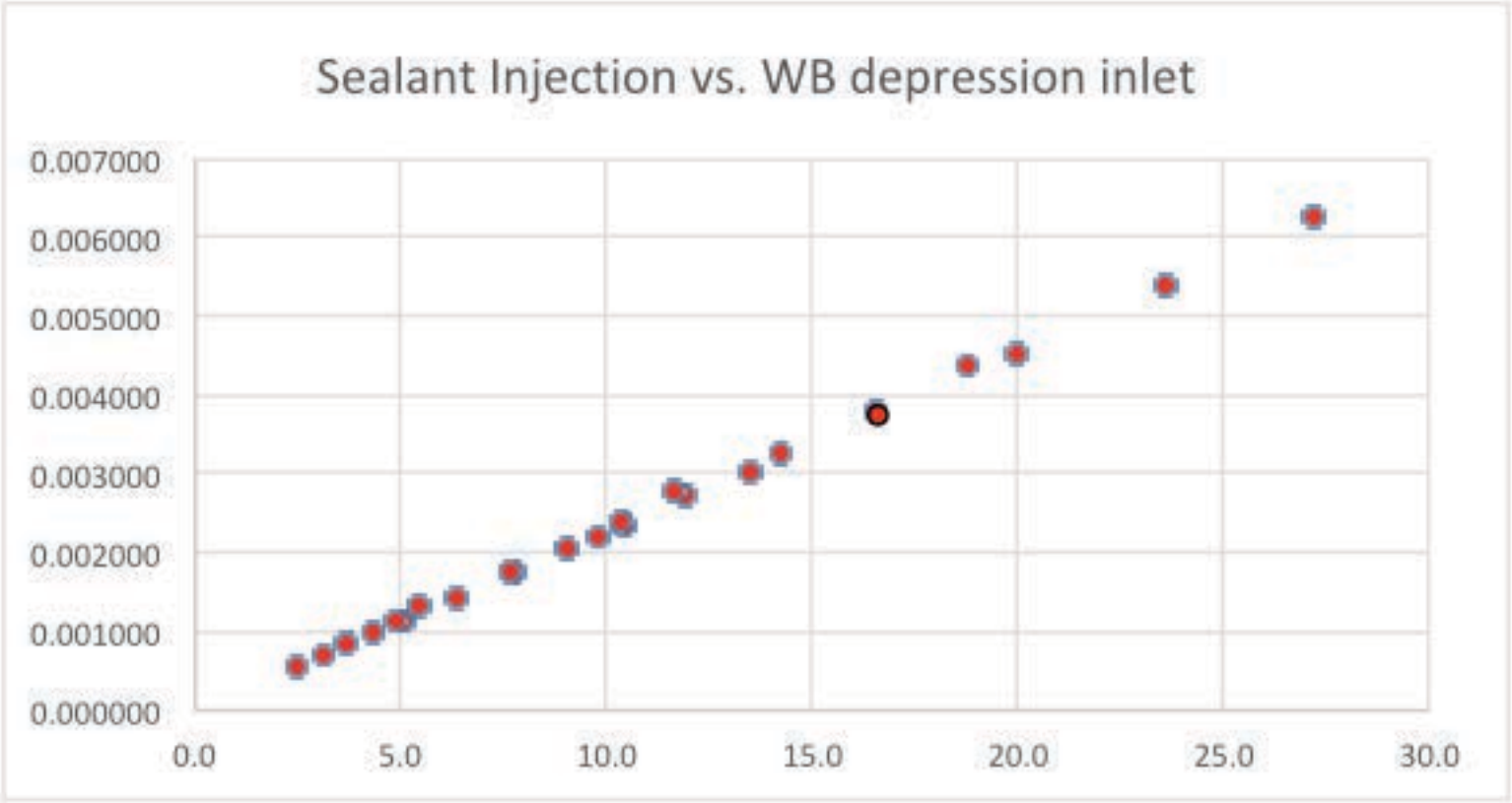
Seal Time

Most affected by:

The amount of fluid that can be pumped in without condensing

- Outdoor Temp. and RH
- Indoor RH
- House pressure
- Size of holes



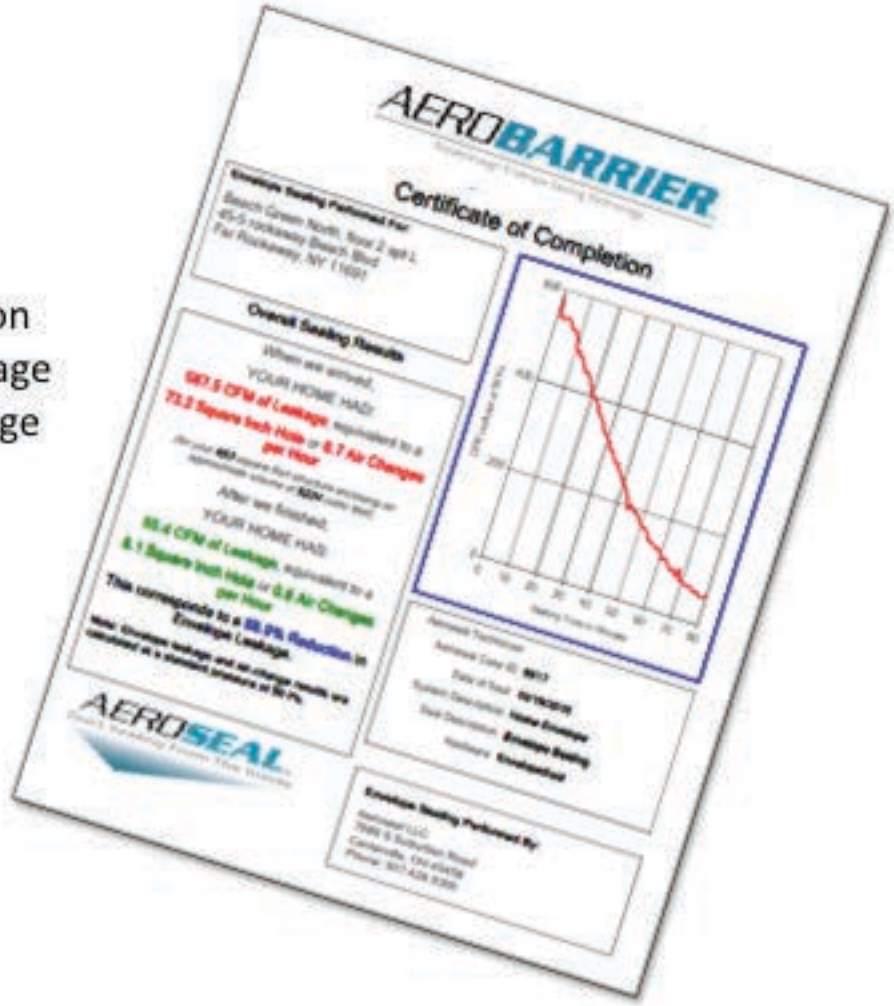


Maximum seal rate is a function of “wet-bulb” depression of the incoming air

The AeroBarrier process

Verified Results!

Every seal provides a certificate of completion outlining the sealing work. Pre and post-leakage are captured and the seal duration and leakage reduction are all displayed on the graph



The Control Center

Measuring and controlling:

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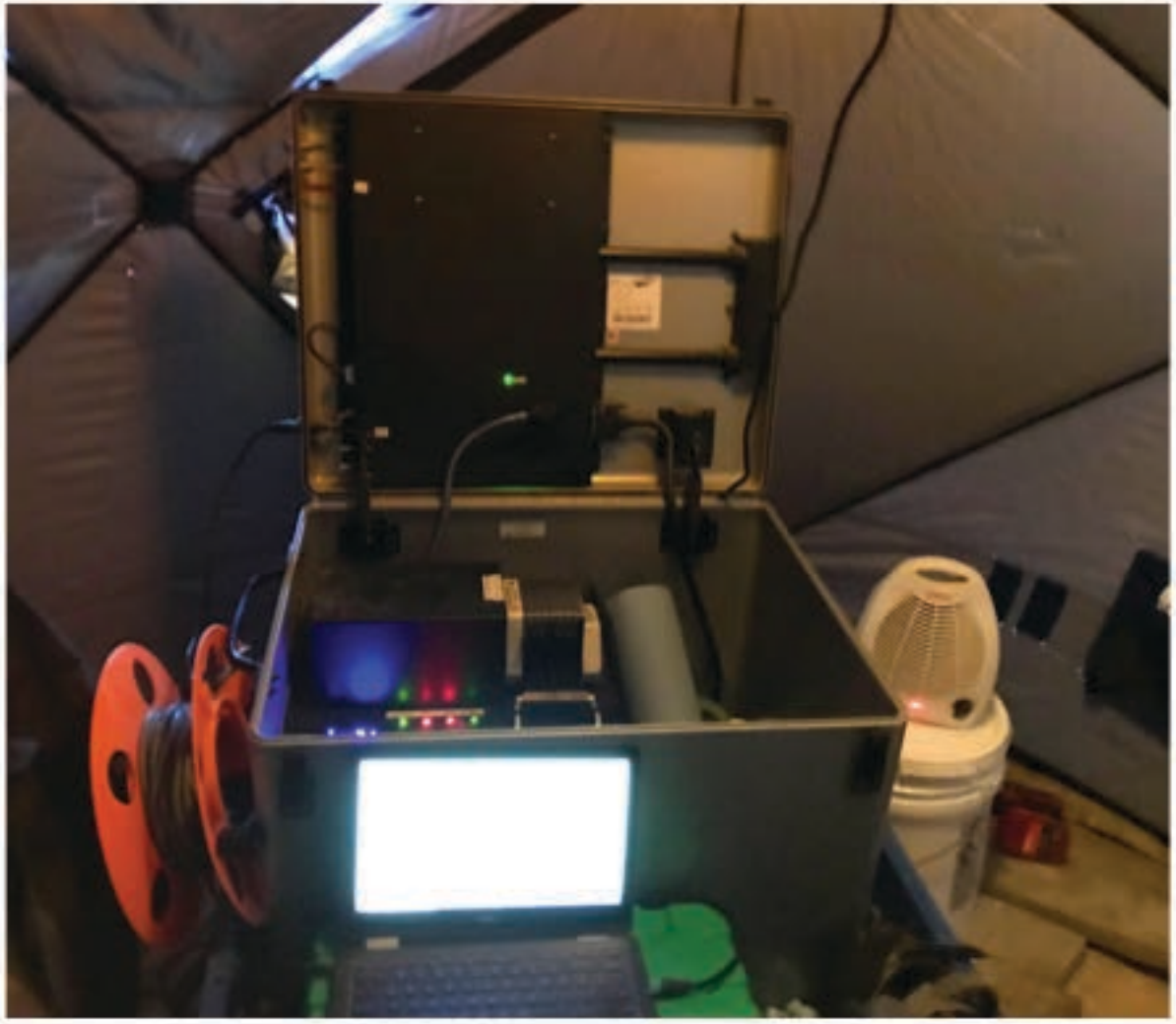
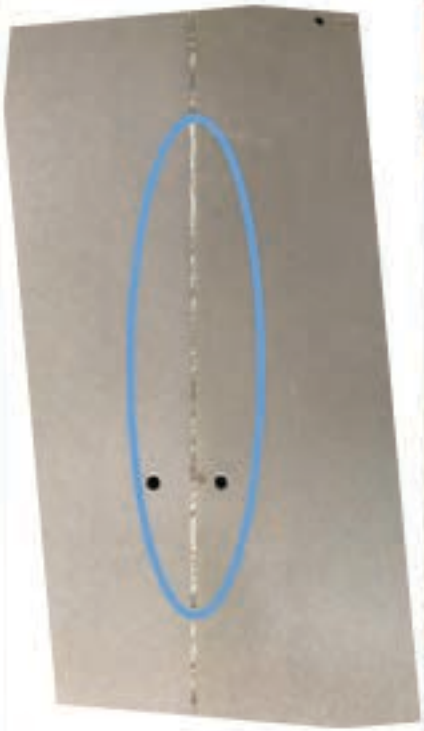


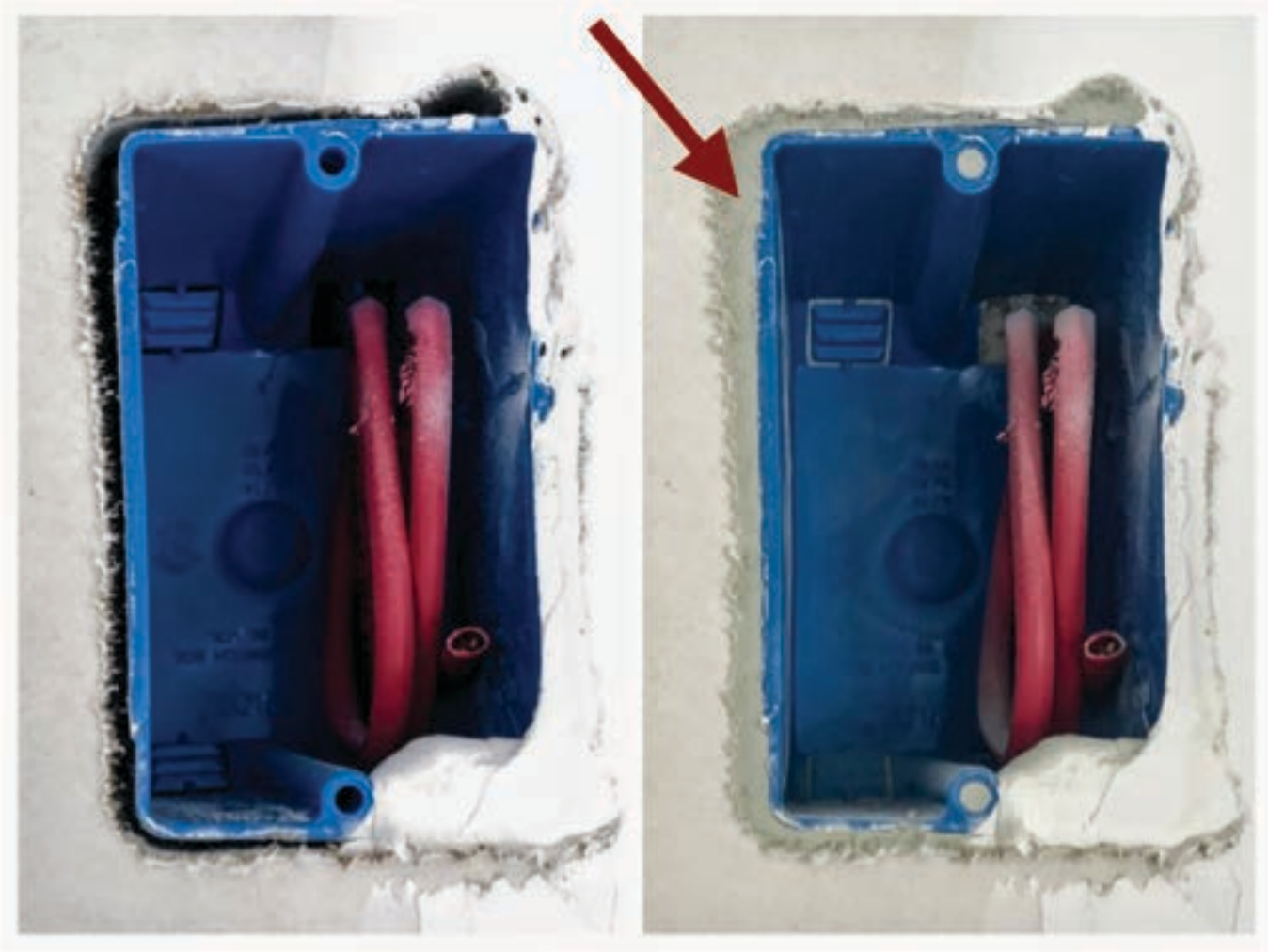
Holes that the Sealant is really good at - 1/2” or under

We drilled some holes

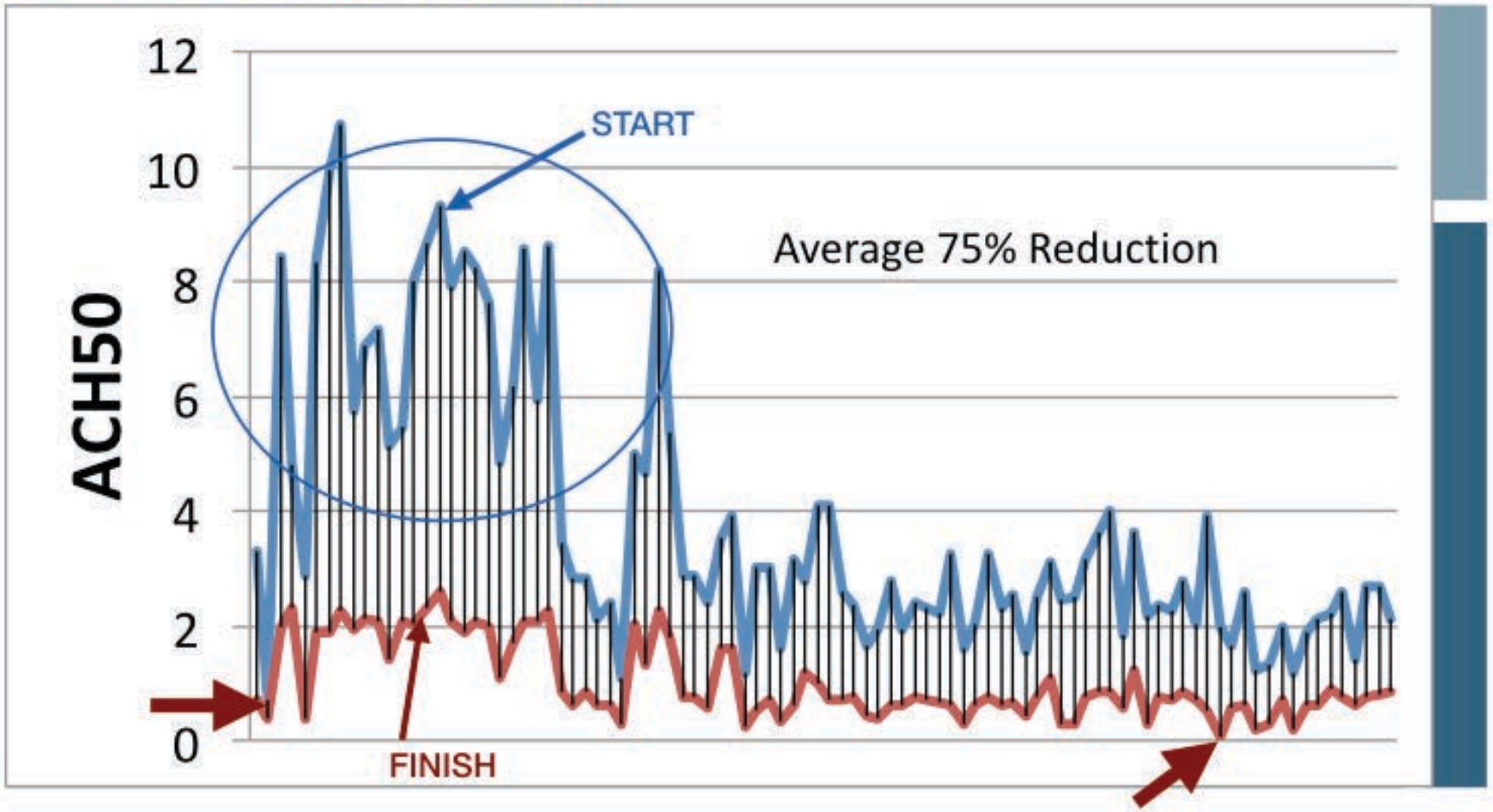


More success

Before and after



Our first 100 tests - Start and Finish



Certificate of Completion

Envelope Sealing Performed For:

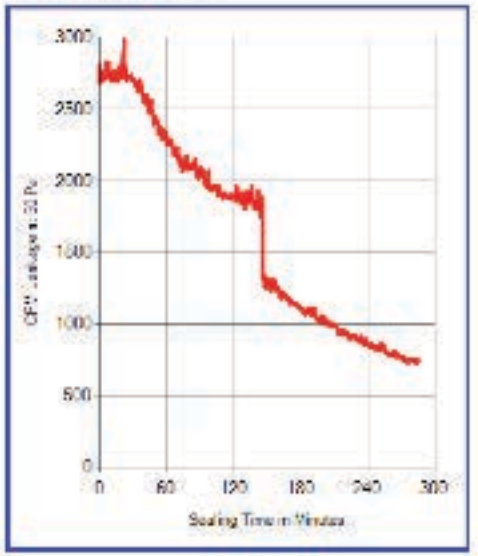
Siteline Lot 20 Group, Siteline
Lot 20 9211 Bayview Ave
Richmond Hill, Ontario L9n 1E8

Overall Sealing Results

When we arrived,
YOUR HOME HAD:
2814.3 CFM of Leakage, equivalent to a
338.8 Square Inch Hole or **8.66 Air Changes per Hour**
*(for your **2300** square-foot structure enclosing a volume of **19488** cubic feet).*

After we finished,
YOUR HOME HAS:
750.5 CFM of Leakage, equivalent to a
90.4 Square Inch Hole or **2.31 Air Changes per Hour**

This corresponds to a 73.3% Reduction in Envelope Leakage.



Aeroseal Case ID	**8005**
Date of Seal	**8/21/2018**
System Description	**Home Envelope**
Seal Description	**Envelope Sealing**

Our first big rescue job
8.66 ACH to 2.31 ACH50

Certificate of Completion

Envelope Sealing Performed For:

REEVES - Ryan North , REEVES FINE HOMES
4813 Carryig Place
Seeley's Bay, ONTARIO K0K0B5

Overall Sealing Results

When we arrived,

YOUR HOME HAD:

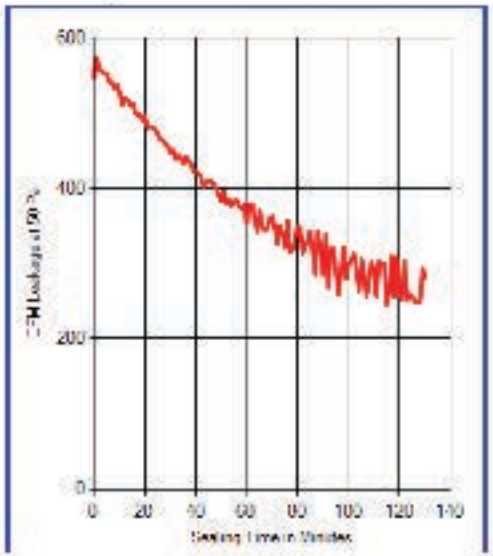
559.6 CFM of Leakage, equivalent to a **67.4 Square Inch Hole** or **0.71 Air Changes per Hour**

*(for your **3200** square-foot structure enclosing a volume of **47351** cubic feet).*

After we finished,

YOUR HOME HAS:

280.9 CFM of Leakage, equivalent to a **33.8 Square Inch Hole** or **0.36 Air Changes per Hour**



Aeroseal Case ID **8005**

Our First Passive House Experience

Our First Passive House Experience

Is this cost effective?

Certificate of Completion

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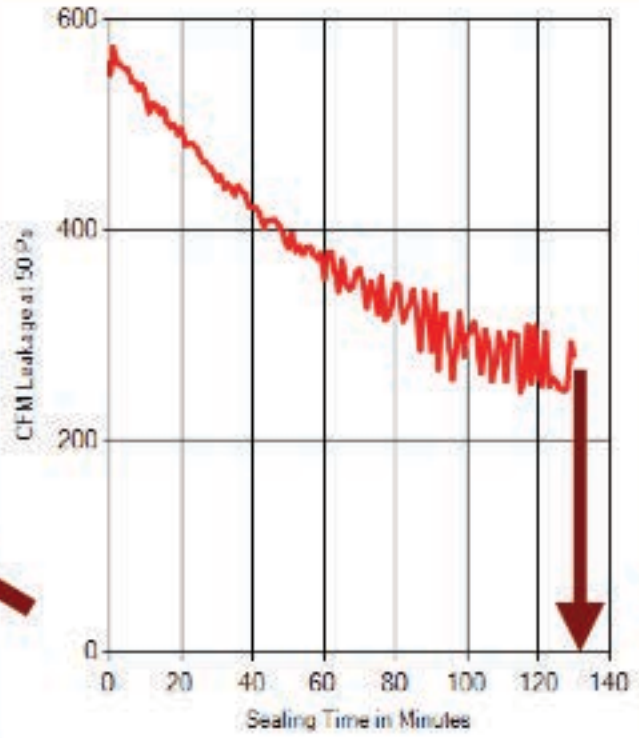
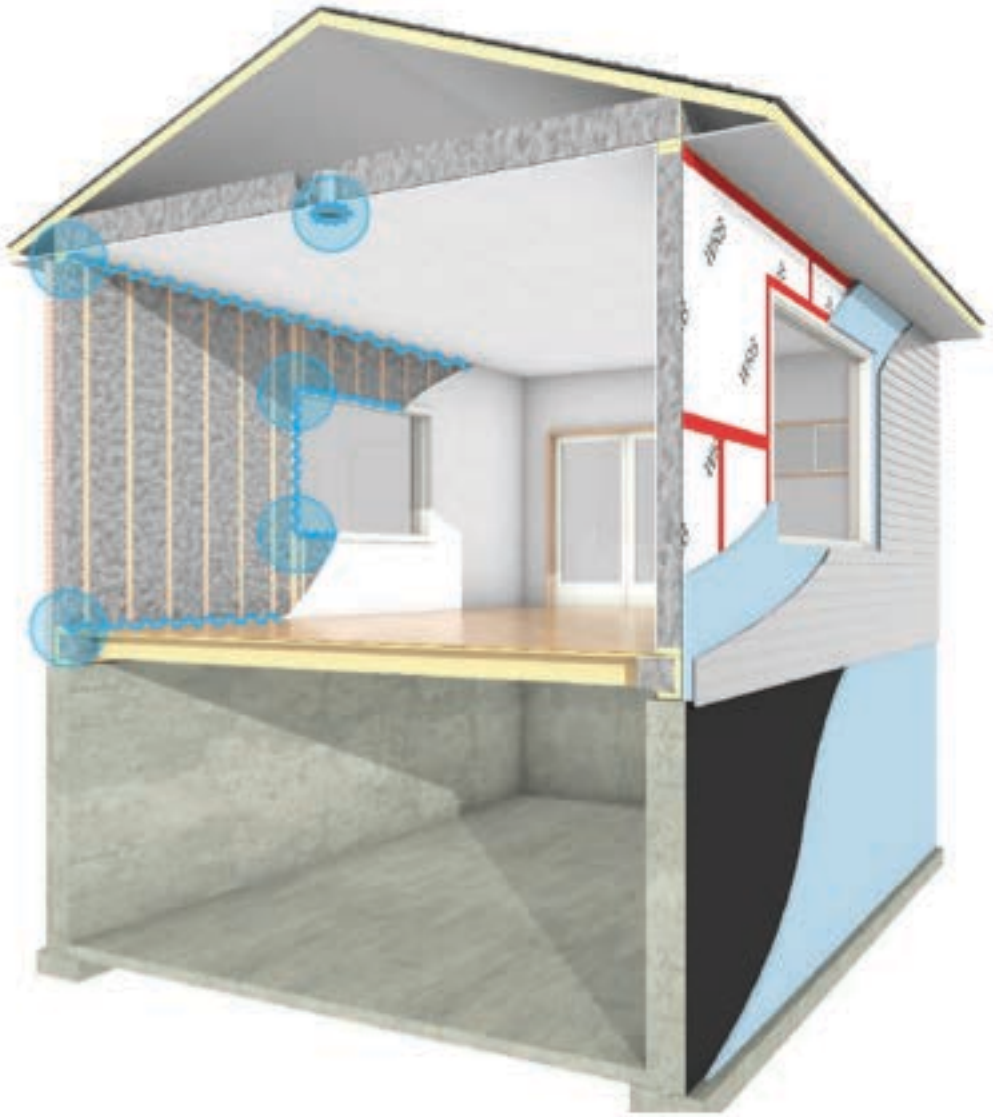


Aeroseal Case ID **8005**

When to Apply

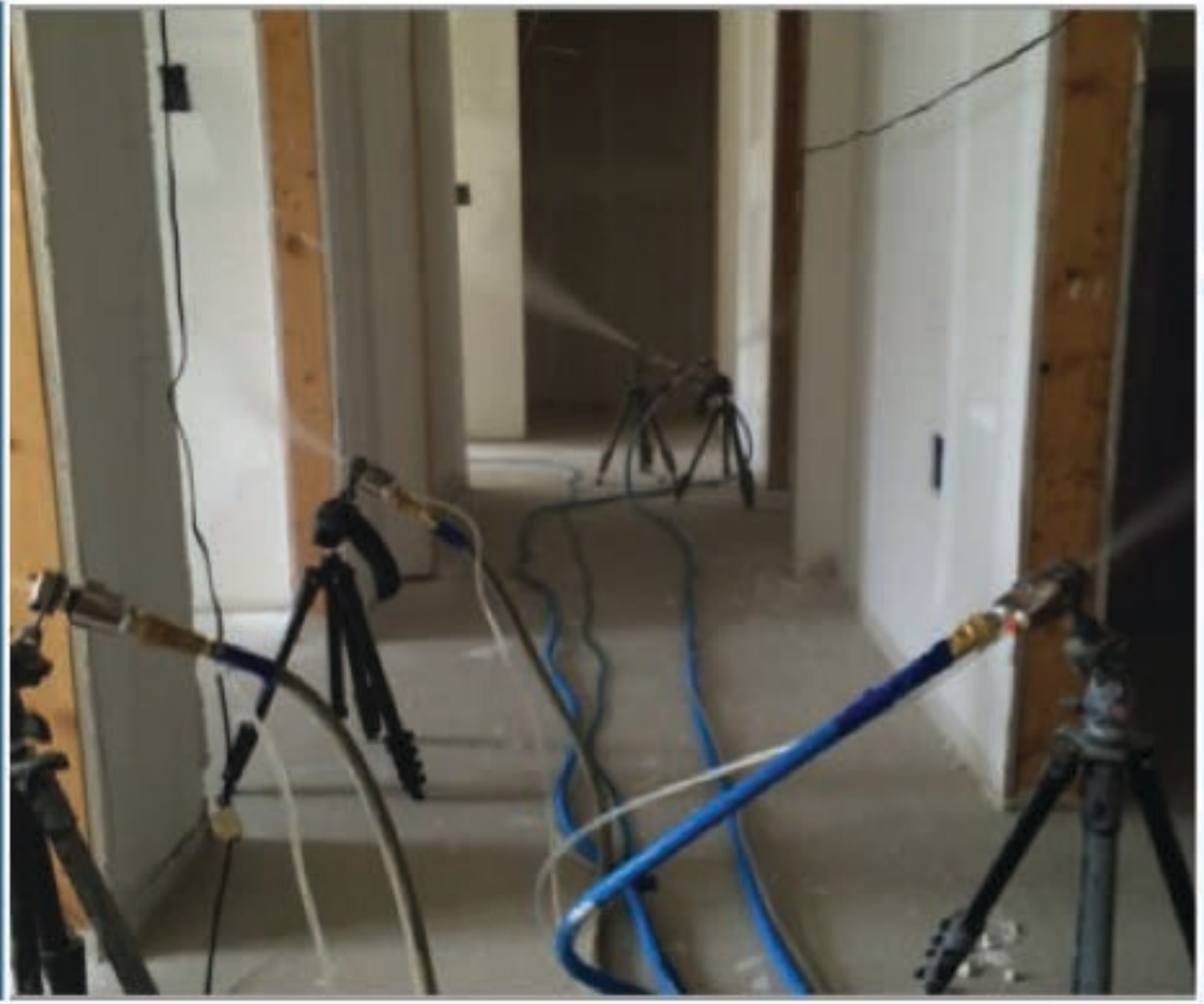
What's your air barrier?

When is it substantially complete?



Exterior Air Barrier Approach

Interior Air Barrier Approach



Is it Safe?

To apply

Long term in the building

AEROSEAL

AeroBarrier X1

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 10 April 2019 Revision date: 07 June 2019 Supersedes : 13 May 2019 Version: 1.2

SECTION 1: Identification

1.1. Identification

Product form : Mixture

Trade name : AeroBarrier X1

1.2. Recommended use and restrictions on use

Use of the substance/mixture : Sealant

1.3. Supplier

Aeroseal LLC
7989 South Suburban Road
Centerville, OH 45458
T:1-877-349-3828

1.4. Emergency telephone number

Emergency number : 877-349-3828 Mon-Fri 8:00am-5:00pm

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Not classified

2.2. GHS Label elements, including precautionary statements

GHS US labeling

No labeling applicable

2.3. Other hazards which do not result in classification

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

AeroBarrier X1 is based on a permeable waterborne acrylic

SECTION 3: Composition/Information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Name	Product identifier	%	GHS-US classification
Water	(CAS-No.) 7732-18-5	50 – 70	Not classified
Acrylic Polymer	TSRN 51721300-5277P	20 - 40	Not classified
Silica, amorphous	(CAS-No.) 7631-86-9	1 – 5	Not classified
Propylene Glycol	(CAS-No.) 57-55-6	1 – 5	Not classified

4 Components

50-70% water

Based on materials with a long history in the industry

AeroBarrier X1 is based on a permeable waterborne acrylic

- Green Guard Gold Certified
- National Green Built Standard Certified Product
- Ultra-Low VOC / No Off-Gasing
- Meets
  - ASTM 2178 air sealing material
  - ASTM E84 flame spread - O
  - ASTM E84 smoke development - O

GREENGUARD

Home Innovation
NGBS GREEN CERTIFIED

A very small amount of material is left

Start with a 5 gallon pail - 70% water

Some particles dry and fall to the floor

Some are exhausted out

Remaining product covers a 248.4 in^2 surface

Overall Sealing Results

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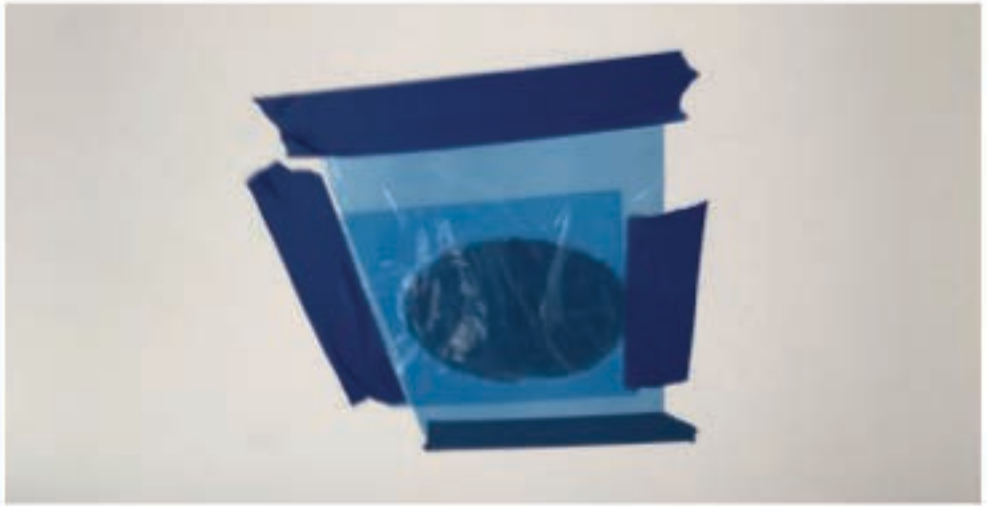
Variance between AeroBarrier and final air test

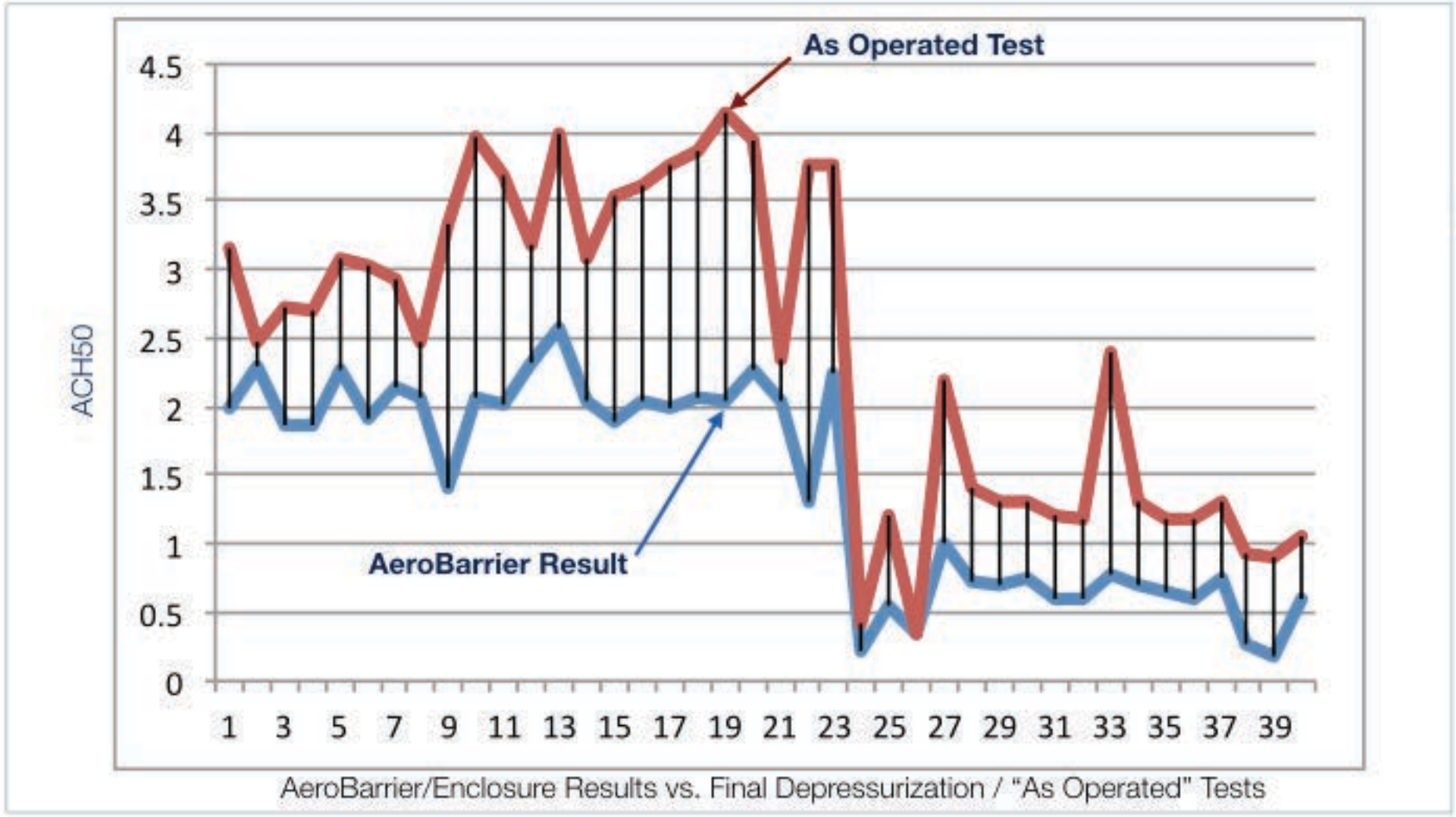
Variance between AeroBarrier and Final air test

- Pressurization vs. depressurization
- Enclosure test vs. “as-operated” test
- Intentional openings sealed
- Single point vs. multi-point test
- Time and activities



NOTE - I have added this slide on the topic of variance because there were some great questions over the evening

- Overall the average variance of 42 sample houses was 0.8 ACH - that is, the “final, depressurization, as built” result was on average 0.8 ACH higher than the AeroBarrier result.
- However, 23 of those houses were those really really poorly constructed houses where we undoubtedly sealed all the small holes and probably some large holes were not sealed. In those houses the average ACH change was 1.8 ACH. You need to know that these houses each had 4 bath fans, a large range hood with a poor damper, a type of HRV that does not have a good backdraft damper, a power vented water heater and a “one-pipe” furnace vent. ALL of these elements were sealed (of course) during the AeroBarrier test and left unsealed in the final test.
- The average of the remaining18 houses was just 0.42 ACH. Again this “variance” doesn’t indicate an issue with the AeroBarrier seal. It just means the method of test is different.
- AeroBarrier presents an “enclosure - window sashes” test, the final test is “enclosure + mechanical + window sashes”. This difference should be seen as helpful to all as you look for ways to improve your overall results - That is, you may want to ask your fan supplier to get you better fans, your window supplier to get you better seals etc.
- That is just 42 houses - this needs more work and we will be doing that


As Operated Test
AeroBarrier Result
ACH50
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39
AeroBarrier/Enclosure Results vs. Final Depressurization / "As Operated" Tests

Bath fan / range hood - 12 CFM per fan

Window sashes and door seals

Power vent water heaters

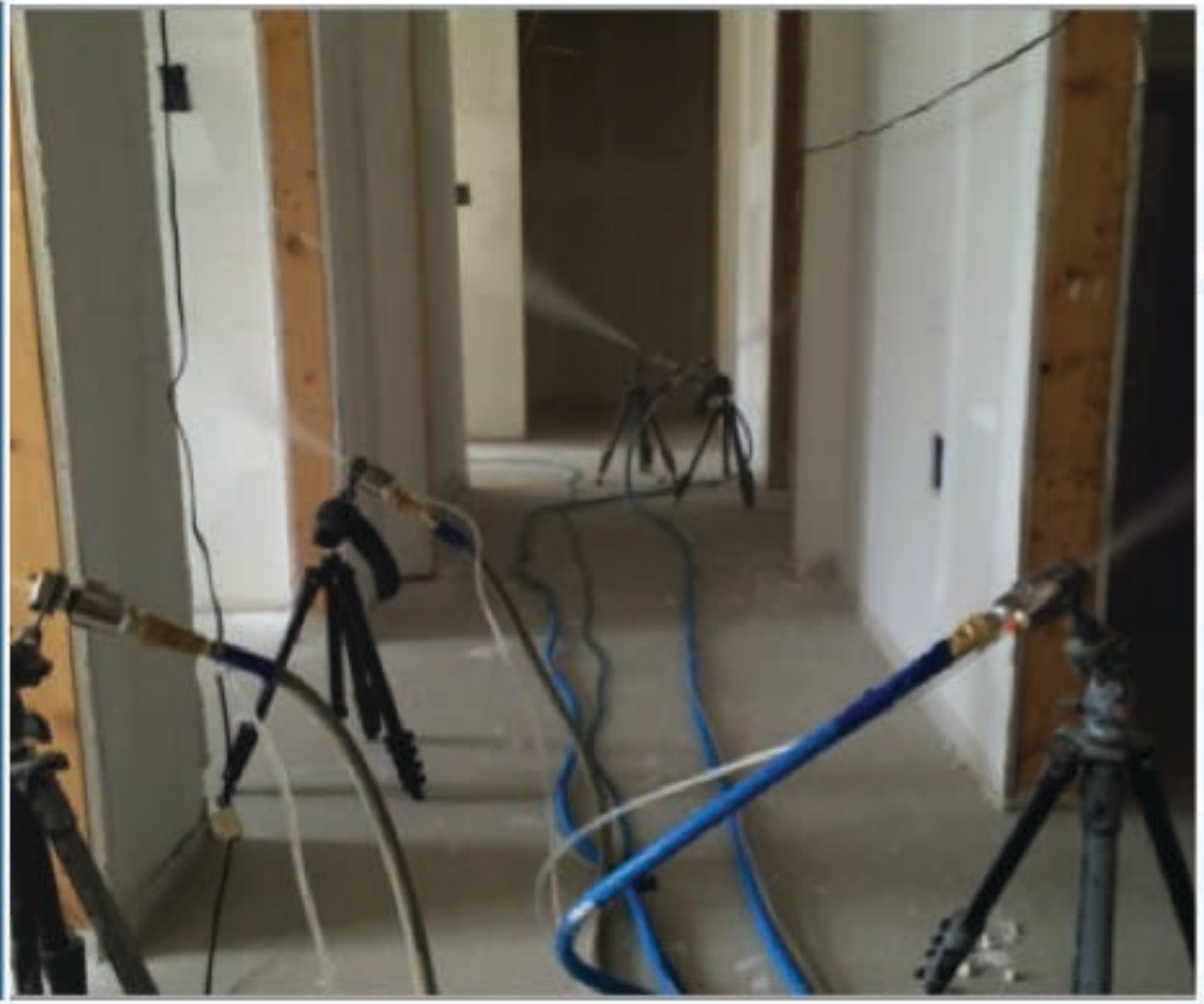
ERVs

Durability Assessment

Flexing

Aging

Compatibility



Flexing

- Expanded and contracted by 20%
- 1/8" joint on wood sample
- Cycled under heat and cold

Aging

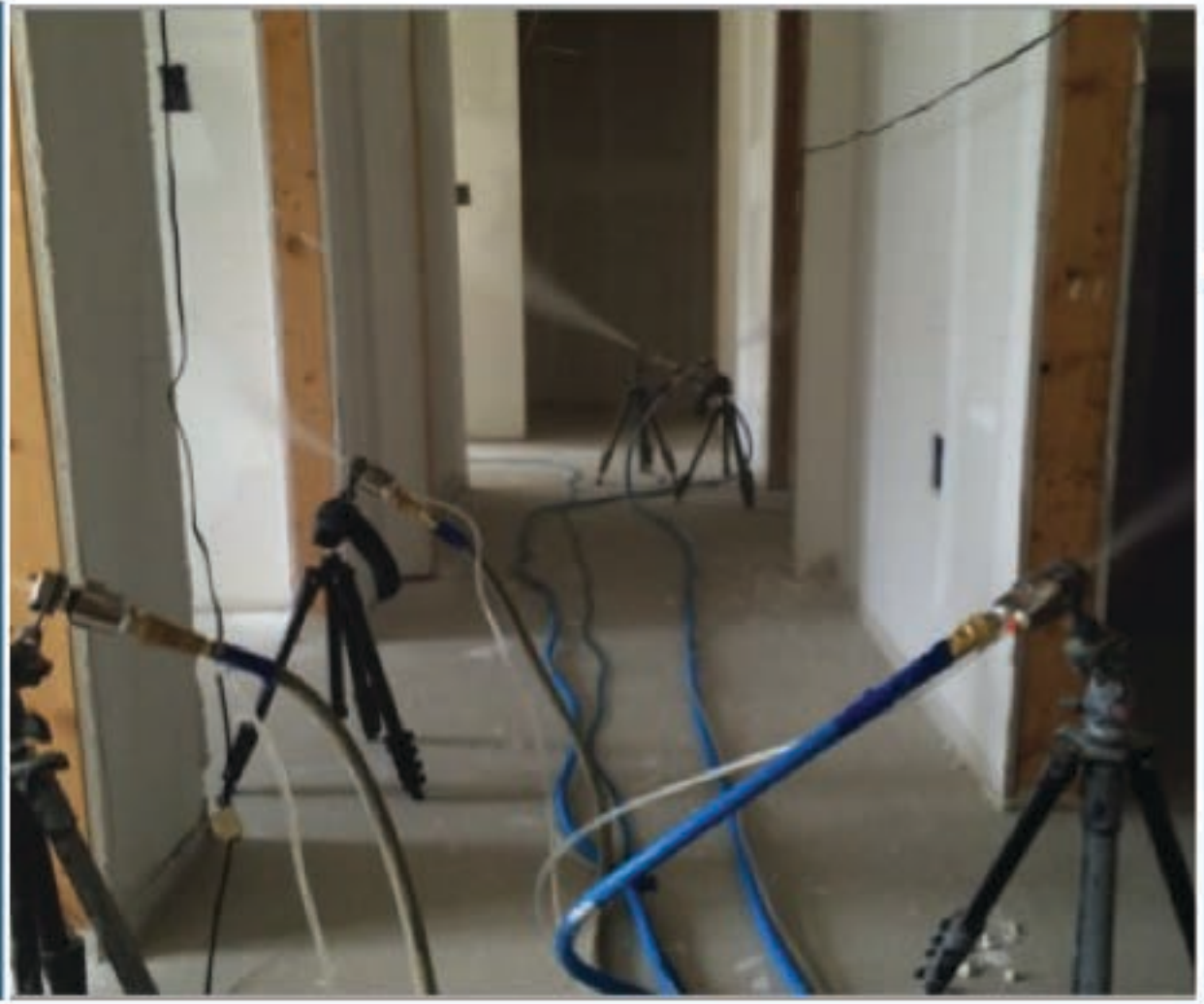
- Accelerated testing to simulate 50 years
- 180 ^{0}F to -30 ^{0}F

Compatibility

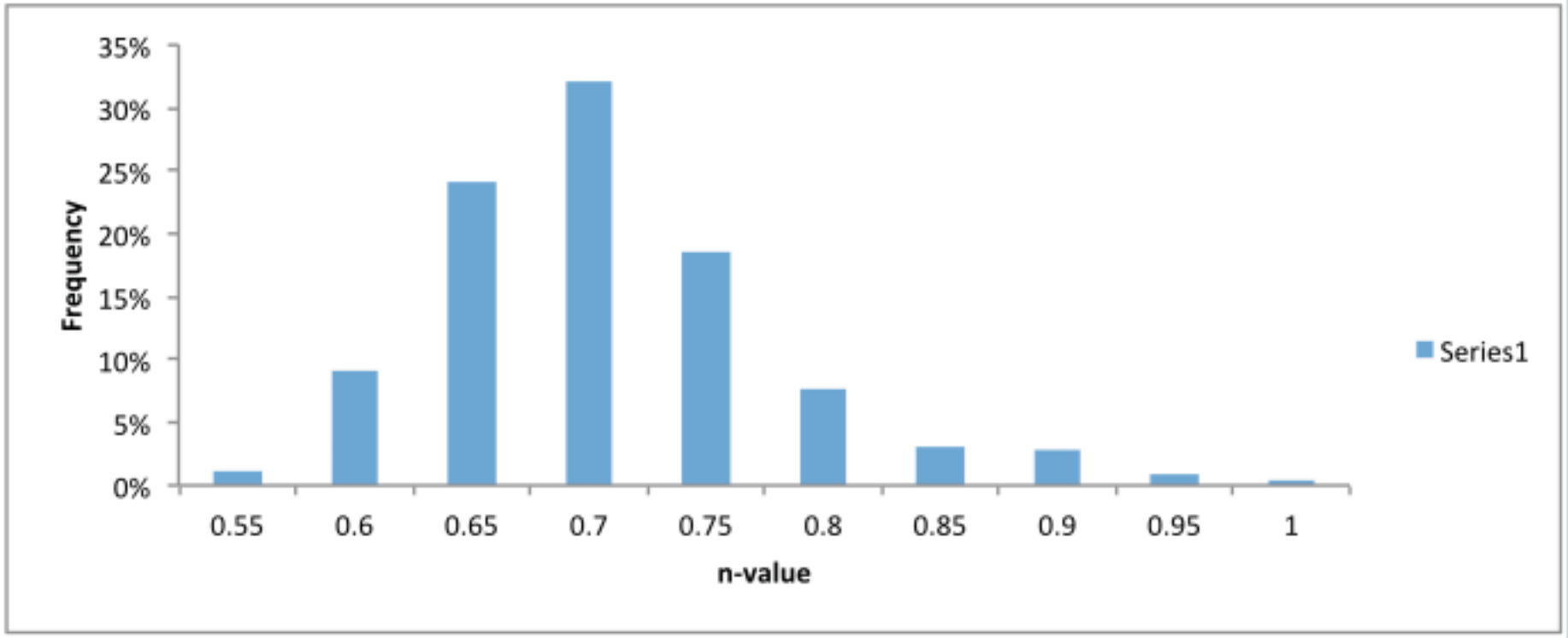
- 41 common building materials
- Under heat and humidity

AeroBarrier is really effective on smaller holes

Are we concerned?



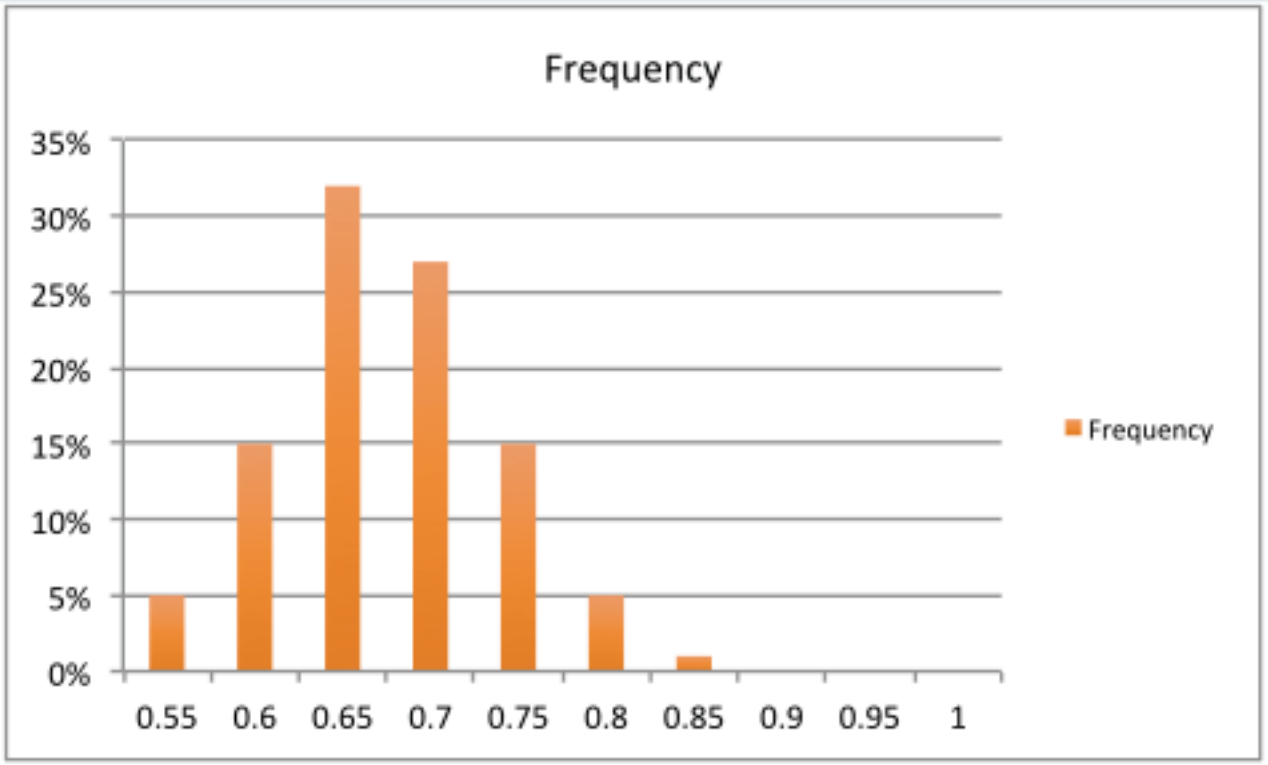
Distribution of Slope of Air Tightness Line - 5000 ES houses



Biggeer holes remaining

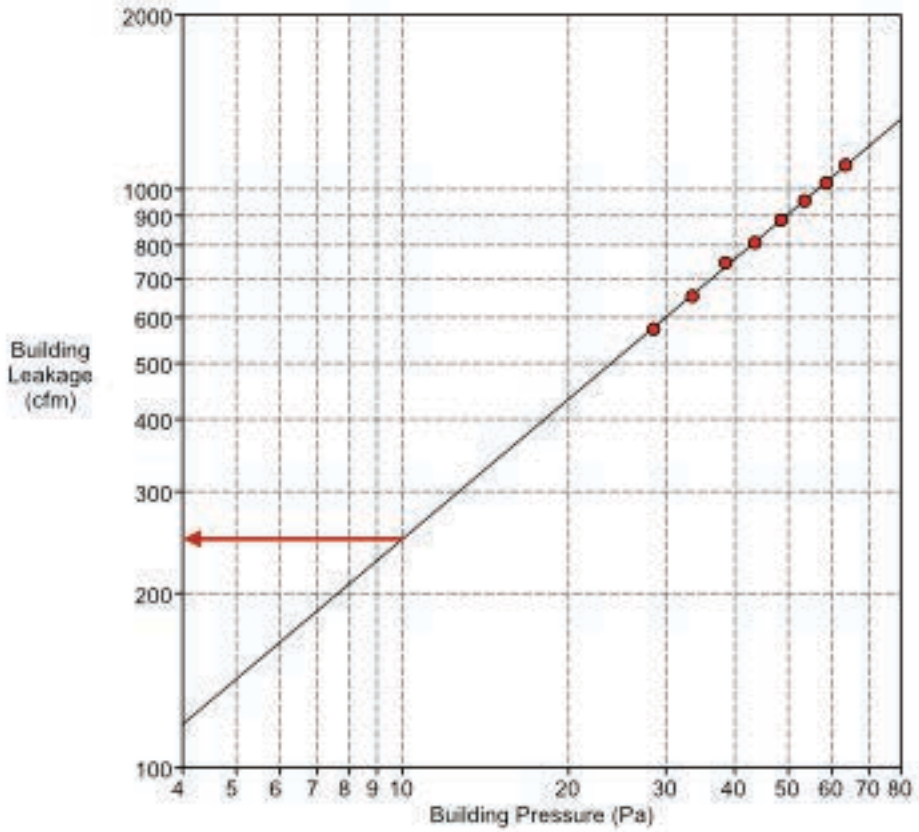
Smaller holes remaining

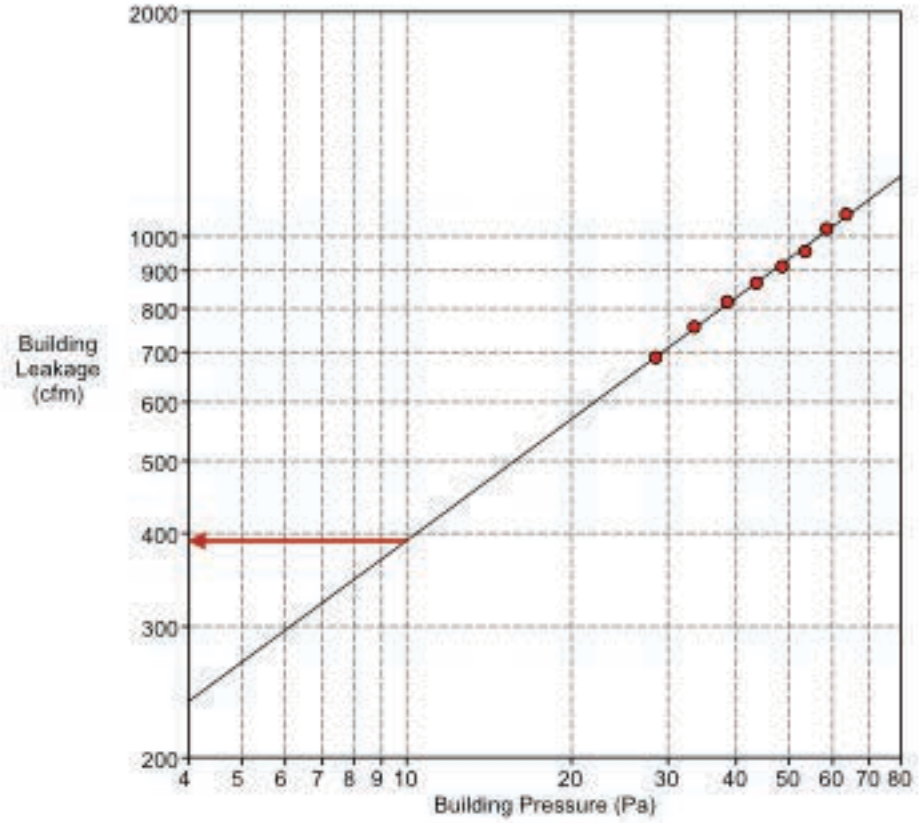
Distribution of Slope of Air Tightness Line - 75 AeroBarrier houses



Bigger holes remaining

Smaller holes remaining





1.82 ACH50
73 in² EqLA
n=0.8

1.82 ACH50
115 in² EqLA
n=0.54

When Every House is under 1.0 ACH50

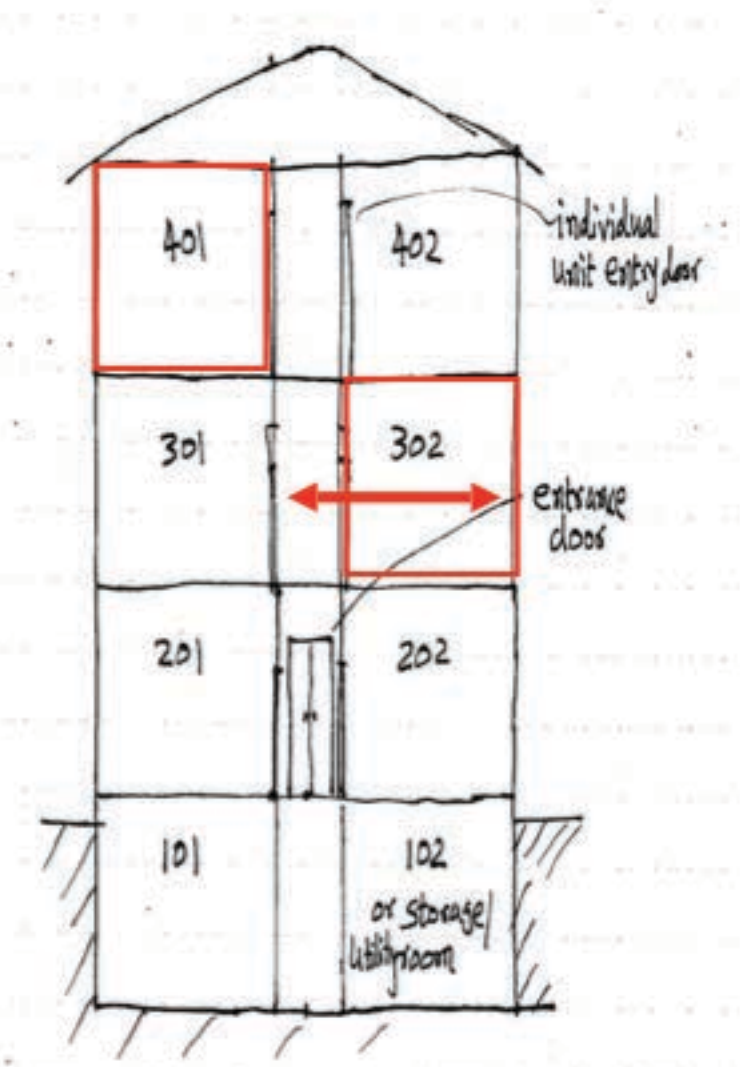
What changes?

- Meet the expectations of clients
- Stop wasting time and materials
- Take out the angst
- Streamline production

Think of the impact on Multifamily

Effective Compartmentalization

- Noise control
- Odor control
- Optimized HVAC



Mandalay Homes

Project Overview:

Project: DOE Challenge Home
Builder: Mandalay Homes
Location: Prescott, Arizona

Results:

Pre-leakage: 3.1 ACH_{50}
Post-Leakage: 0.4 ACH_{50}
Reduction: 86.4%
Sealing Time: 2.5 hours

Mandalay Homes became the first production builder to incorporate AeroBarrier into all of their homes

"AeroBarrier may be the most important innovation to hit the building community in years…The ability to consistently seal all the small leaks that would otherwise take countless man hours to seek and hand seal, assuming you even find them all, in just 1 automated application is simply amazing. The cost effectiveness is beyond immeasurable when you consider the total sealing solution AeroBarrier provides and all the labor saved by automating the application process. We couldn't be happier with AeroBarrier and the fine folks behind the product."

- Geoff Ferrell
Chief Technology Officer
Mandalay Homes

Air Sealing Now - IECC 2009

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	CRITERIA[a]
Air barrier and thermal barrier	A continuous air barrier shall be installed in the building envelope. Exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed. Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair, or knee wall doors to unconditioned attic spaces shall be sealed.
Walls	Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed.
	The junction of the top plate and top of exterior walls shall be sealed. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.

17 References to air sealing

90.1 - 2007

ANSI/ASHRAE/IESNA Standard 90.1-2007
(Supersedes ANSI/ASHRAE/IESNA Standard 90.1-2004)
Includes ANSI/ASHRAE/IESNA Addenda listed in Appendix F

ASHRAE STANDARD

Energy Standard for Buildings Except Low-Rise Residential Buildings

I-P Edition

5.4.3 Air Leakage

5.4.3.1 Building Envelope Sealing. The following areas of the *building envelope* shall be sealed, caulked, gasketed, or weather-stripped to minimize air leakage:

a. joints around *fenestration* and *door* frames
b. junctions between *walls* and foundations, between *walls* at building corners, between *walls* and structural *floors* or *roofs*, and between *walls* and *roof* or *wall* panels
c. openings at penetrations of utility services through *roofs*, *walls*, and *floors*
d. site-built *fenestration* and *doors*
e. building assemblies used as ducts or plenums
f. joints, seams, and penetrations of vapor retarders
g. all other openings in the *building envelope*

90.1 - 2010

STANDARD

ANSI/ASHRAE/IES Standard 90.1-2010
(Supersedes ANSI/ASHRAE/IESNA Standard 90.1-2007)
Includes ANSI/ASHRAE/IES Addenda listed in Appendix F

Energy Standard for Buildings Except Low-Rise Residential Buildings

I-P Edition

5.4.3 Air Leakage

5.4.3.1 ***Continuous Air Barrier.*** The entire *building envelope* shall be designed and constructed with a *continuous air barrier.*

5.4.3.1.1 Air Barrier Design. The air barrier shall be designed and noted in the following manner:

a. All air barrier components of each *building envelope* assembly shall be clearly identified or otherwise noted on *construction documents*.
b. The joints, interconnections, and penetrations of the air barrier components including lighting *fixtures* shall be detailed or otherwise noted.
c. The *continuous air barrier* shall extend over all surfaces of the *building envelope* (at the lowest floor, exterior *walls*, and ceiling or *roof*).
d. The *continuous air barrier* shall be designed to resist positive and negative pressures from wind, stack effect, and mechanical *ventilation*.

2010

5.4.3.1.2 Air Barrier Installation The following areas of the *continuous air barrier* in the *building envelope* shall be wrapped, sealed, caulked, gasketed, or taped in an approved manner to minimize air leakage:

a. Joints around *fenestration* and *door* frames (both manufactured and site-built).
b. Junctions between *walls* and *floors*, between *walls* at building corners, between *walls* and *roofs or ceilings*.
c. Penetrations through *the air barrier in building envelope roofs*, *walls*, and *floors*.
d. Building assemblies used as ducts or *plenums*.
e. Joints, seams, connections between planes, and other changes in air barrier materials.

2010

5.4.3.1.3 Acceptable Materials and Assemblies.

Continuous air barrier materials and assemblies for the *opaque building envelope* shall comply with one of the following requirements:

Materials that have an air permeance not exceeding 0.004 cfm/ft^2 @ 0.3 in. w.g. (75 Pa) when tested in accordance with ASTM E 2178.

Materials such as:

Plywood & OSB —minimum 3/8 in.

Extruded polystyrene insulation board or foil faced Insulation board—minimum 1/2 in.

Exterior gypsum sheathing or interior gypsum board—minimum 1/2 in.

Cement board—minimum 1/2 in.

Roofing membranes

Portland cement/sandparge,stucco - min. 1/2”

Cast-in-place and precast concrete.

Sheetmetal

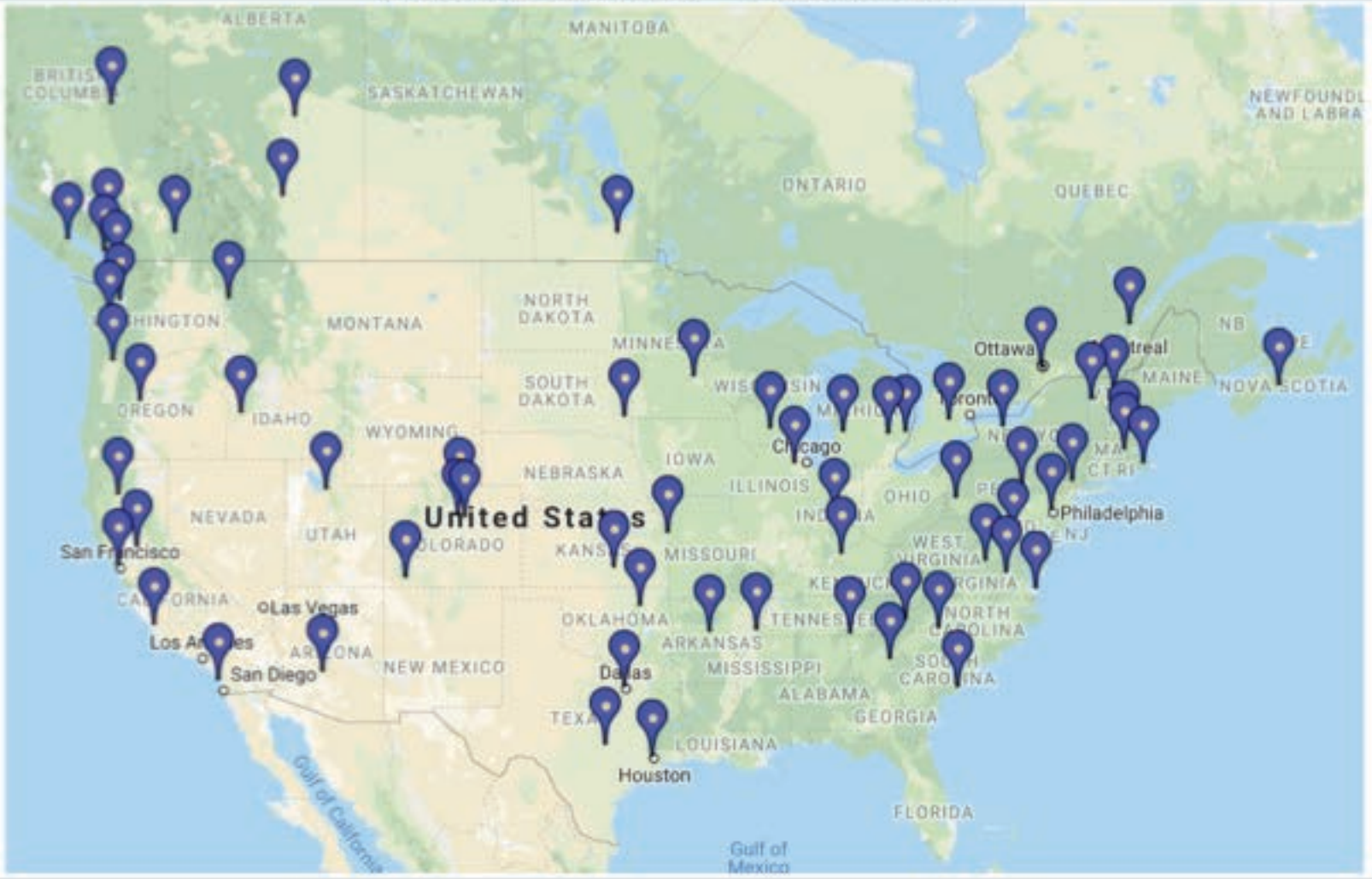
Closed cell 2lb/ft^3 nominal density spray polyurethane foam—minimum 1 in.

Poor execution

Waste of materials and time

Wasted air sealing effort

AeroBarrier Dealers



Full Circle

1986 - R2000 Home

0.23 ACH50

Spray foamed from the outside

SEAMAN & SONS BUILDERS

Full Circle

2015 - NET ZERO

0.19 ACH50

Spray foam / 3”
XPS / Tyvek wrap

SEAMAN & SONS BUILDERS

Full Circle

2019 - Family Cottage

0.06 ACH50

ICF & AeroBarrier

SEAMAN & SONS BUILDERS

Insulating in Custom Homes & Renovations for over three generations

When we arrived,

YOUR STRUCTURE HAD:

765.3 CFM of Leakage, equivalent to a

92.1 Square Inch Hole or 1.96 Air Changes per Hour

(for your 2422 square-foot structure enclosing a volume of 23428 cubic feet).

After we finished,

YOUR STRUCTURE HAS:

24.7 CFM of Leakage, equivalent to a

3.0 Square Inch Hole or 0.06 Air Changes per Hour

This corresponds to a 96.8% Reduction in Envelope Leakage.

Note: Envelope leakage and air-change results are calculated at a standard pressure of 50 Pa.

Full Circle

1986 - R2000 Home

0.23 ACH50

Spray foamed from the outside

SEAMAN & SONS BUILDERS

Next Steps

In my opinion….

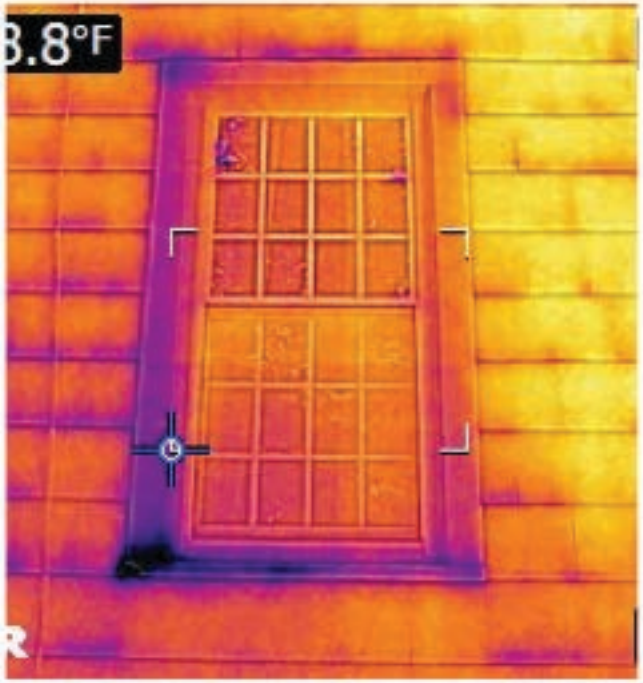
- A “game changing" technology that you have to try
- “Invest” and it will be cost neutral
- Challenge your designers, consultants, trades and suppliers to consider how it could change their world
- Its a productivity improvement the industry needs

Thank You

Gord Cooke

Download the App
Construction Instruction
at APP Stores

Come visit us at
Ci Live



How many holes?

How much waste?

When do they want fresh air?

More Windows….

But Opened less

What about IAQ?

IAQ Defined

3. DEFINITIONS

acceptable indoor air quality: air toward which a substantial majority of occupants express no dissatisfaction with respect to odor and sensory irritation and in which there are not likely to be contaminants at concentrations that are known to pose a health risk.

This standard does not address specific pollutant concentration levels. It also does not address certain potential pollutant sources such as unvented combustion space heaters and contamination from outdoor sources or from episodic occupant-controlled events such as painting, smoking, cleaning, or other high-polluting events. For information on resi-

IAQ Control Strategies

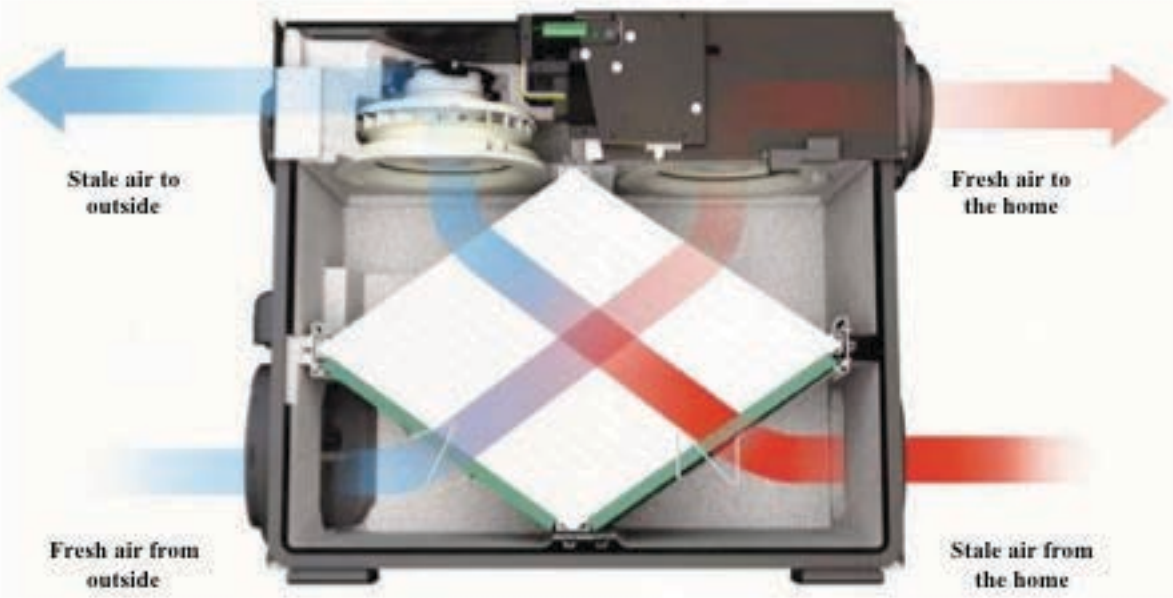
1. **Remove Pollutants**
2. **Source control**
   - "Seal" or Isolate
   - If you can't remove it find a way to isolate or seal it
3. **Ventilate**
   - Dilute pollutants with "fresh" outdoor air
   - Point source removal
4. **Filter**

Ventilation & IAQ Systems

Mechanical Ventilation

All houses, old or new, tight or loose need it

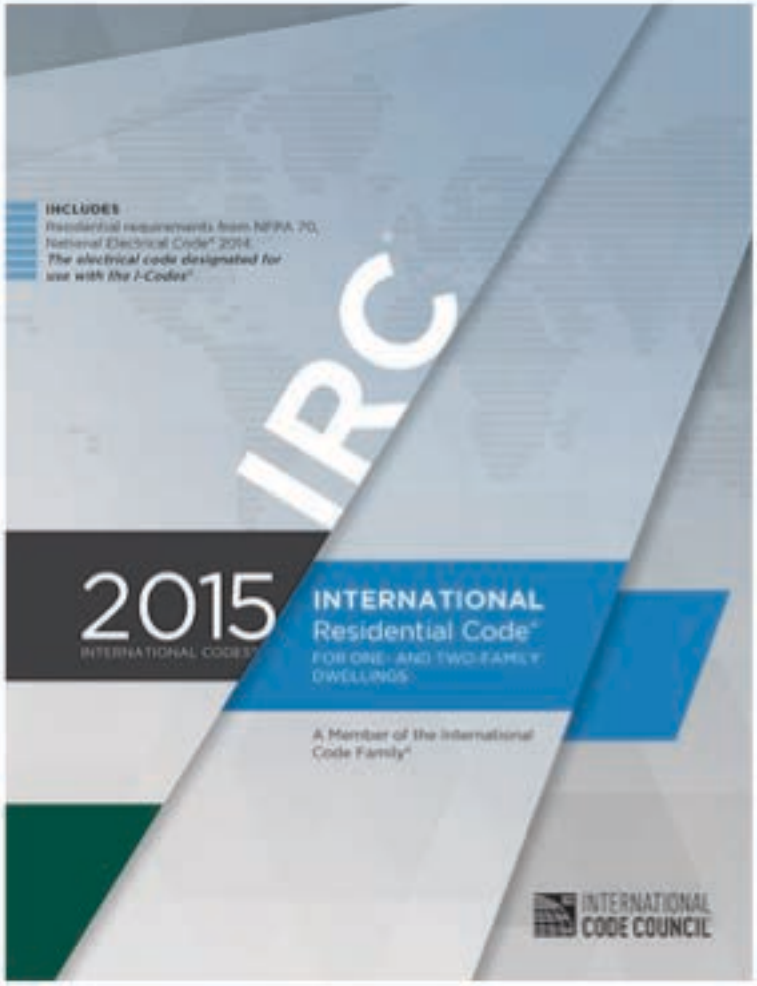
- Properly sized
- Controlled
- Measured flow
- Integrated



The Code Connection

IRC Section 303.4

Where the air infiltration rate of a dwelling unit is less than 5 air changes per hour when tested with a blower door at a pressure of 0.2 inch w.c. (50Pa) in accordance with Section N1102.4.1.2, the dwelling unit shall be provided with a whole-house ventilation in accordance with Section M1507.3



ASHRAE 62.2 - 2010 - a minimum

The assumption is that houses leak at 2 CFM / 100 ft^2

Based on occupants & size of home

CFM = (# of beds + 1) x 7.5 + (0.01 x sq.ft.)

OR

Floor Area (sq. ft)	Number of Bedrooms			
	0-1	2-3	4-5	6-7
<1500	30	45	60	75
1501 - 3000	45	60	75	90
3001 - 4500	60	75	90	105
4501 - 6000	75	90	105	120

ASHRAE 62.2 - 2013:

Increased Continuous CAPACITY

No assumption of air leakage

Based on occupants & size of home

CFM = (# of beds + 1) x 7.5 + (0.03 x sq.ft.)

OR

Floor Area (sq. ft)	Number of Bedrooms			
	0-1	2-3	4-5	6-7
<1500	60	75	90	105
1501 - 3000	90	105	120	135
3001 - 4500	120	135	150	175
4501 - 6000	165	180	195	210

Construction Instruction®
Building Science for Everyone, Everywhere

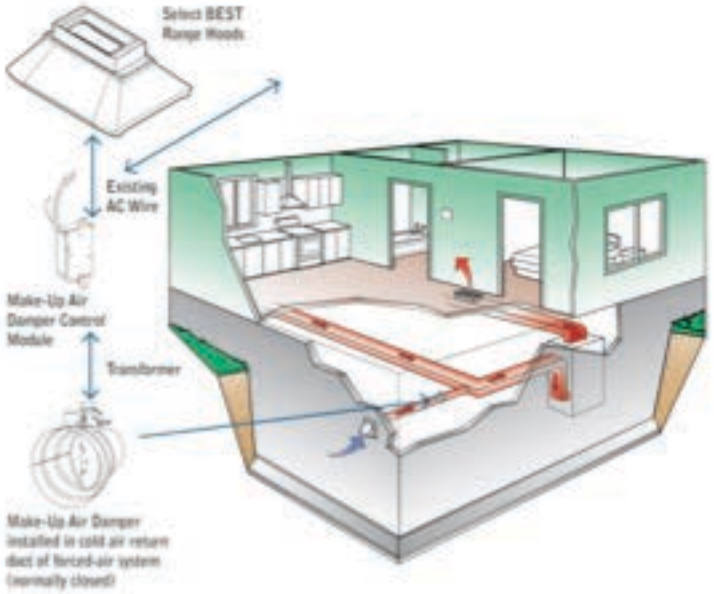
Energy Recovery Ventilator (ERV) in an Attic

Summer

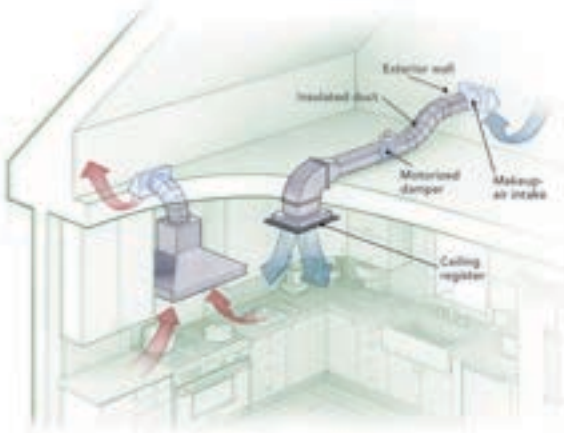
More Exhaust Appliances?

What about make-up air?

Fan manufacturers have new, helpful strategies



Over 400 CFM ??



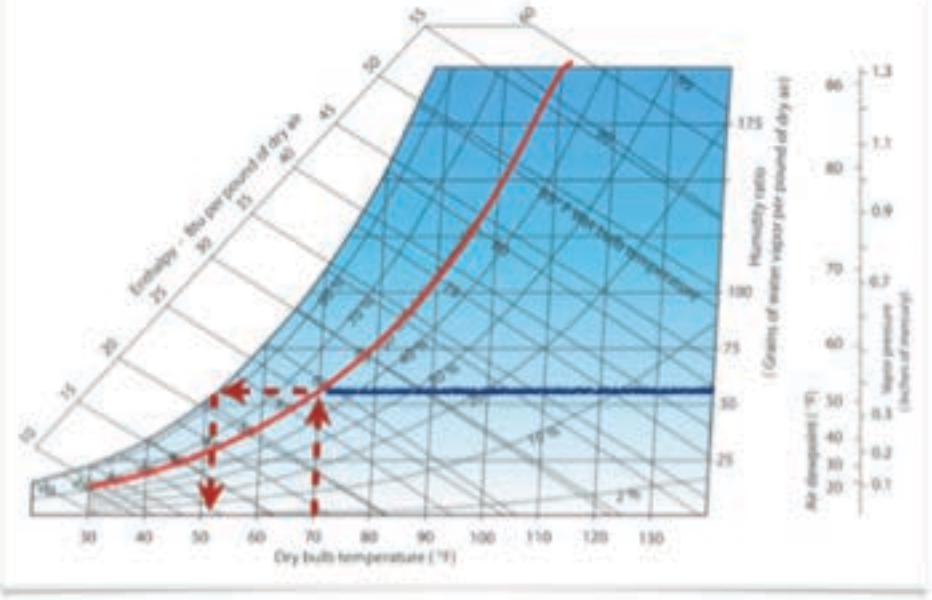
The Moisture Challenge

Sensible loads are on the way down

Latent loads are on their way up

- 15 – 25 pints per day per family – peaking at 50 pints
- 20 – 40 pints per day by air leakage
- 40 – 70 pints per day by ventilation
- 10 – 25 pints per day by diffusion

The difference between 50% (dry and comfortable) and 65% (sticky, muggy) is just 6 - 8 pints in the air



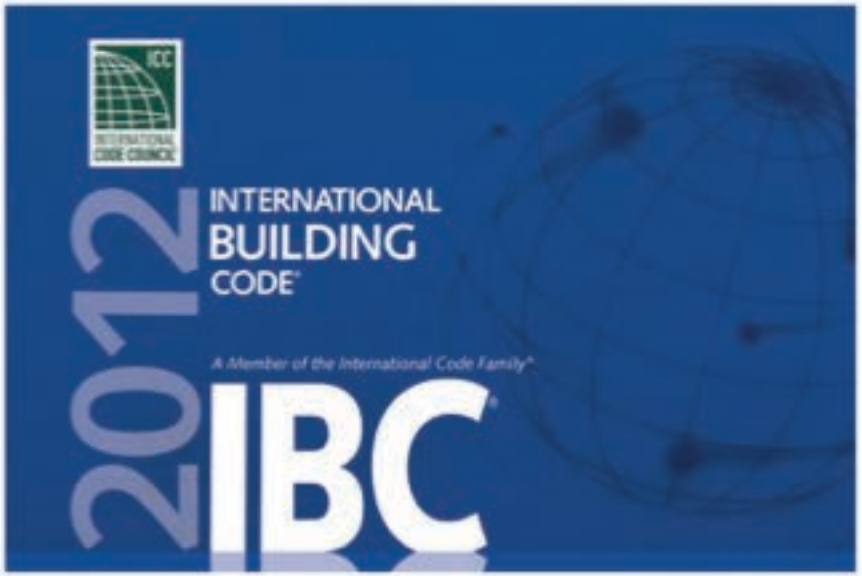
The Moisture Opportunities

MOISTURE CONTROL STRATEGIES	POTENTIAL MOISTURE REDUCTION / DAY	POWER CONSUMPTION
Make homes tighter	10 – 20 pints	----
Properly size the AC	35 – 45 pints – for a 2 Ton running 12 hrs /day	3 pints / kWh
Use an ERV	20 – 30 pints	15 pints / kWh
Whole house dehumidifier	70 – 90 pintss	6 pints / kWh

ASHRAE 90.1 ECB

Energy Cost Budget

A tool for modeling compliance with ASHRAE Standard 90.1-2010



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