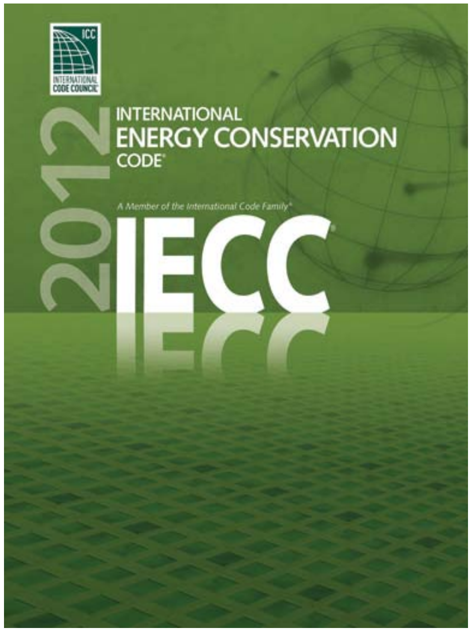
Energy Boot Camp for Builders

Building Science and Changes to the Montana Energy Code



**New Construction
PTCS Duct Sealing &
Blower Door Training**

NCAT

December 2013
Presented by Dale Horton, Architect
National Center for Appropriate Technology

AIR FLOW BASICS

- For air to move, you need a hole and a pressure difference.
- Air always flows from high (or positive) pressure to low (or negative) pressure.
- <u>CFM in always equals CFM Out.</u>

What Is Pressure?

- Force pressing against a surface
- Weight per unit area
- Pounds per square inch
- Inches of water column
- Pascal: Newtons per meter squared

(850 lbs per 2 small feet)

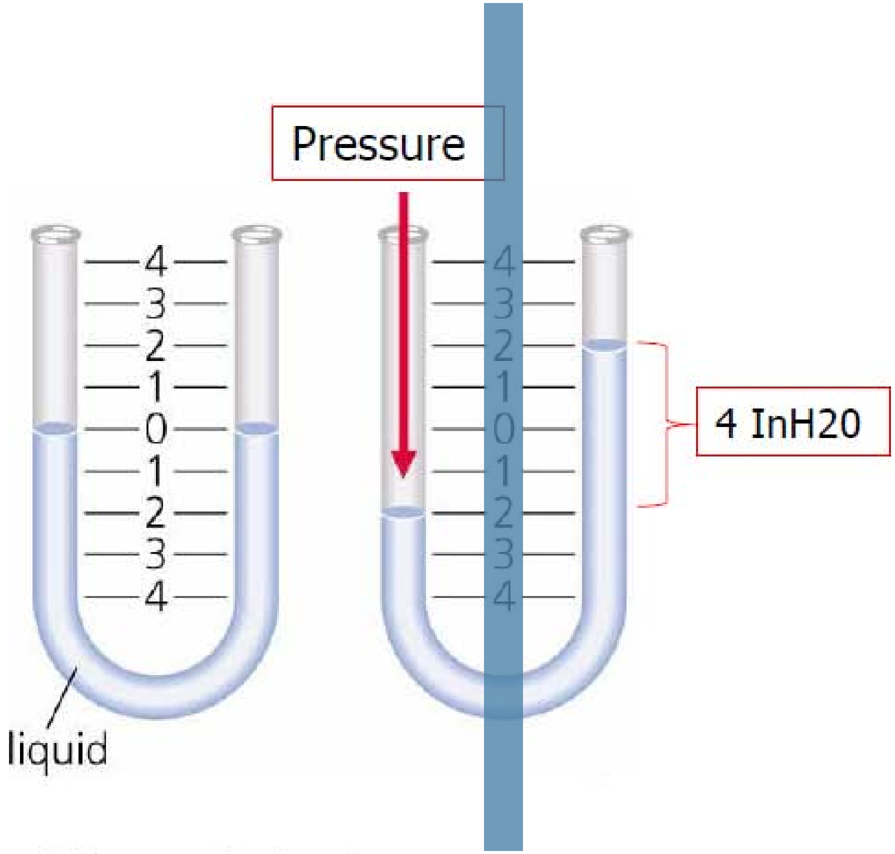
A Simple Manometer

What a manometer is:

- A pressure gauge

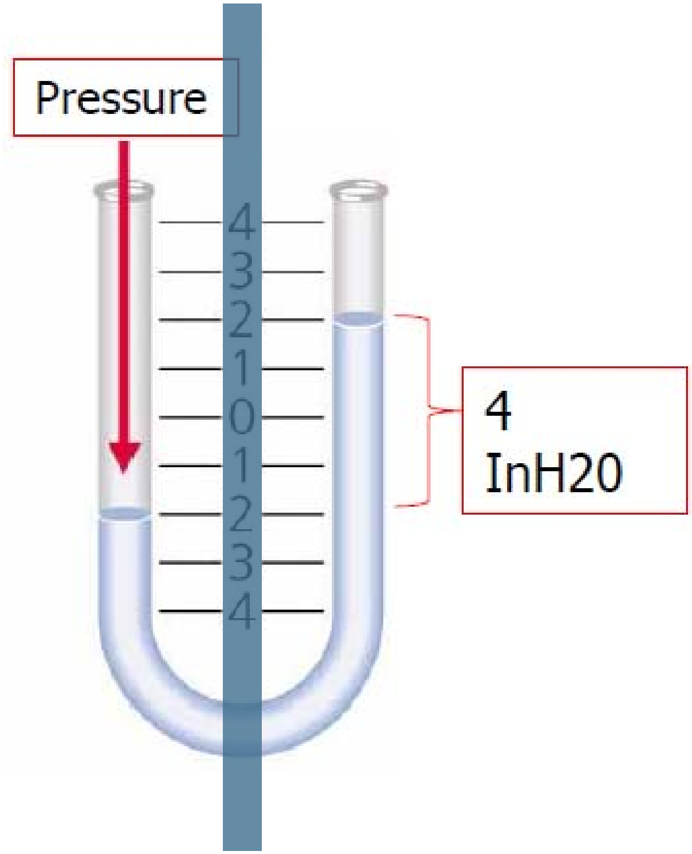
What a manometer does:

- Measures the pressure *difference* between two areas.



The original manometer

A Simple Manometer



This rudimentary manometer is displaying a pressure difference of 4 inches of H20.

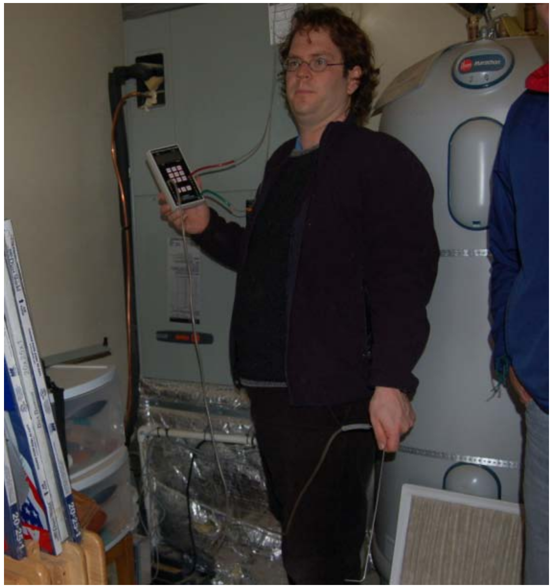
What does this equal in Pa?

1 InH20 = 250 Pa

4 x 250 = 1000 Pa

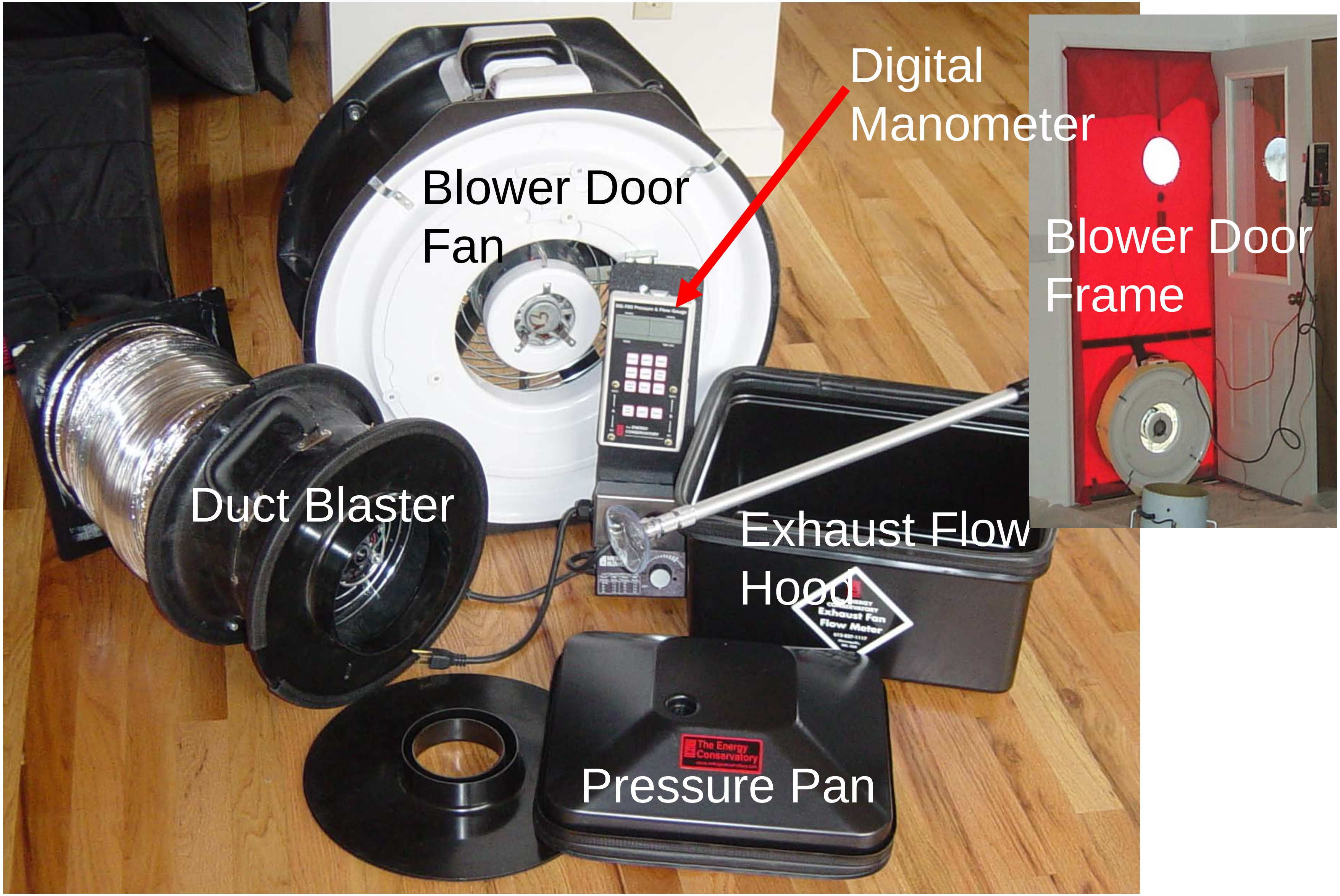
Examples of House Pressure Measurements

- Wind (Ave. 4 Pa)
- Stack Effect (1-3 Pa)
- Furnace plenum (120 Pa)
- Boot (5 Pa)
- Flue (-3 Pa)
- Bedroom with doors closed (up to 10 Pa)
- Room with a big exhaust fan (-20 Pa)
- House pressurized by blower door (50 Pa)
- Potential Back Draft Problems (-3 Pa)

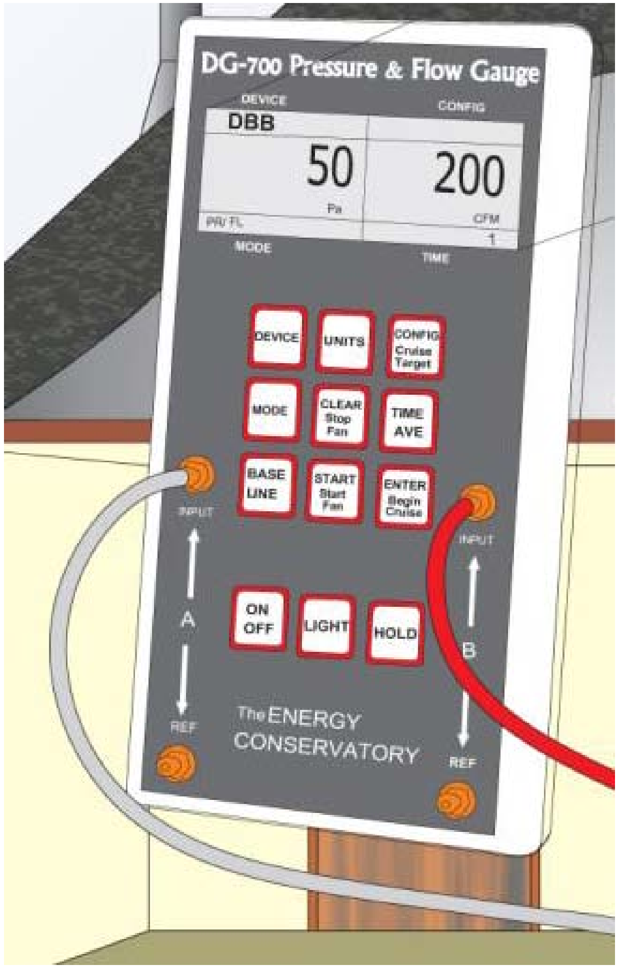


Source: PTCS

Typical Performance Testing Equipment



The Manometer



There are several different types of manometers:

- Energy Conservatory DG 700
- Retrotec DM-2
- Infiltec DM-4

For PTCS trainings, we use Energy Conservatory Equipment

Energy Conservatory

Key references for the discussion of performance testing are available on the web at:

http://www.energyconservatory.com/support/support5.htm

- *Blower Door Operation Manual*
- *Quick Guide #DEP700-CR - 1 Point Depress Test with DG-700*
- *Duct Blaster Operation Manual*
- *Quick Guide #PR700-CR - 1 Point Total Leakage Press Test with DG-700*
- *Quick Guide #PR700 (Outside) - 1 Point Leakage to Outside Press Test with DG-700*

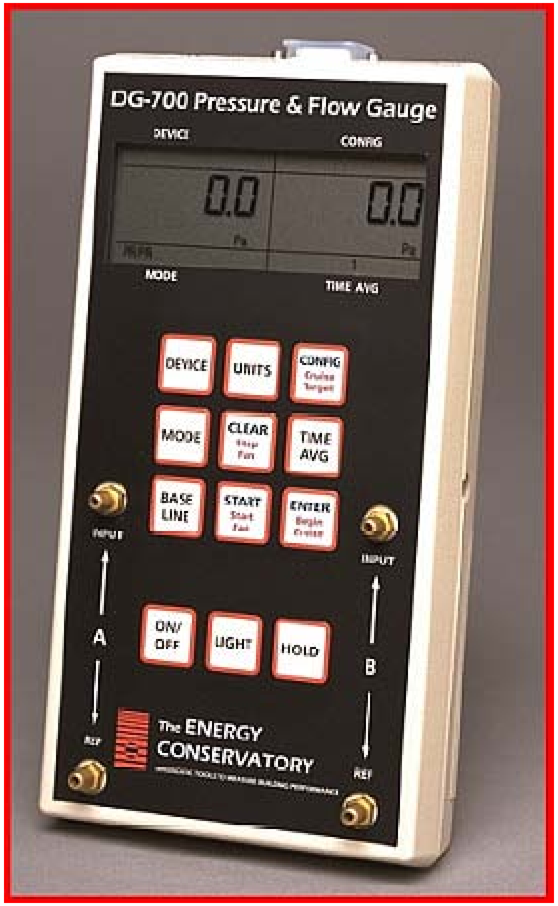
The ENERGY CONSERVATORY

The Digital Manometer

Measures the pressure *difference* between two areas.

Input = 1st area

Reference = 2nd area

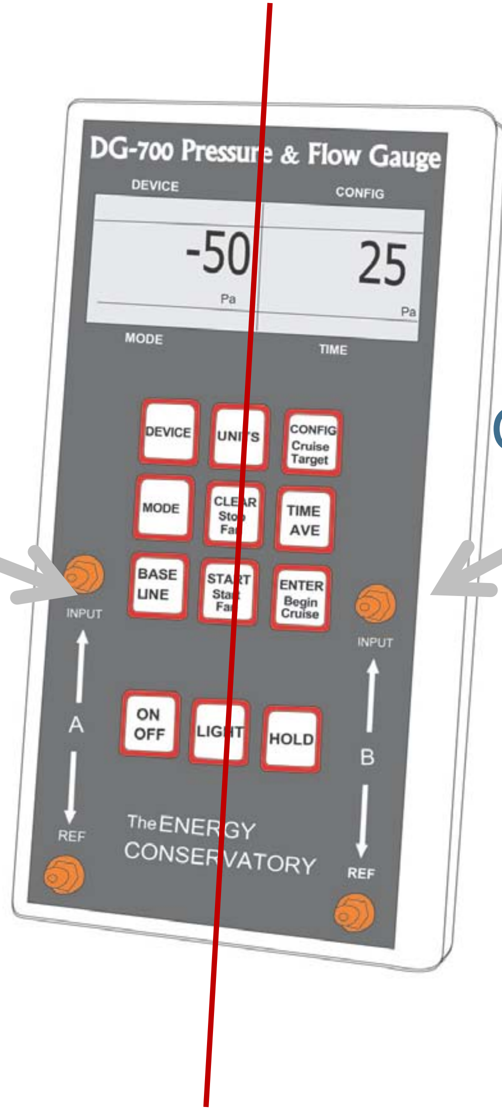


The Digital Manometer

The DG-700 manometer also has 2 channels:

Channel A

Channel B



The Digital Manometer

The Manometer Mantra:

<u>("Input Nipple")</u> with reference to <u>("Ref Nipple")</u>

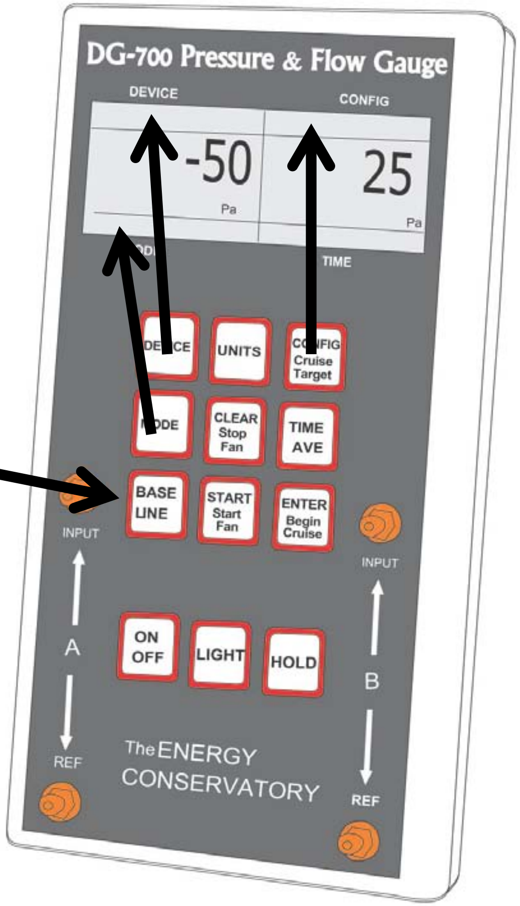
(WRT)

Input

DG700 Tips

Always Start With “Mode”

Perform Baseline from left to right on 3rd row of buttons

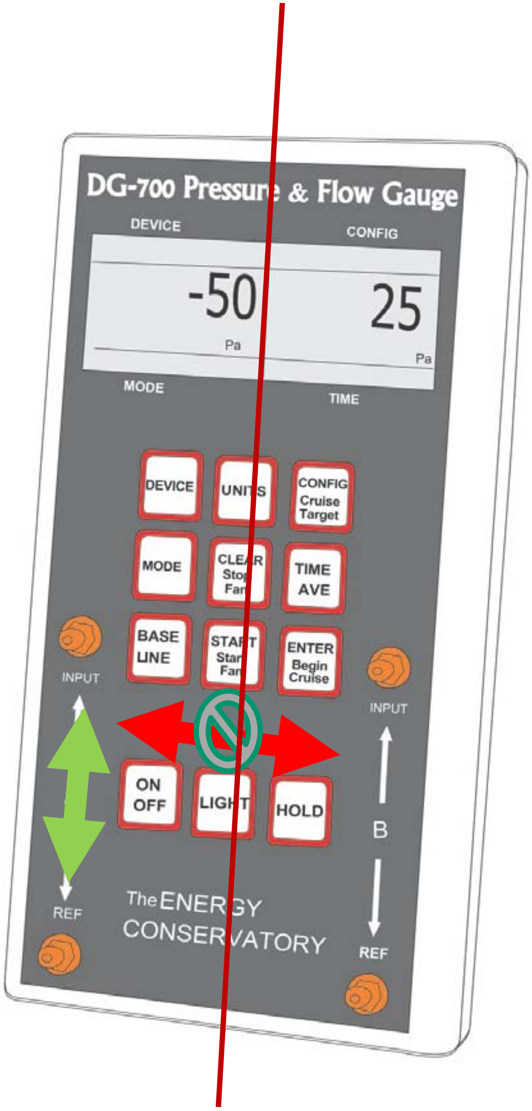


Source: PTCS

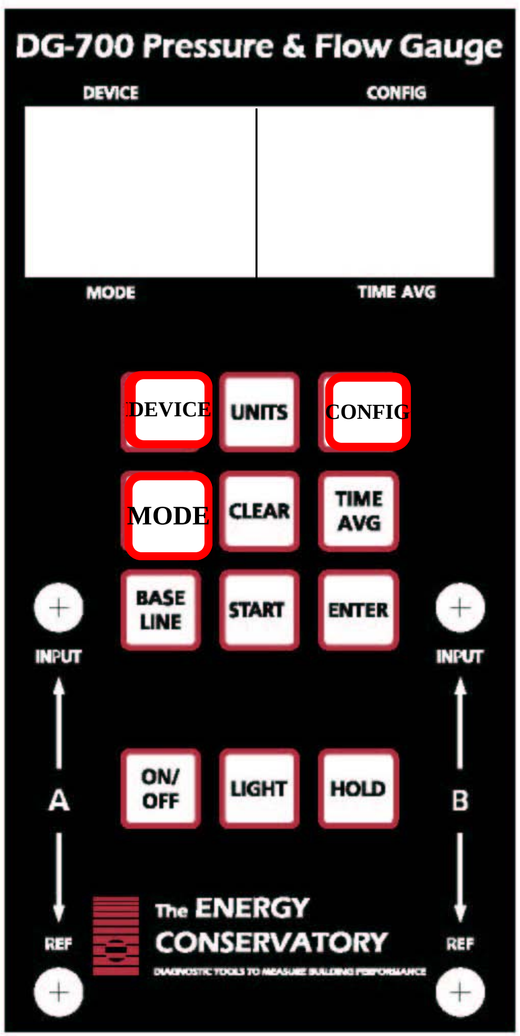
The Digital Manometer

- Displays the *difference* in pressure between the <u>input and the reference</u>.

  - *Does not display the difference in pressure between channels.*



Configuring the Manometer



MODE — Tells manometer what measurements to display (e.g pressure or flow)

DEVICE — Tells manometer what equipment is being used

CONFIG — Tells manometer what the equipment configuration is (ring number)

Configuring the Manometer - MODE

Mode

Tell it what you want to read

PR/PR	Measures the pressure difference between "input" and reference on both channels A and B
PR/FL	Measures the amount pressure recorded on channel A, and the amount of air flowing through device on channel B
PR/FL@50	Calculates the amount of air that would flow through device on channel B if pressure on channel A was 50 Pa. (for homes only)
PR/FL@25	Calculates the amount of air that would flow through device on channel B if pressure on channel A was 25 Pa. (for ducts)

Configuring the Manometer - Device

Device

Tell it what you're connected to

BD3	Blower Door Model 3
DB A	Duct Blaster Model A (White Fan)
DB B	Duct Blaster Model B (Black Fan)
TF, EXH, BD4, etc.	TrueFlow Plate and other Energy Conservatory Equipment.

Configuring the Manometer - Config

Config

Tell it how big the hole is (what ring)

Open	Open fan, no ring attached
A1	Ring A (Blower door); Ring 1 (Duct Blaster)
B2	Ring B (Blower Door); Ring 2 (Duct Blaster)
C3	Ring C (Blower Door); Ring 3 (Duct Blaster)

List of Performance Tests in ***Action Order***

1. Dominant Duct Leakage Test
2. Room Zonal Pressure Difference Test
3. Combustion Appliance Zone Test
4. Blower Door Test*
5. Zonal & Pressure Pan Tests w/ BD fan
6. Total Duct Leakage Test*
7. Duct Leakage to the Outside Test*
8. Exhaust Fan Flow Test

* - Indicates test related to code

PTCS Duct Training – New Construction

Dominant Duct Leakage

Not a Code Required Test

PTCS
Performance Tested
Comfort Systems

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Dominant Duct Leak Test
Return Leaks

STEPS

1. Set manometer to PR/PR.

2. Connect probe from outside to side A.

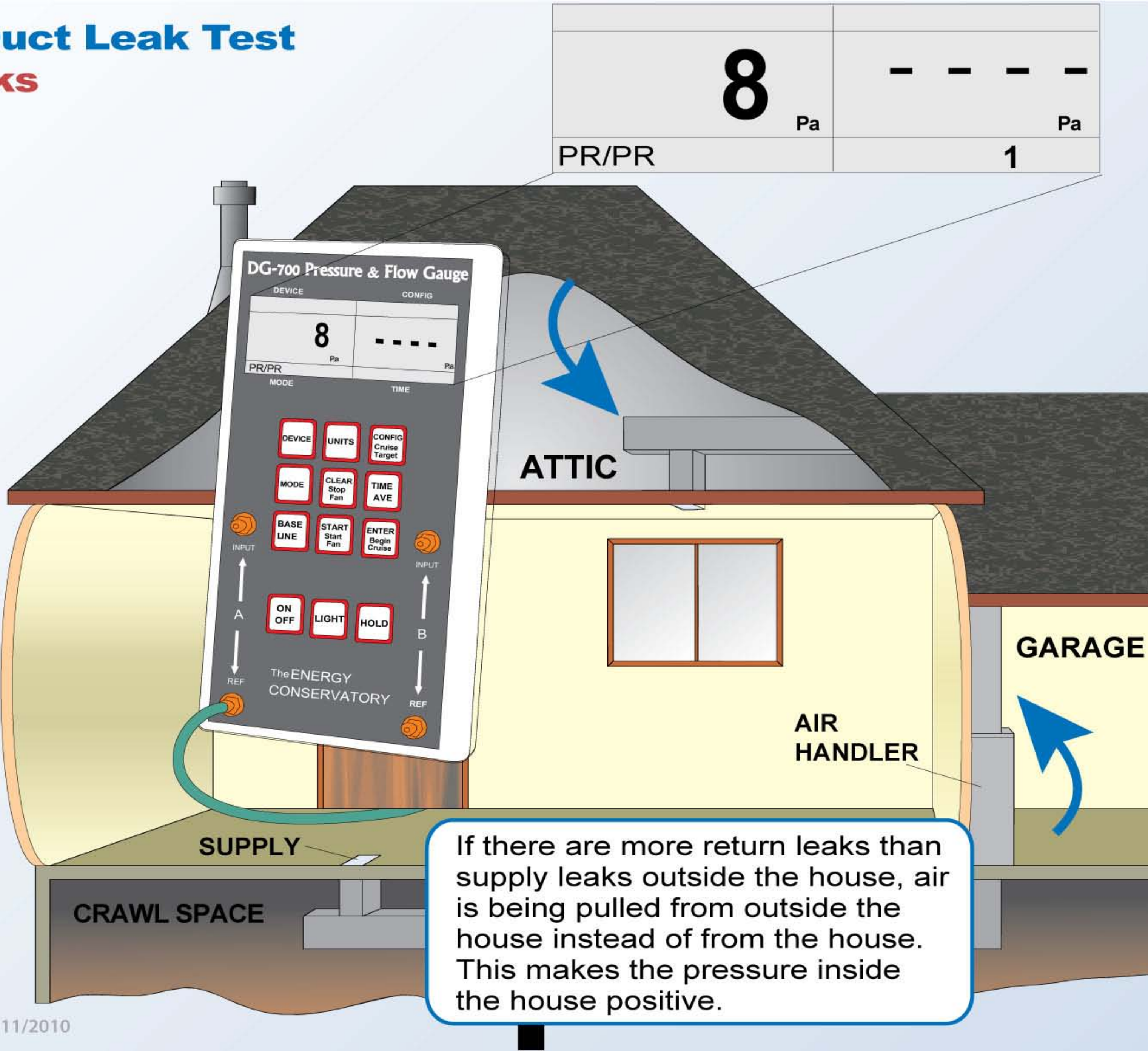
3. Close exterior doors and open interior doors.

4. Turn OFF dryer, all fans and combustion equipment.

5. Record pressure reading on side A (baseline pressure).

6. Turn on the furnace fan.

7. Record reading on side A. If the house becomes more depressurized (compared to baseline) you have more supply leaks than return leaks.



If there are more return leaks than supply leaks outside the house, air is being pulled from outside the house instead of from the house. This makes the pressure inside the house positive.

Dominant Duct Leak Test
Supply Leaks

STEPS

1. Set manometer to PR/PR.

2. Connect probe from outside to side A.

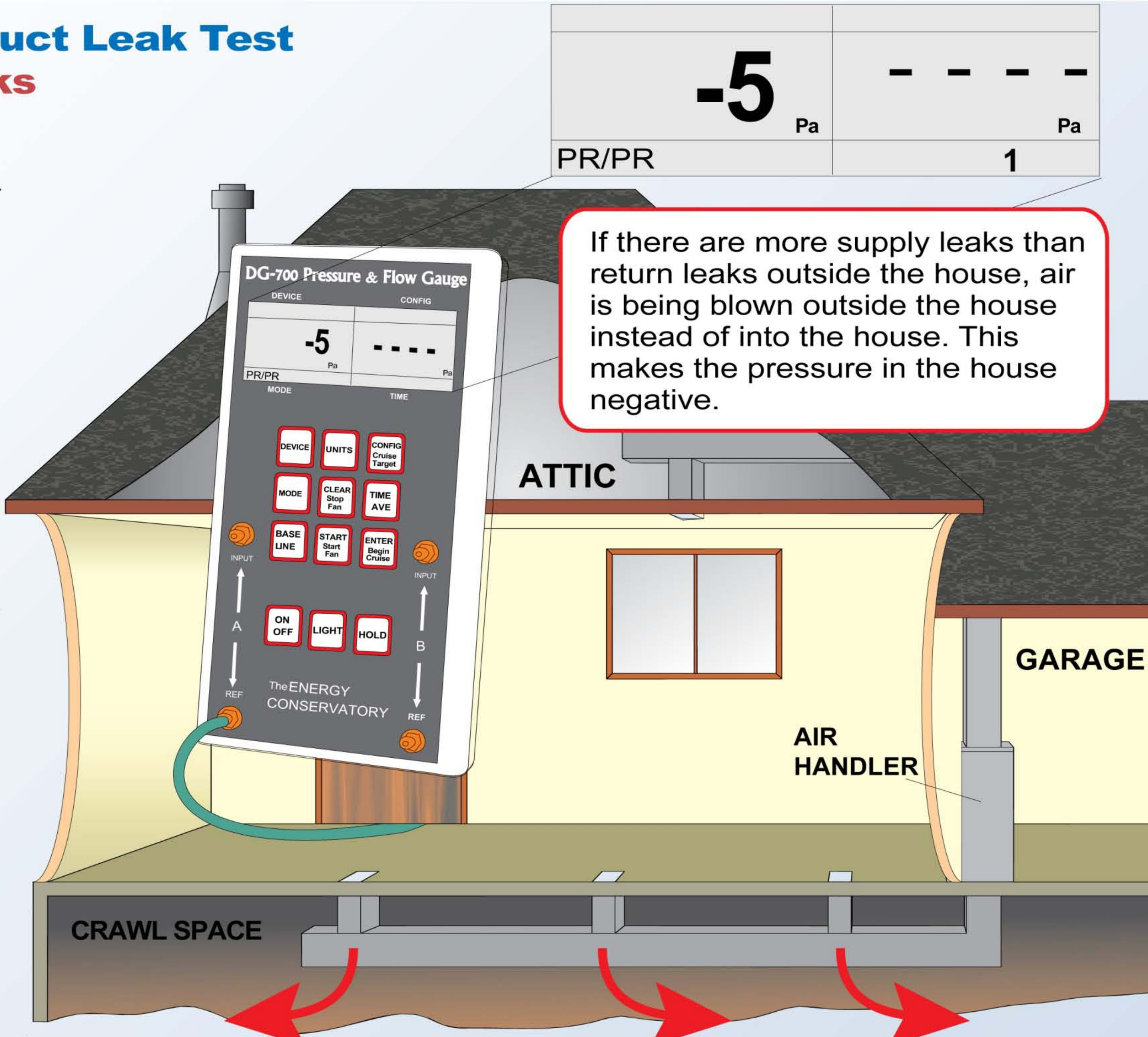
3. Close exterior doors and open interior doors.

4. Turn OFF dryer, all fans and combustion equipment.

5. Record pressure reading on side A (baseline pressure).

6. Turn on the furnace fan.

7. Record reading on side A. If the house becomes more depressurized (compared to baseline) you have more supply leaks than return leaks.



PTCS Duct Training – New Construction

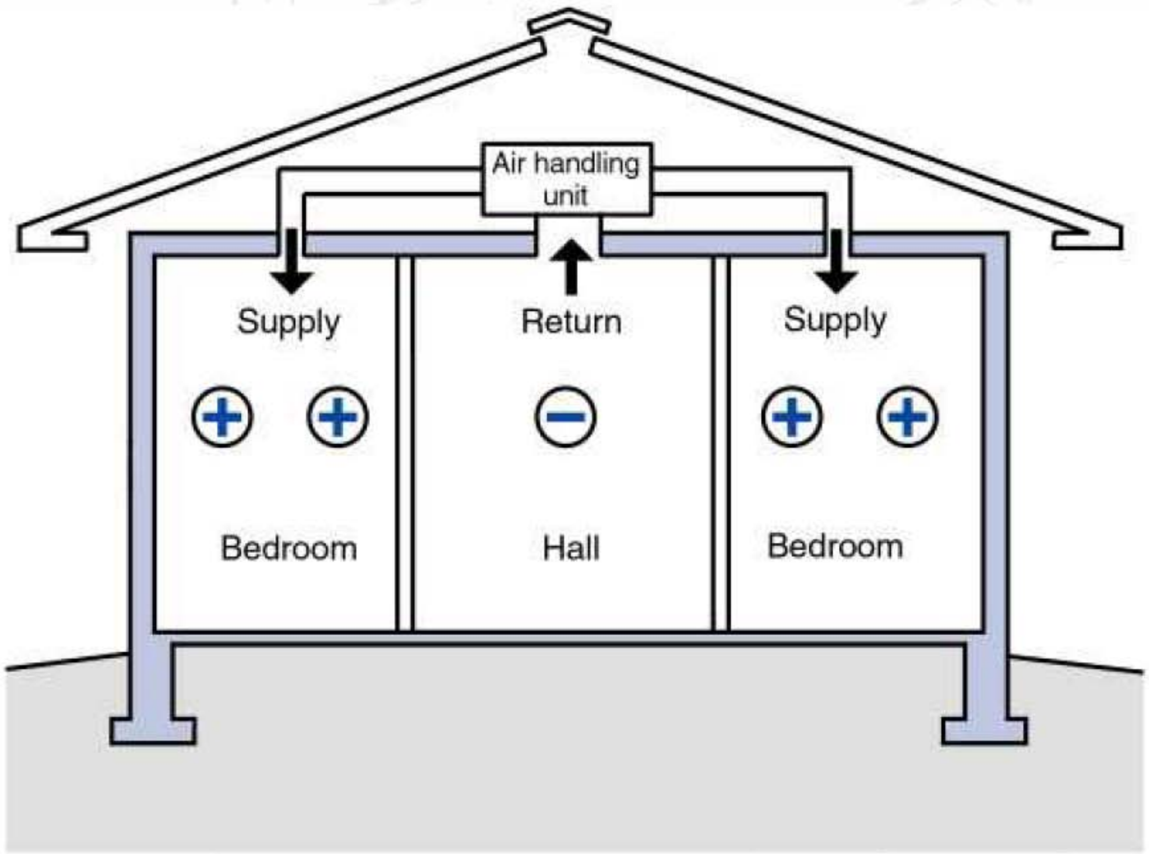
Room Zonal Pressure Difference

Not a Code Required Test

PTCS

Performance Tested Comfort Systems

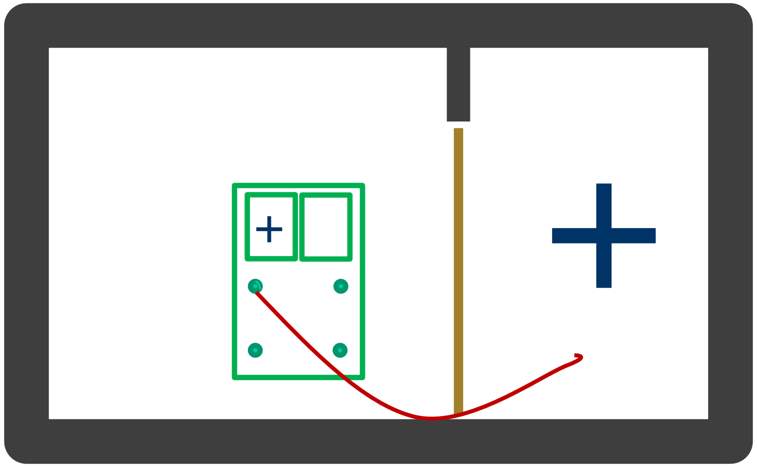
Room Zonal Pressure Test



The NWESH program requires that the pressure between bedrooms and common area be tested to assure that the pressure difference in no more than 3 Pa.

Zonal Pressure Test

Measure pressure difference between room and central zone of home.



What is the pressure in the room WRT the central zone?

-

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PTCS Duct Training – New Construction

Combustion Appliance
Zone Test

Not a Code Required Test

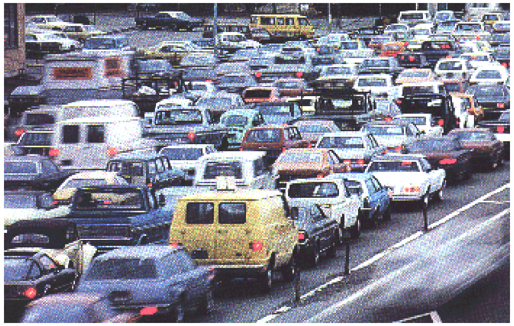
PTCS
Performance Tested
Comfort Systems

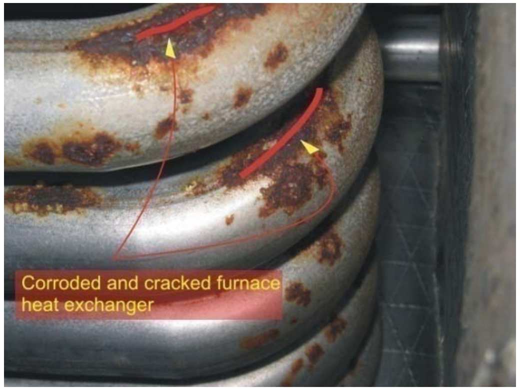
What’ A CAZ?

Any zone in the house , including the garage, that contains a vented combustion appliance

Causes of CO in Homes

- Urban Traffic
- Cars started in garages
- Unvented combustion equipment
- Backdrafting combustion equipment
- Failed heat exchangers
- Really dumb stuff (barbecuing indoors, running generators indoors etc
- If there is Combustion there might be CO

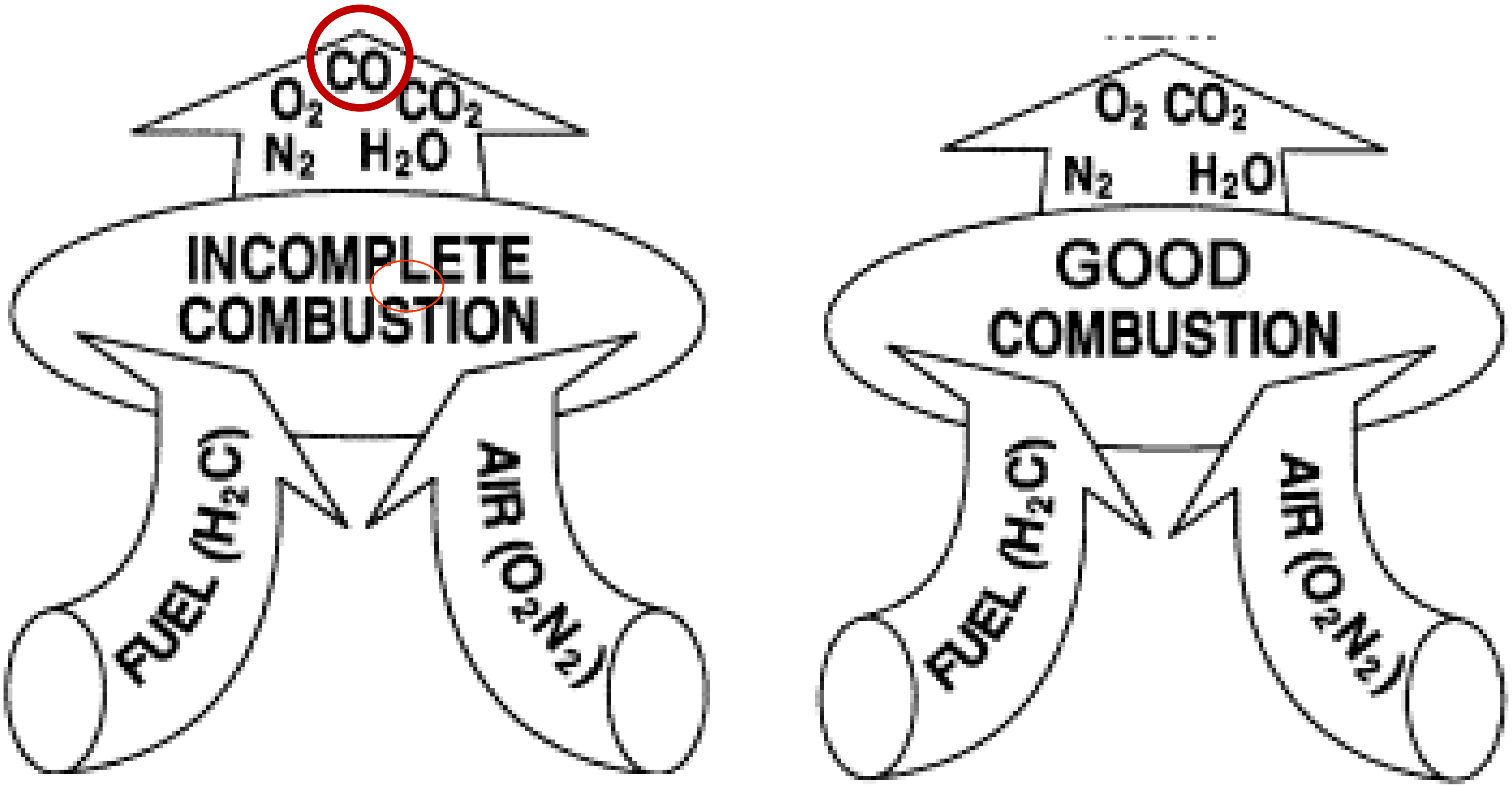




Carbon Monoxide (CO)

PPM CO in air	Percent CO in air	Symptoms experienced by healthy adults	Comments
Less than 35 ppm	0.00%	No effect in healthy adults	35 ppm is WISHA 8-hour average permissible limit
100 ppm	0.01%	Slight headache, fatigue, shortness of breath, errors in judgment	
200 ppm	0.02%	Headache, fatigue, nausea, dizziness	200 ppm is the WISHA ceiling limit
400 ppm	0.04%	Severe headache, fatigue, nausea, dizziness, confusion, can be life-threatening after 3 hours of exposure	
800 ppm	0.08%	Headache, confusion, collapse, death if exposure is prolonged	
1500 ppm	0.15%	Headache, dizziness, nausea, convulsions, collapse, death within 1 hour	Levels greater than 1500 ppm are considered "immediately dangerous to life or health" (IDLH)
3000 ppm	0.30%	Death within 30 minutes	
6000 ppm	0.60%	Death within 10-15 minutes	
12,000 ppm	1.20%	Nearly instant death	

Carbon Monoxide (CO)



Unvented Combustion Equipment - Not Safe

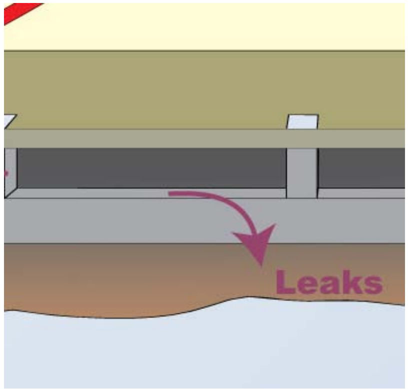
NFPA Standard 54 Combustion Venting Categories

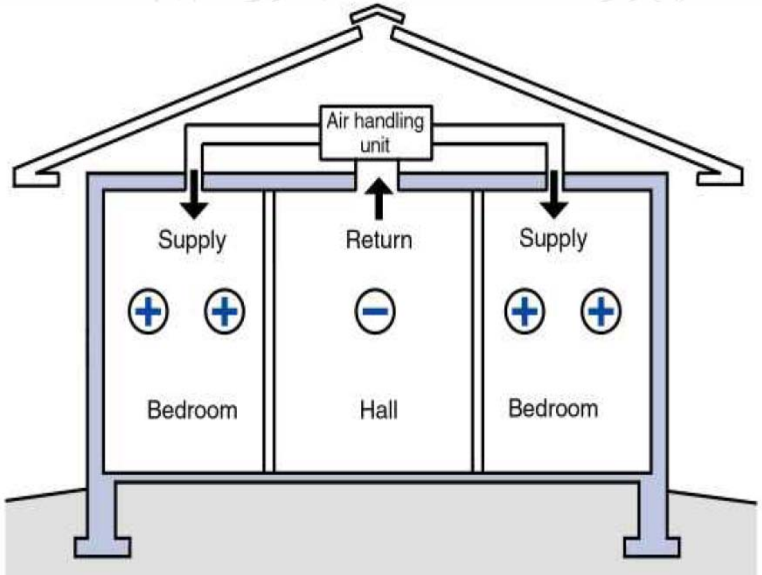
Class I	**Negative Pressure Venting Non-Condensing**
Class II	**Negative Pressure Venting Condensing**
Class II	**Positive Pressure Venting Non-Condensing**
Class IV	**Positive Pressure Venting Condensing**

Why Category I Appliances Vent

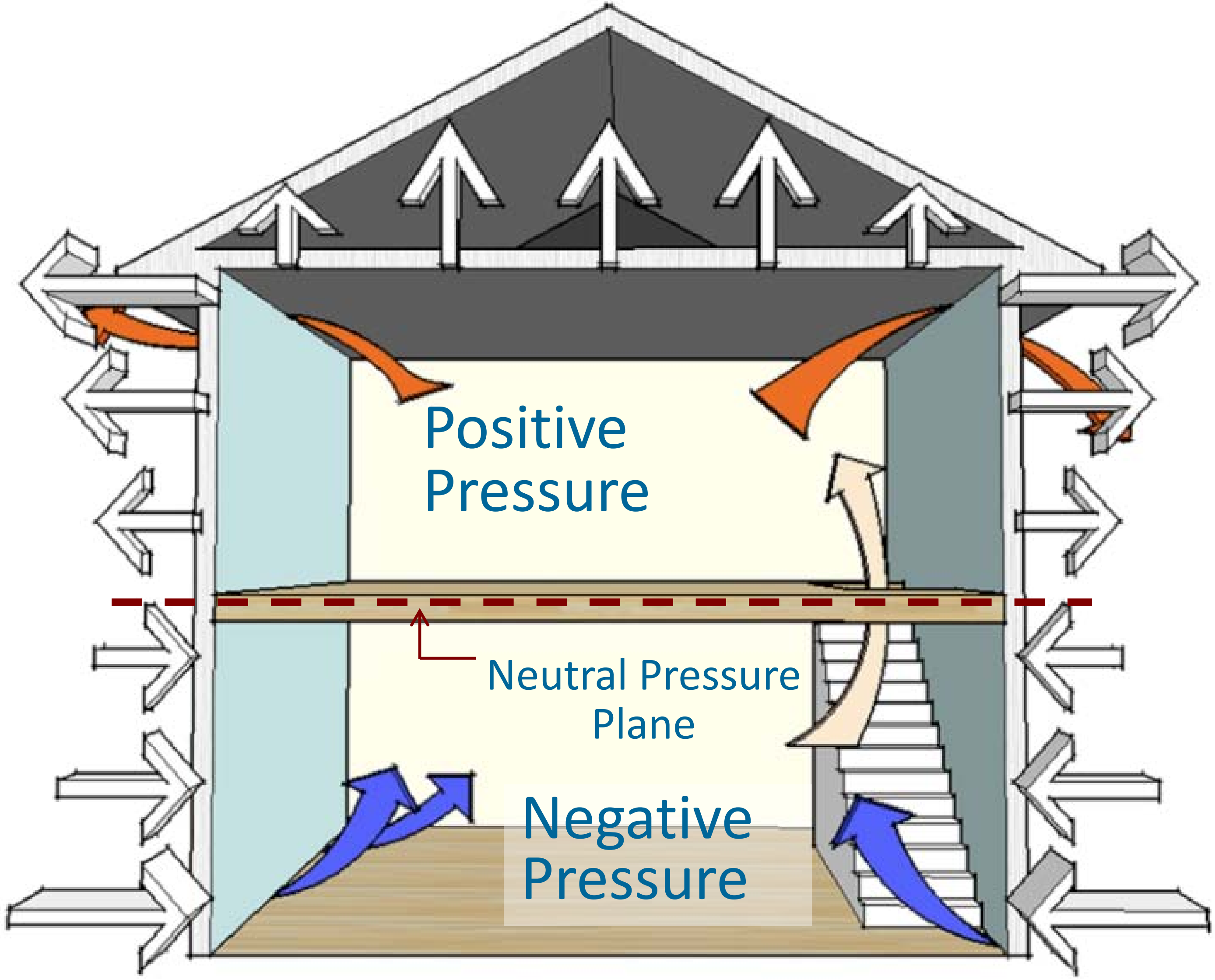
The Driving Forces That Change Air Pressure in a House

- Wind
- Stack (the Chimney effect)
- Exhaust Fans
- Duct leakage
- Unbalanced forced air systems (interior door closure)



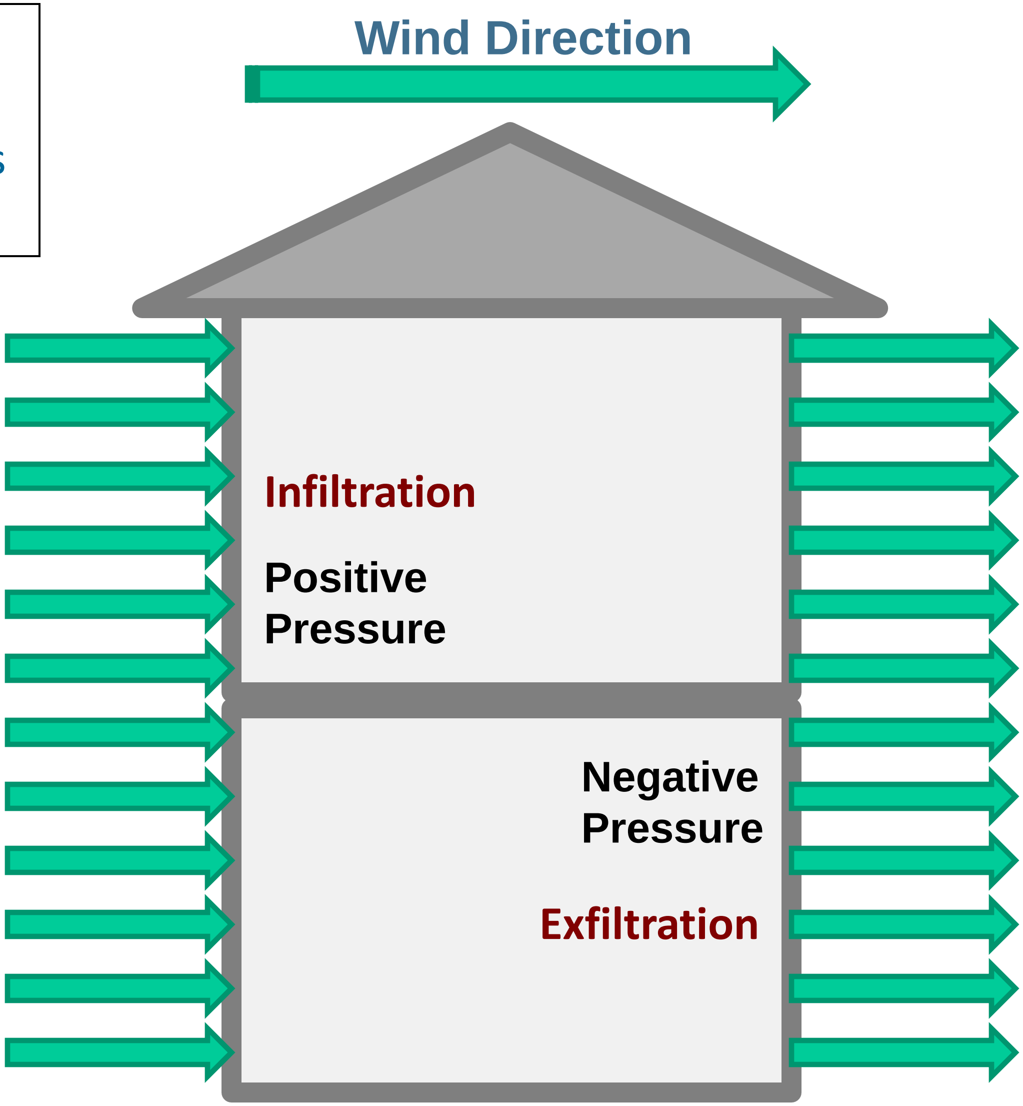


Stack Effect: The most persistent consistent pressure effect.

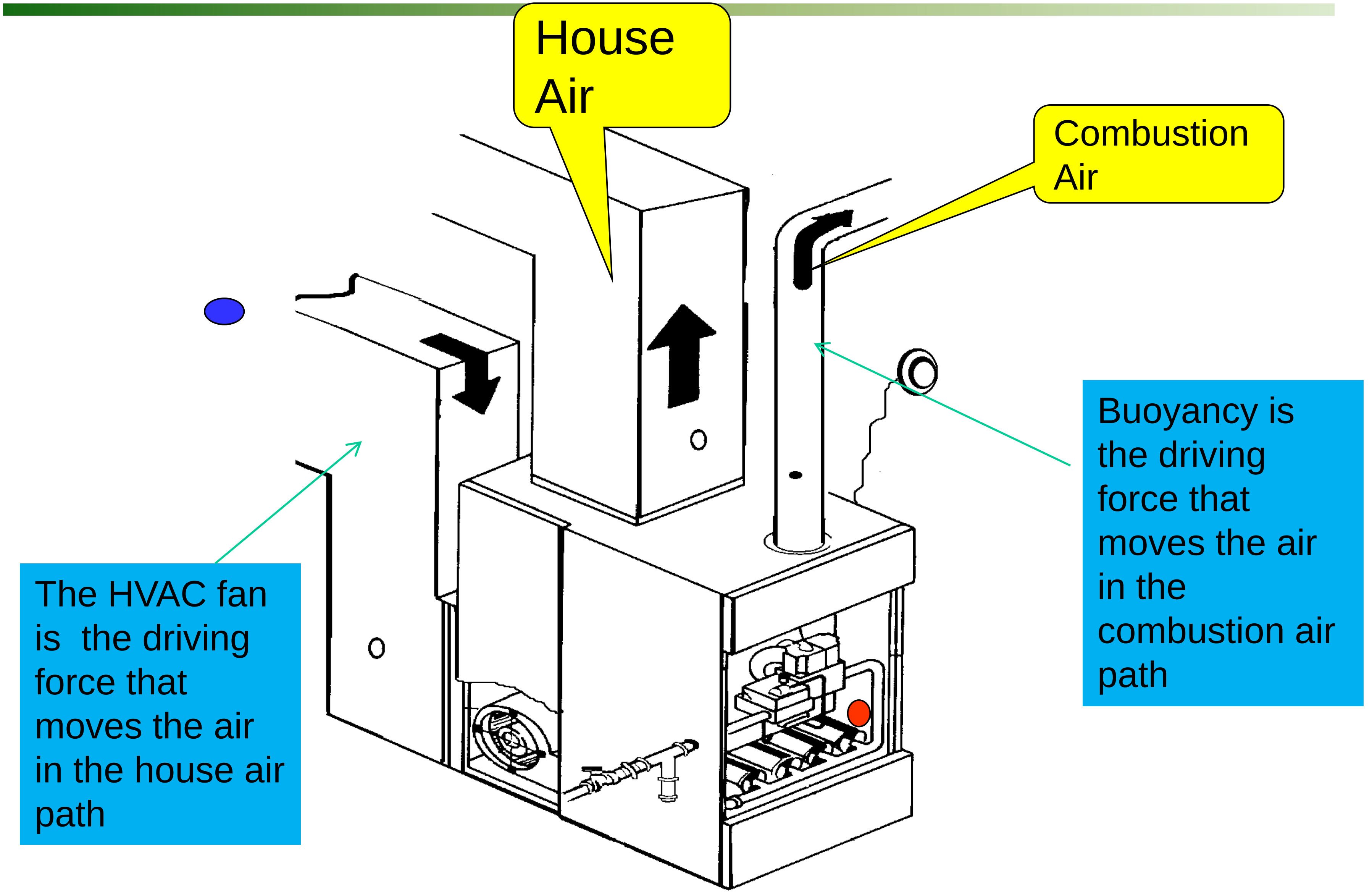


Wind Driven Pressures

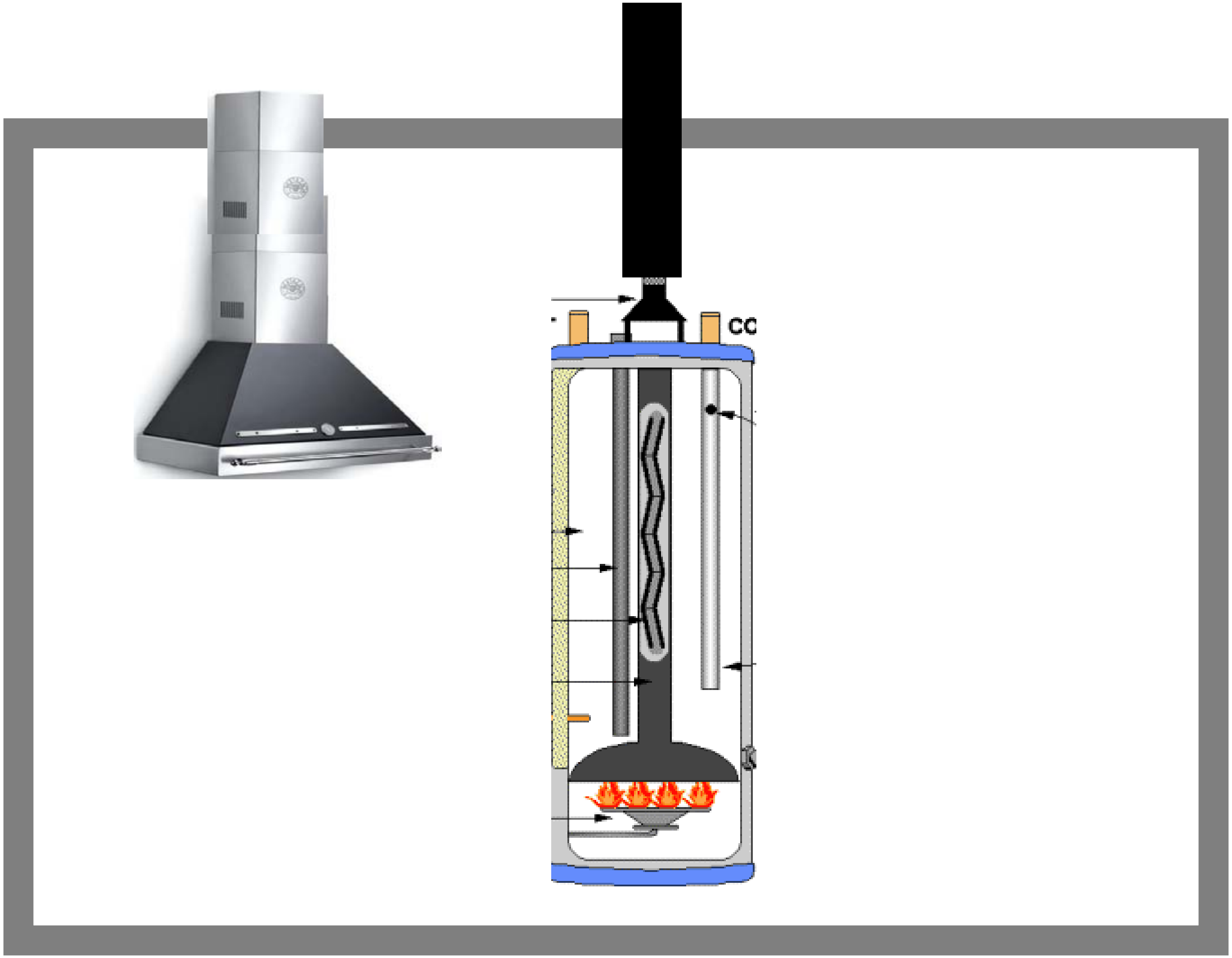
Wind creates positive and negative pressures within the house.



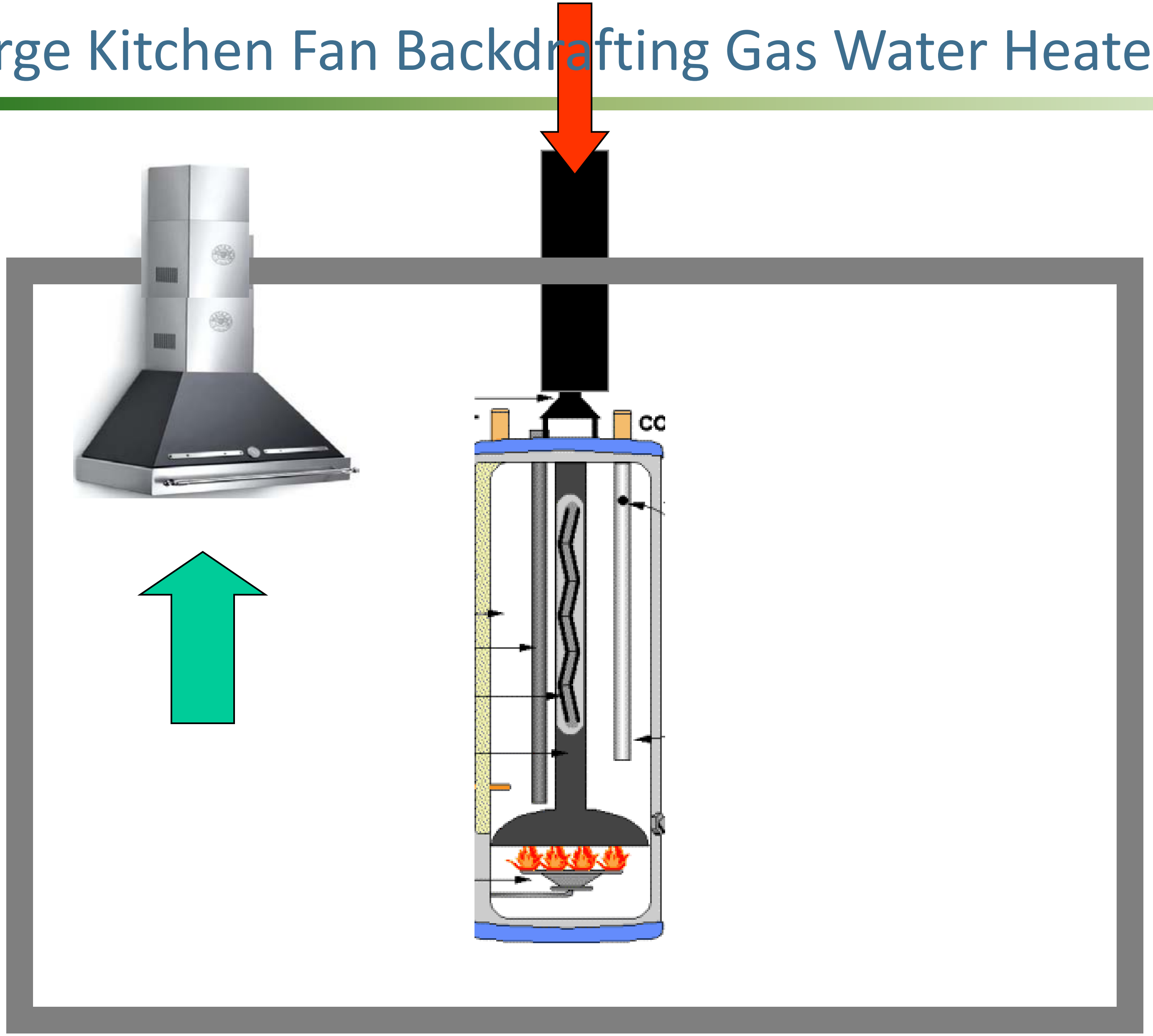
The Two Paths of Air in a Furnace



Correct Venting, Gas water Heater Venting Successfully

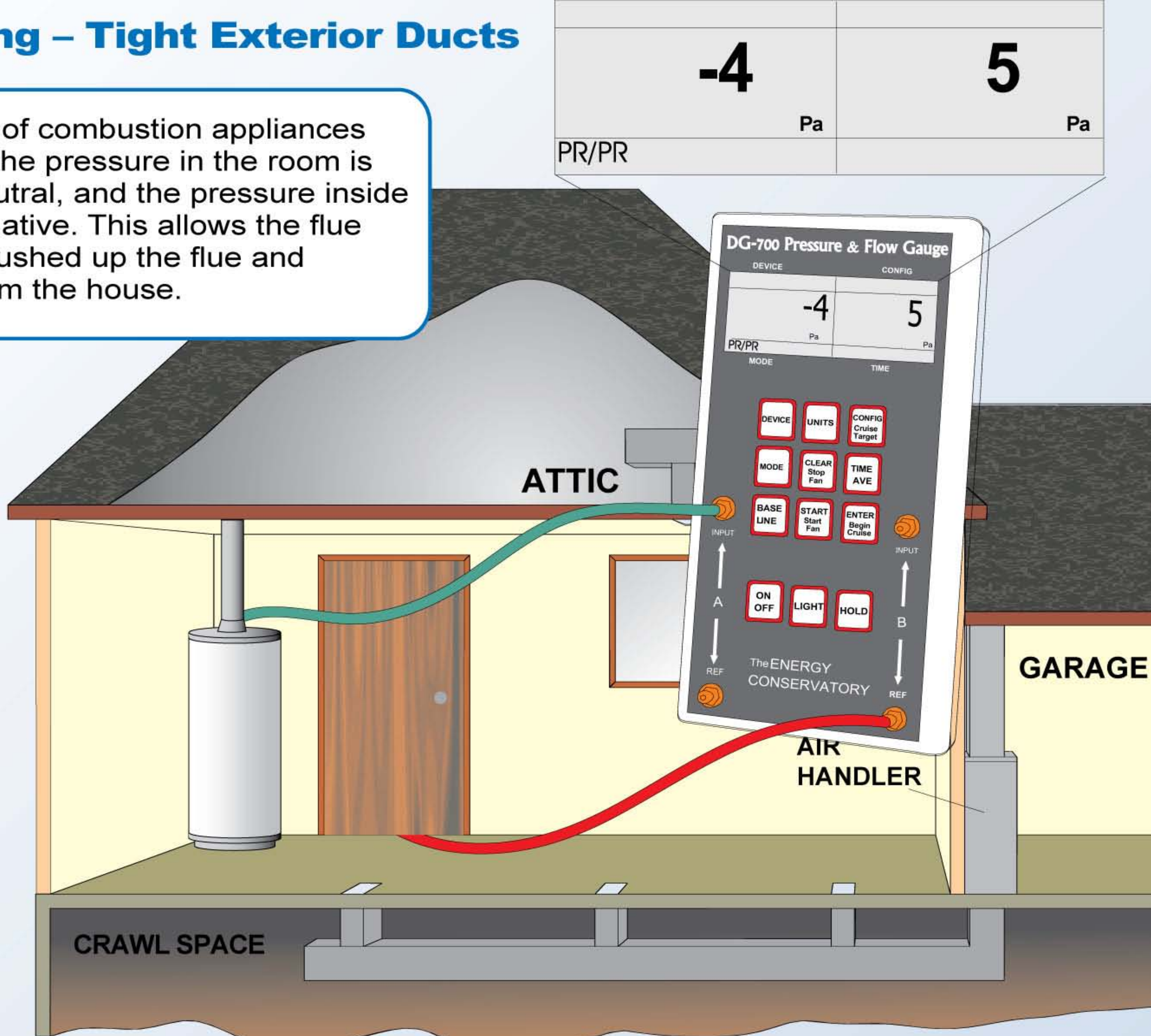


Large Kitchen Fan Backdrafting Gas Water Heater



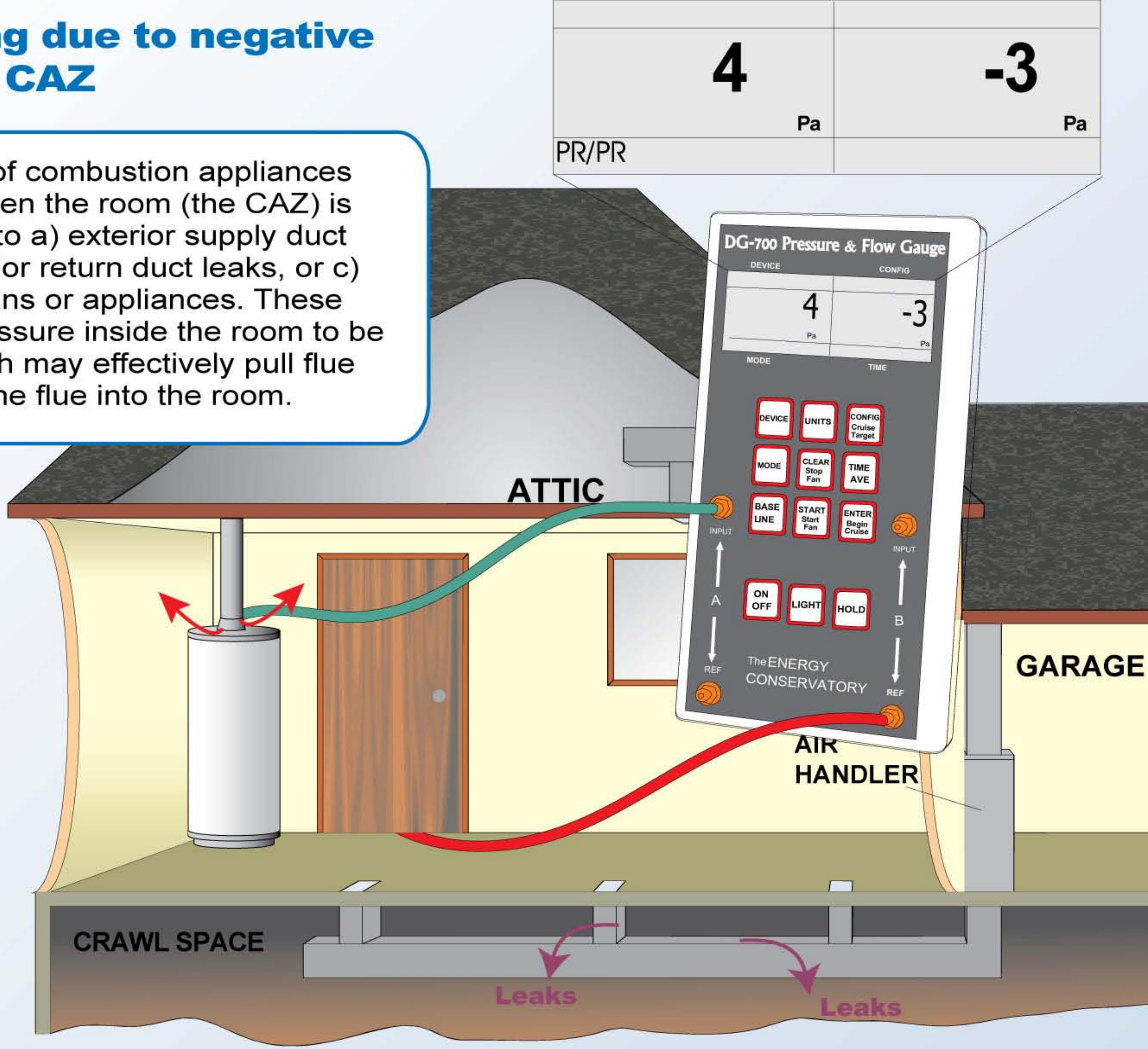
Good Venting – Tight Exterior Ducts

Good venting of combustion appliances occurs when the pressure in the room is positive or neutral, and the pressure inside the flue is negative. This allows the flue gases to be pushed up the flue and exhausted from the house.

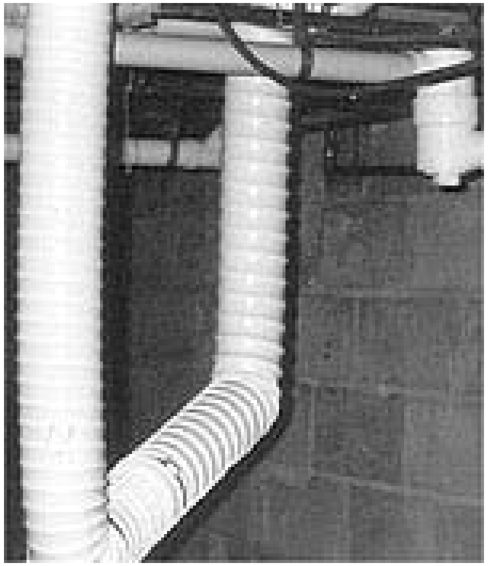


Backdrafting due to negative pressure in CAZ

Backdrafting of combustion appliances may occur when the room (the CAZ) is negative due to a) exterior supply duct leaks, b) interior return duct leaks, or c) big exhaust fans or appliances. These cause the pressure inside the room to be negative which may effectively pull flue gases down the flue into the room.



Home Appliance Induced Depressurization

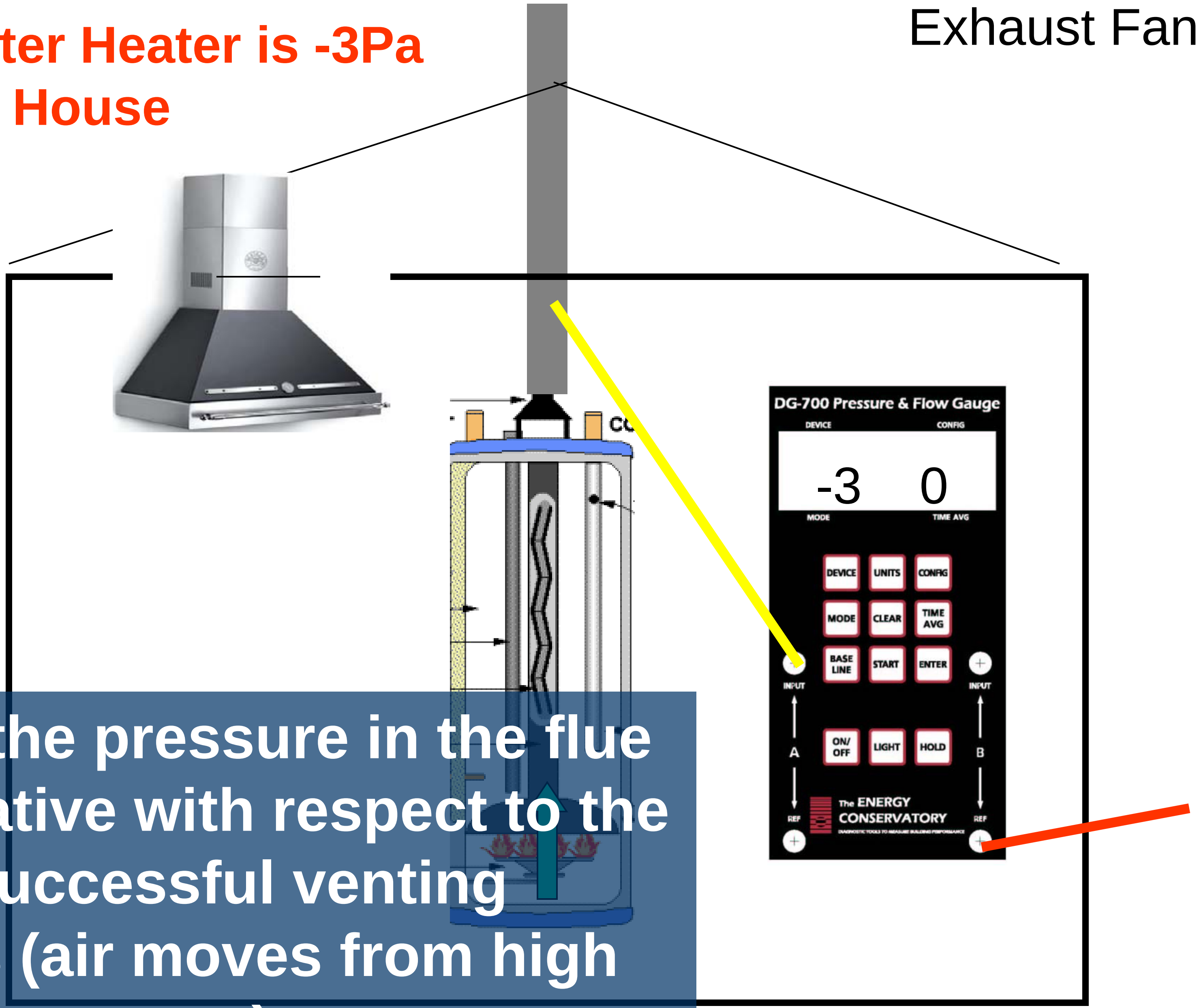


Beware of Over Sized Fans

- Tim Allen "More Power" Kitchen fans are sometimes rated at 1,200 CFM.
- Installed in a commercial environment, code would require make up air.

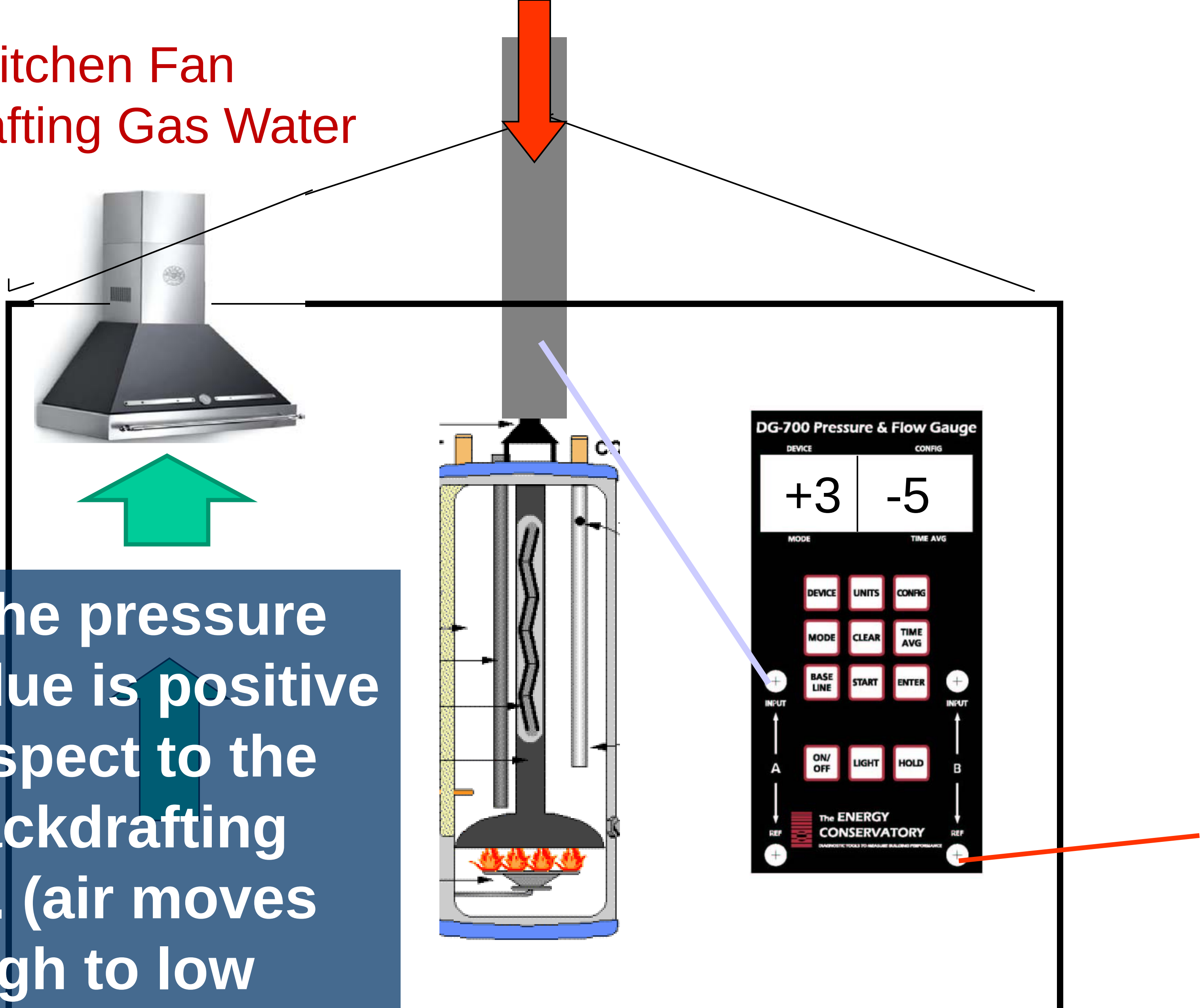
The Water Heater is -3Pa WRT to House

Exhaust Fans



When the pressure in the flue is negative with respect to the CAZ, successful venting occurs (air moves from high to low pressure)

Large Kitchen Fan Backdrafting Gas Water Heater



When the pressure in the flue is positive with respect to the CAZ backdrafting occurs. (air moves from high to low pressure)

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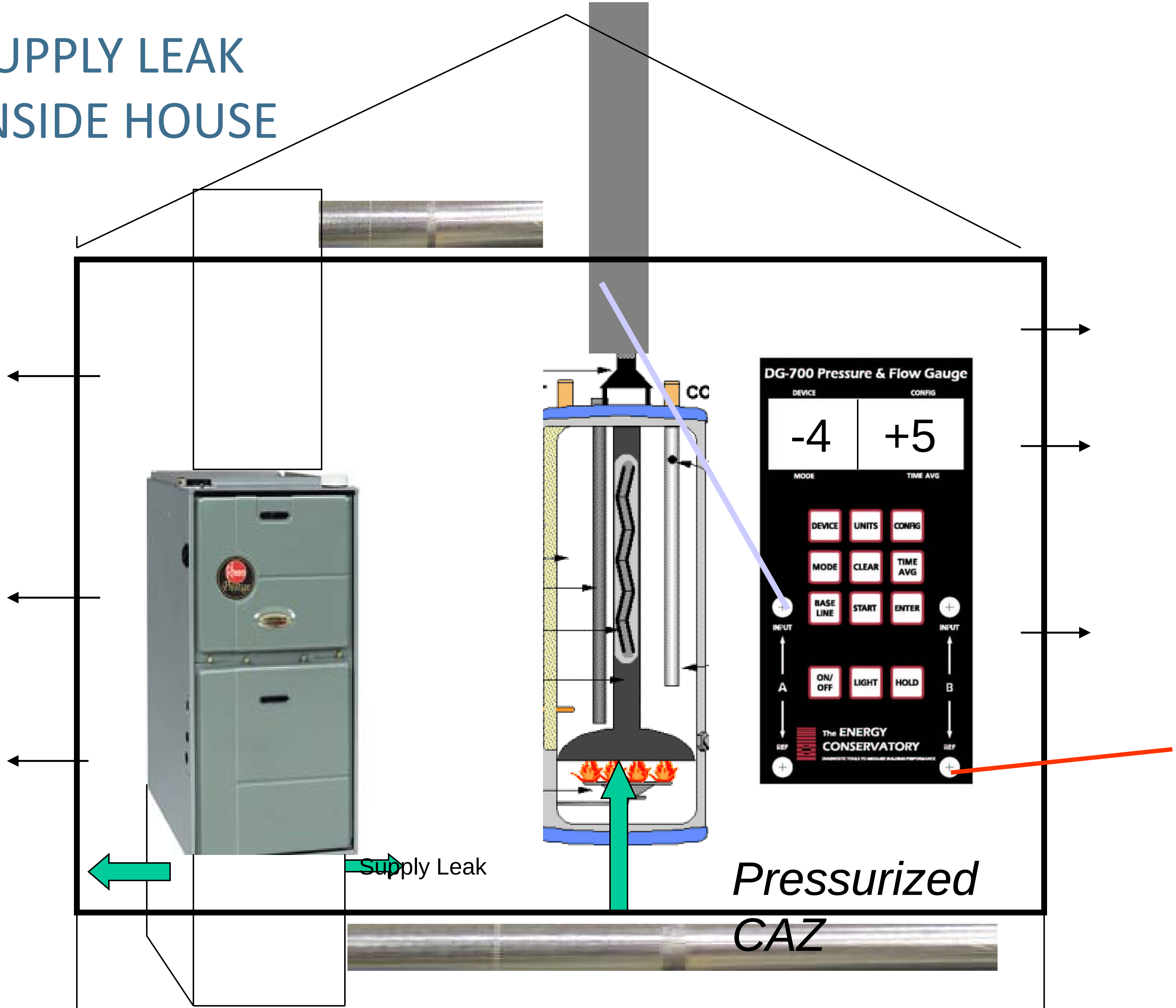
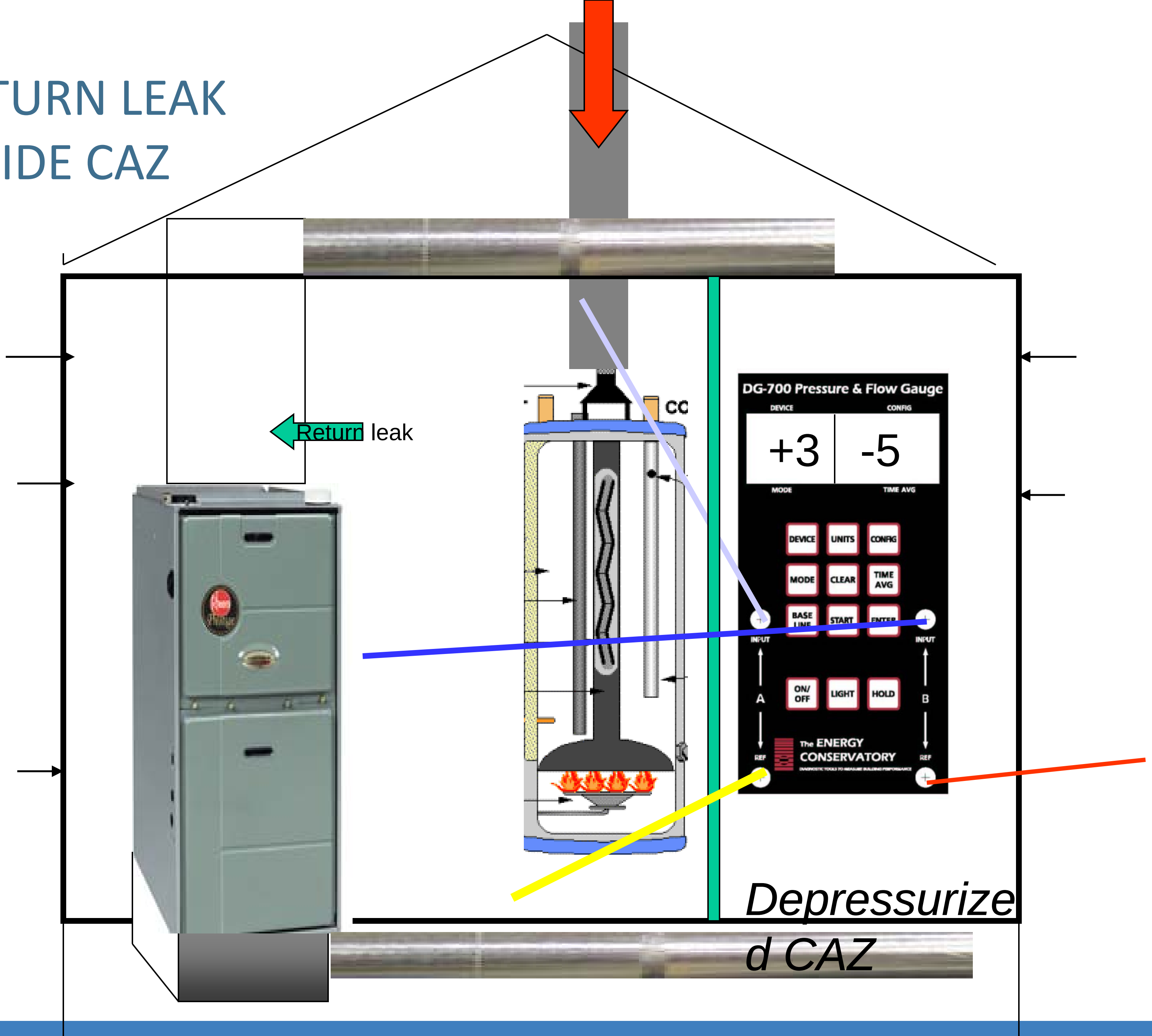
SUPPLY LEAK INSIDE HOUSE

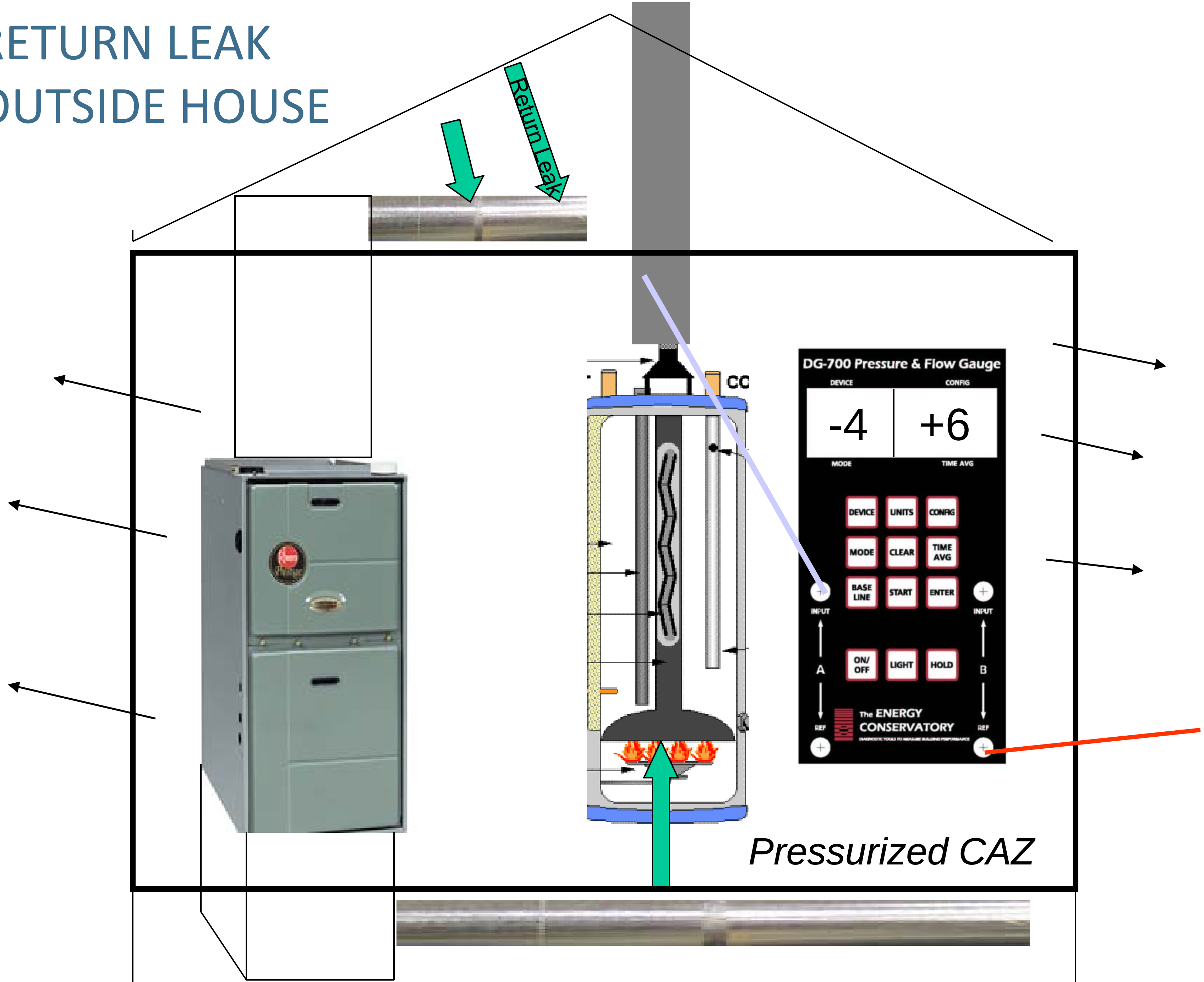


RETURN LEAK INSIDE CAZ

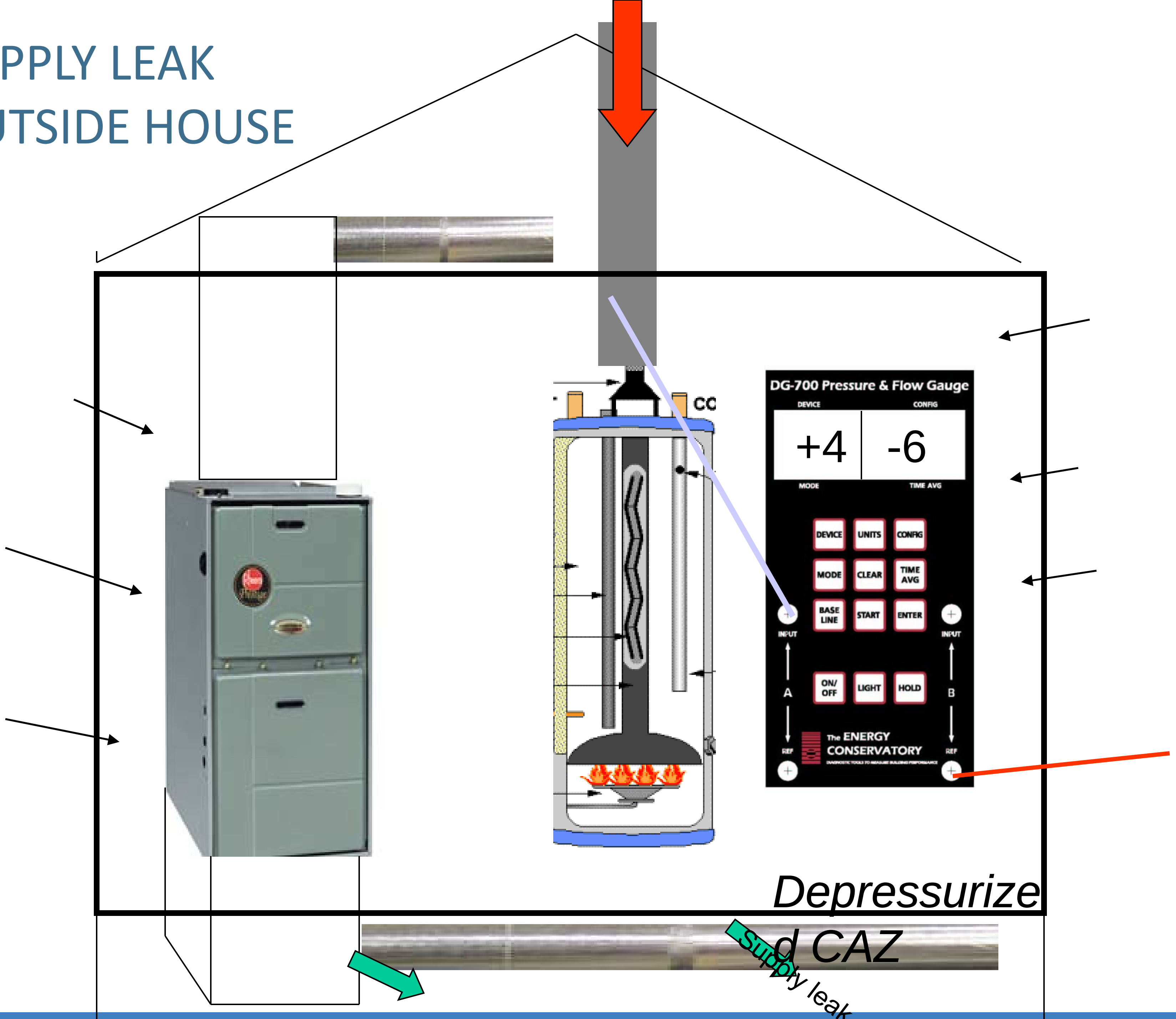


Depressurized CAZ

RETURN LEAK OUTSIDE HOUSE



SUPPLY LEAK
OUTSIDE HOUSE



CAZ (Combustion Appliance Zone) Test

STEPS

1. Stand in the combustion appliance zone (CAZ) (e.g. in the house, if the atmospherically vented combustion appliance is in the house).

2. Set Manometer to PR/PR. Connect hose from reference on side A to outside.

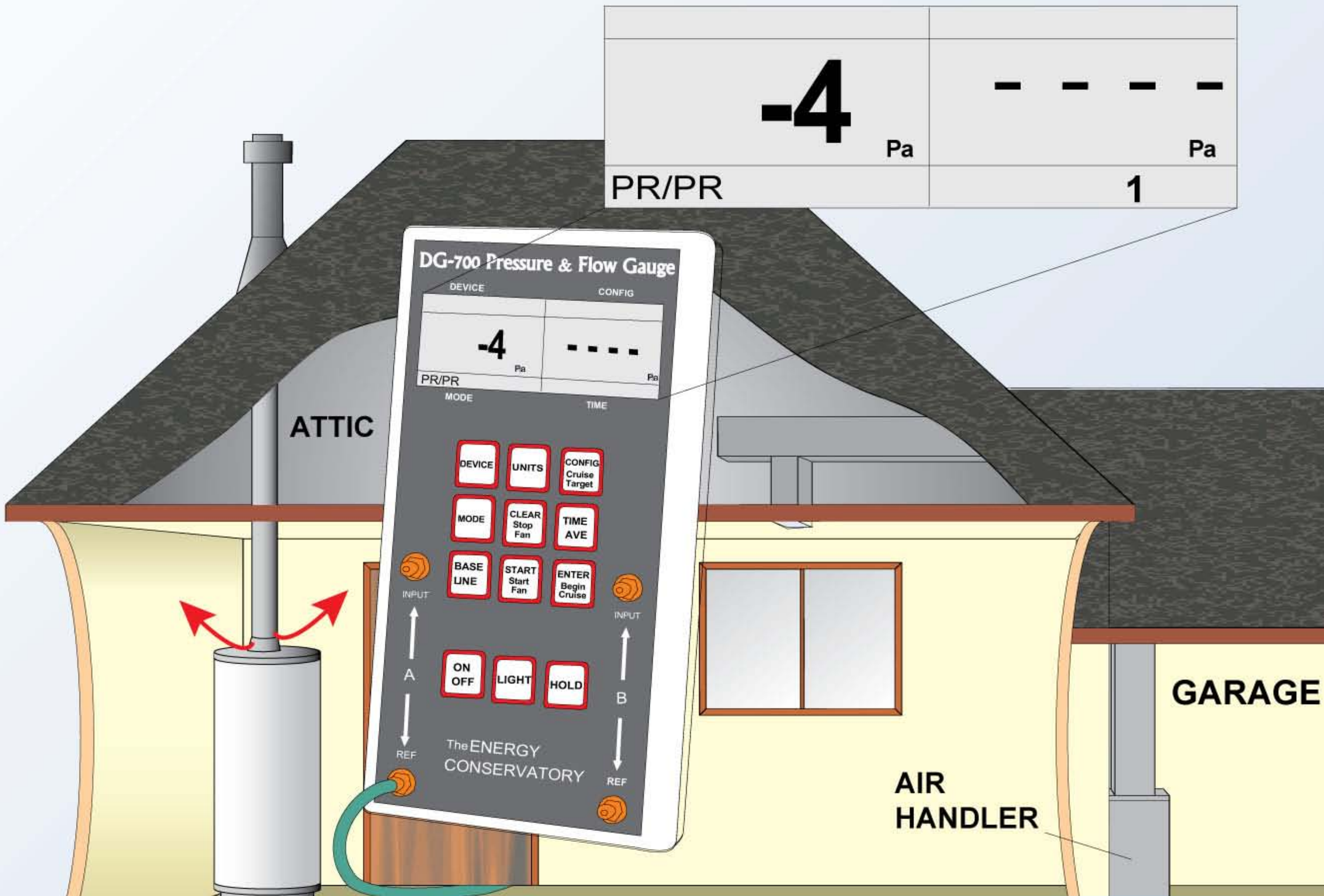
3. Read baseline pressure in the CAZ on side A.

4. For the three conditions outlined below, set up the house as described then read the pressure. How much did it change? If it went down by 3 Pa or more compared to baseline, there may be a risk of backdrafting

A) Turn on the air handler

B) Close Interior Doors

C) Turn on all exhaust appliances such as fans and dryer (note: this step is not required by PTCS)



Net Depressurization Example

"Net" equals how much the pressure goes down when the air handler is turned ON (compared to baseline).

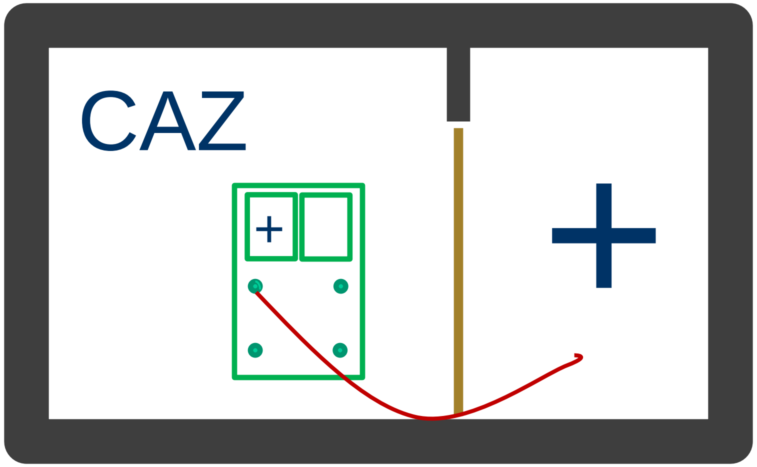
Air Handler ON Reading — -3 Pa -2 $\boxed{-1}$ 0 1 2 $\boxed{3\ \text{Pa}}$ — Air Handler OFF Baseline Reading

Net Depressurization is -4 Pa

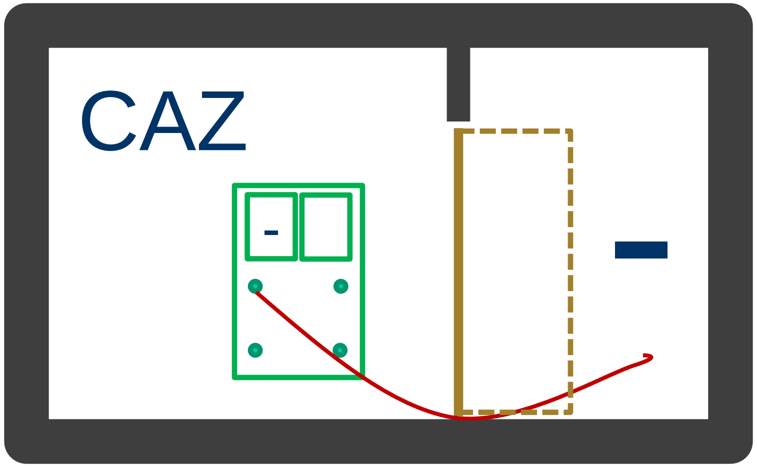
Setting Up the CAZ Test

If zone behind closed door is

Positive WRT CAZ
Leave door closed

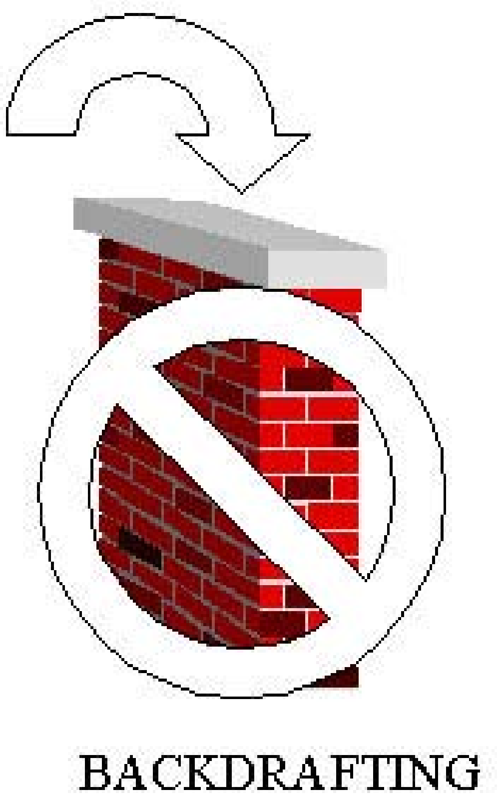


Negative WRT CAZ
Open door



Fixing The Problem

- Make more holes in the house
- Push more air into the house
- Suck more air out of the venting system
- Get rid of the back drafting appliance
- Get rid of the source of depressurization

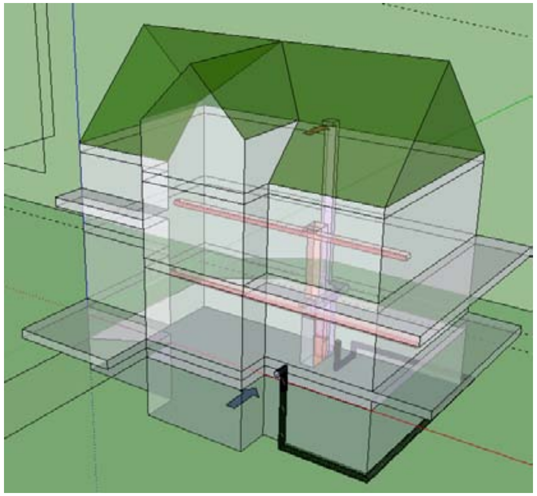


Removing the Source of Depressurization

- Seal holes in top of building
- Seal return duct leaks in the CAZ
- Seal supply leaks outside the envelope of the house
- Eliminate high speed on oversized kitchen fans

Combustion Appliance Zone Pressure Test Example

Baseline in CAZ	-3 Pa	<u>Adjusted</u>
Air Handler On	-4 Pa	-1 Pa
Basement Bath Fan	-6 Pa	-3 Pa
1st Floor Bath Fan	-8 Pa	-5 Pa
Kitchen Fan	-14.5 Pa	-11.5 Pa
2nd Floor Bath Fan	-17 Pa	-14 Pa
Clothes Dryer	-19 Pa	-16 Pa



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House Depressurization Limits (HGL) Per EC

Appliance Type	Depressurization Limits
Individual Natural Draft Water Heater (WH)	2 Pa
Natural Draft WH & Natural Draft Furnace or Boiler	3 Pa
Natural Draft WH & Induced Draft (ID) Furnace/Boiler	5 Pa
Individual Natural Draft Furnace/Boiler	5 Pa
Individual ID Furnace/Boiler	15 Pa
Power Vented & Sealed Combustion Appliances	>25 Pa

From the Minneapolis Blower Door Operation Manual
published by the Energy Conservatory

PTCS Duct Training – New Construction

Blower Door Test

A Code Required Test
(for all homes)

PTCS
Performance Tested
Comfort Systems

The Blower Door

Blower Door

Measure how much air leaks through cracks and ducts

If the fan is blowing 2,000 cfm out of the house, and it’s staying at the same pressure (-50 Pa), there must be 2,000 cfm of air leaking through holes in the house

Source: PTCS

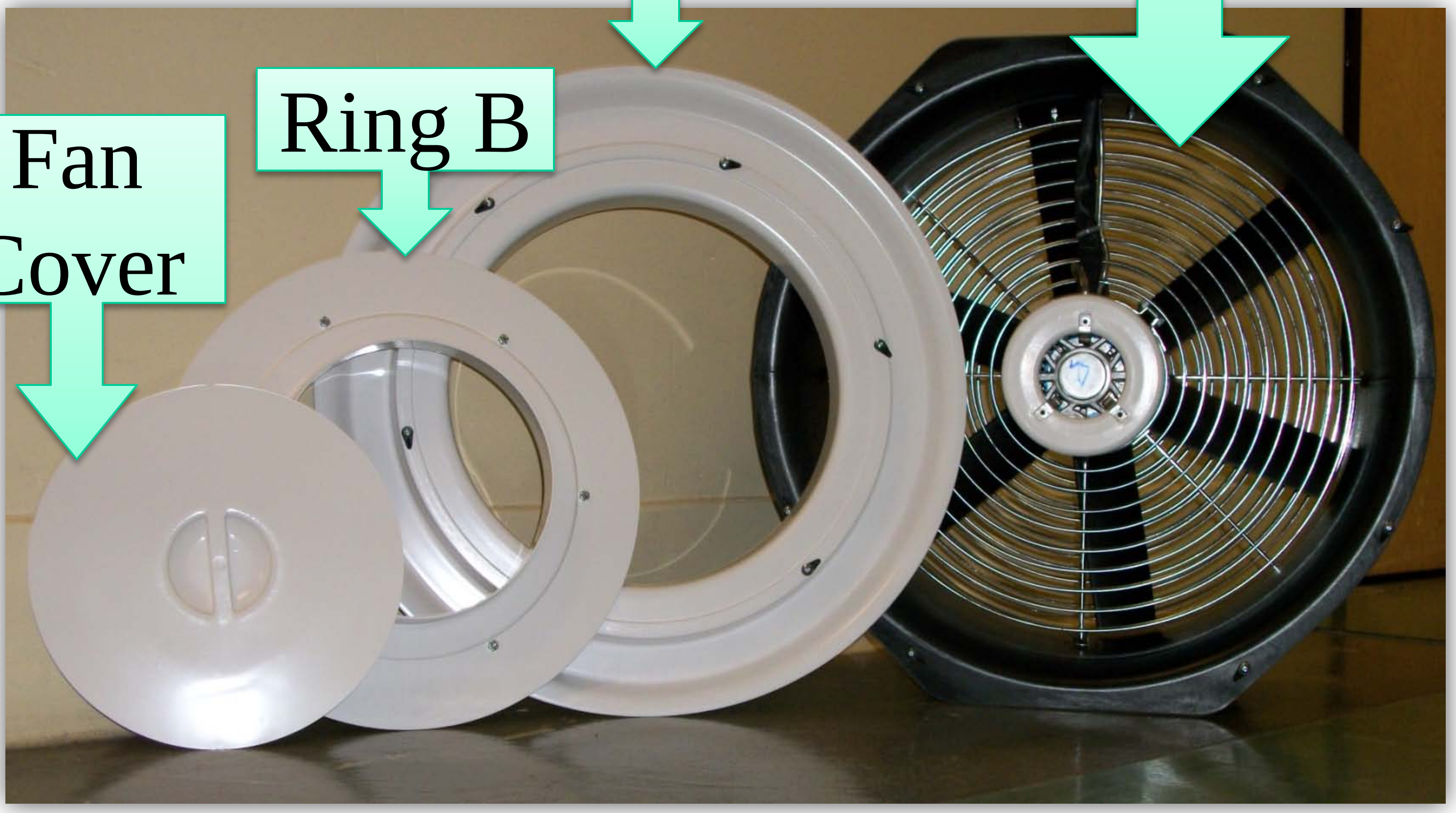
NCAT

Typical House Tightness Levels

	ACH50	CFM 2000 SF
Older Homes	10+	>2600
Typical New Home ~2000	7	1800
2009 IECC Tightness Limit Zone 6	7	1800
Montana State Energy Code	4	1050
Proposed MT State Energy Code	4	1050
Energy Star Homes	4	1050
Idaho New Homes 2013	3.6	930
2012 IECC Tightness Limit Zone 6	3	800

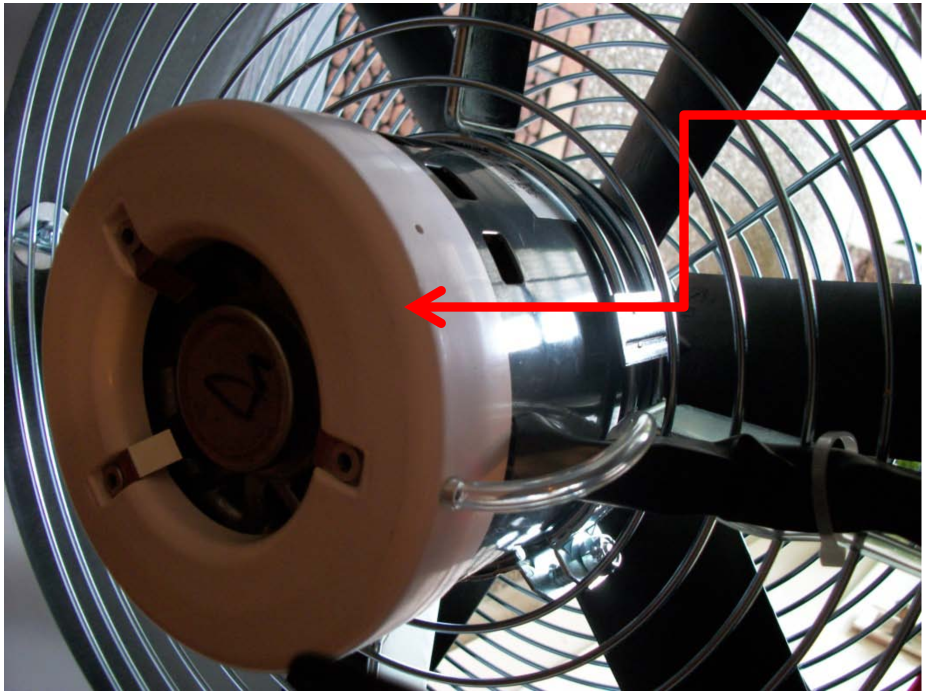
Example based on 2,000 Ft^2 house with n = 14.5.

The Blower Door Parts - Rings



The Blower Door – The Skin

Blower Door Parts – the Pressure Sensor Ring



Pressure sensor on front side of fan

Manometer measures pressure difference

The higher the pressure drop, the bigger the flow

Given the same configuration (ring size) the higher the pressure, the bigger the flow

Higher Pressure = More Flow

The Measurement

Pressurizing the House

Pressure x hole size = flow

Energy Conservatory Blower Door Model 3	
Fan Configuration	Flow Range (CFM)
Open Fan	6300 – 2430
Ring A	2800 – 915
Ring B	1100 – 300
Ring C	330 – 85

The larger the opening, the greater the flow.

Safety Mandates

1. Do not use the blower door if you see one of these!
   - Fire (Pressurize the home = blast furnace)
   - Ash (Depressurize the home = ashes spread)
2. All gas appliances (combustion furnaces and water heaters) must be off (set it to pilot)
3. House should be inspected for potential asbestos contamination

Blower Door Test
Depressurizing a House

STEPS

1. Install blower door with fan exhausting air from house. Rings must be to the inside of the house.

2. Connect hoses as shown.

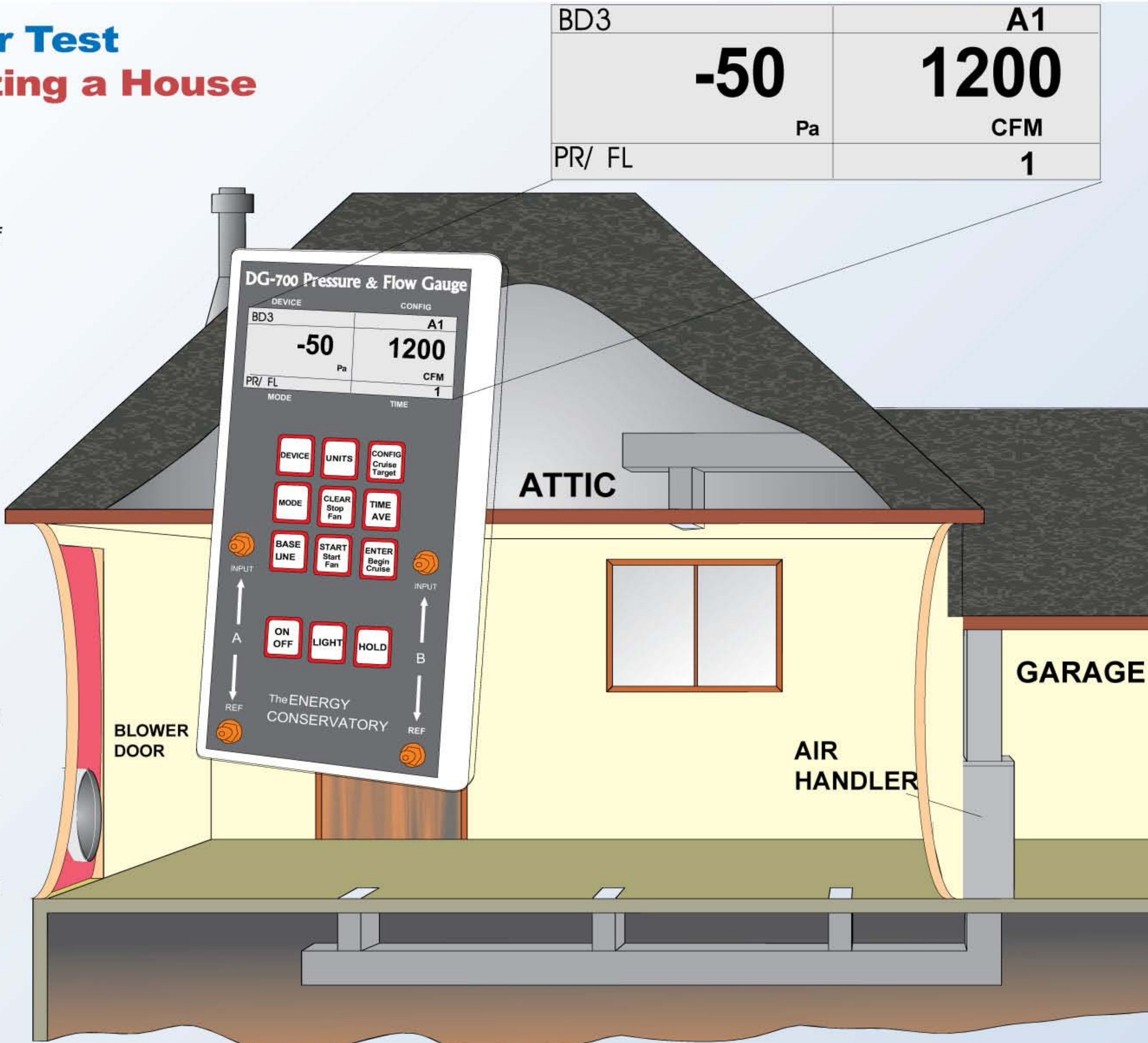
3. Manometer MODE should read PR/FL, CONFIG should reflect ring used (open, A,B, or C), and DEVICE should reflect BD3.

4. Open all interior doors. Close all exterior doors and windows.

5. Turn OFF airhandler, dryer, all fans and combustion equipment.

6. Turn on blower door, depressurize house to -50 Pascals (side A reading), +/- 0.5 Pa. (hint: canvas should be bulging inward). Use the smallest ring possible to get to -50 Pa. If you have to change the ring, be sure to reflect that in the manometer CONFIG setting.

7. Record reading on side B. This is your house cfm leakage at 50 Pa.



One-point and Multi-point Blower Door Test Procedures

(assumes DG-700)

- Perform baseline measurement (with fan sealed)
- Choose and install appropriate flow ring
- Select Device in DG-700 (i.e., BD-3)
- Select flow ring configuration in DG-700 (i.e., A1)

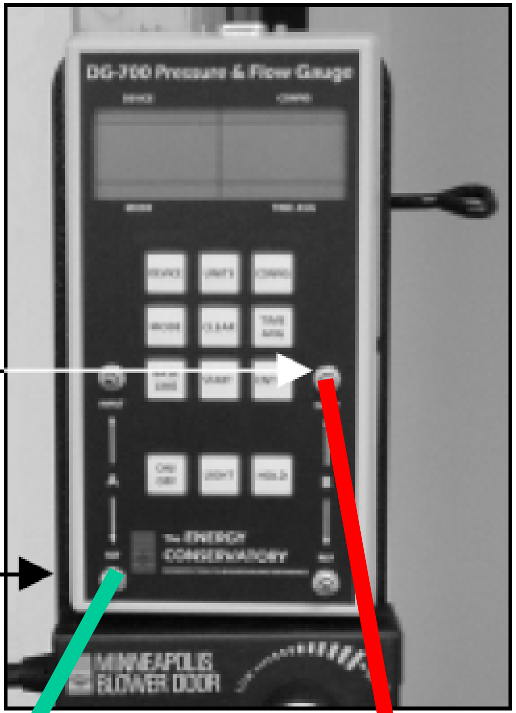
For One-point Test choose a mode setting of PR/FL@50, increase fan speed until channel A is to within 5 Pa of 50, Channel B will display the one-point leakage estimate.

For Multi-point test take readings such as 60, 50, 40, 30 Pa, use Tectite software to correlate data, use during windy periods or if greater accuracy is desired.

Blower Door De-pressurization Test

Connect the **Red** tubing to the Channel B Input tap. ***<u>Channel B is used to measure Fan pressure and flow.</u>***

Connect the **Green** tubing to the Channel A Reference tap. ***<u>Channel A is used to measure building pressure with reference to outside.</u>***



To Fan

To Outside

Can’t Reach Fifty Factor

For DG-700 users, adjustment is made automatically if performing a one point test in PR/FL@50 mode

For DG-3 users if you can’t depressurize house to 50 Pa with an open fan then adjust measured air flow with CRF

Example: House can only be depressurized to 28 Pa with measured fan flow of 5,600 CFM.

CRF = 1.46 so adjusted flow is

5,600 x 1.46 = 8,176 CFM

Table 2: Can't Reach Fifty Factors

Building Pressure (Pa)	CRF Factor	Building Pressure (Pa)	CRF Factor
48	1.03	28	1.46
46	1.06	26	1.53
44	1.09	24	1.61
42	1.12	22	1.71
40	1.16	20	1.81
38	1.20	18	1.94
36	1.24	16	2.10
34	1.28	14	2.29
32	1.34	12	2.53
30	1.39	10	2.85

Blower Door Math

To calculate air changes per hour at 50 Pa:

$$ACH_{50} = \frac{CFM_{50} \text{ x } 60}{\text{House Volume}}$$

The volume is cubic feet enclosed by the conditioned space boundary.

To convert air change rate at 50 Pa to the air change rate at natural conditions:

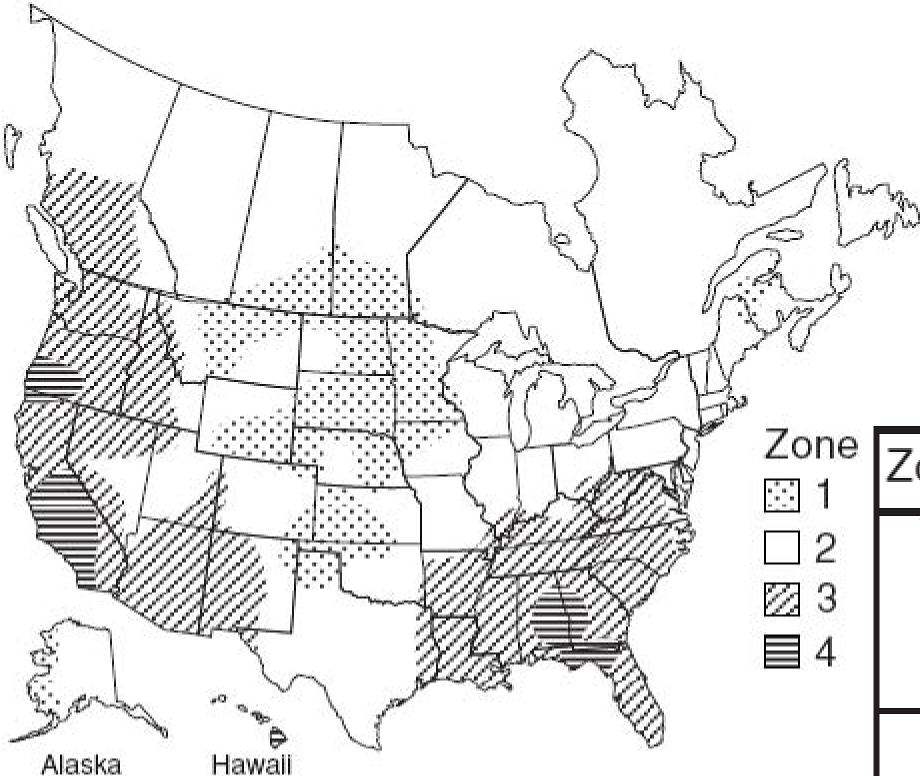
$$ACH_{nat} = \frac{CFM_{50} \text{ x } 60}{\text{n x House Volume}}$$

n – The correlation factor shown on the following slide.

NCAT

Converting CFM50 to Air Change Values

(Provides Approximate Values)



$$ACH_n = \frac{ACH_{50}}{n}$$

$$ACH_{50} = ACH_n \times n$$

$$CFM_n = \frac{CFM_{50}}{n}$$

$$CFM_{50} = CFM_n \times n$$

n-Factor Table

Zone	# of stories →	1	1.5	2	3
1	Well-shielded	18.6	16.7	14.9	13.0
	Normal	15.5	14.0	12.4	10.9
	Exposed	14.0	12.6	11.2	9.8
2	Well-shielded	22.2	20.0	17.8	15.5
	Normal	18.5	16.7	14.8	13.0
	Exposed	16.7	15.0	13.3	11.7
3	Well-shielded	25.8	23.2	20.6	18.1
	Normal	21.5	19.4	17.2	15.1
	Exposed	19.4	17.4	15.5	13.5
4	Well-shielded	29.4	26.5	23.5	20.6
	Normal	24.5	22.1	19.6	17.2
	Exposed	22.1	19.8	17.6	15.4

Leakage Area Estimates

An alternative means of quantifying building tightness is to estimate the leakage area associated with a specific air flow.

House Air Leakage Area Estimates

1. Divide CFM50 by 10 to get square inches of leakage area. (Simple but approximate)
2. Use TECTITE™ software from the Energy Conservatory with multi-point blower door test.

NCAT

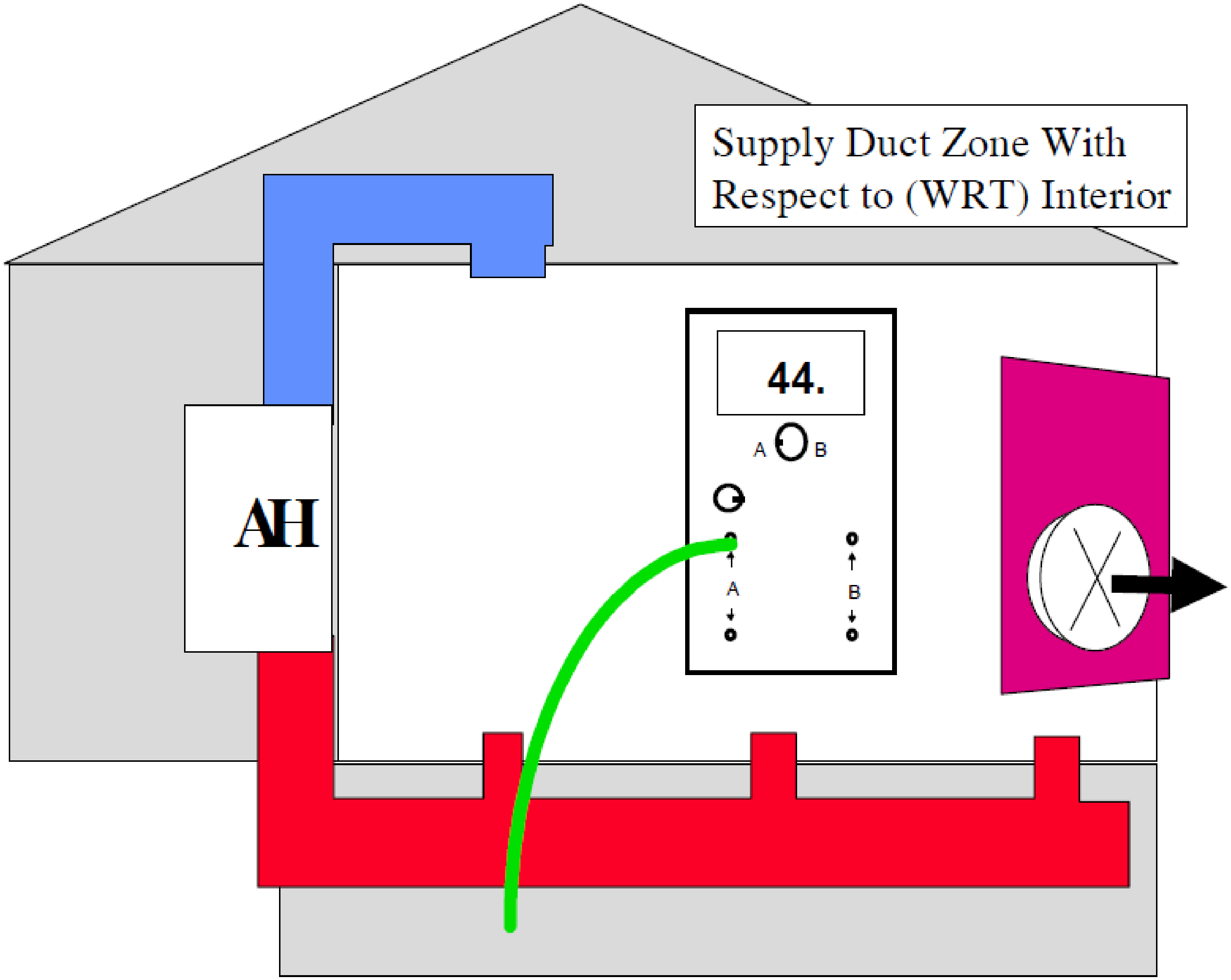
PTCS Duct Training – New Construction

Zonal and Pressure
Pan Test w/ BD Fan

Not a Code Required Test

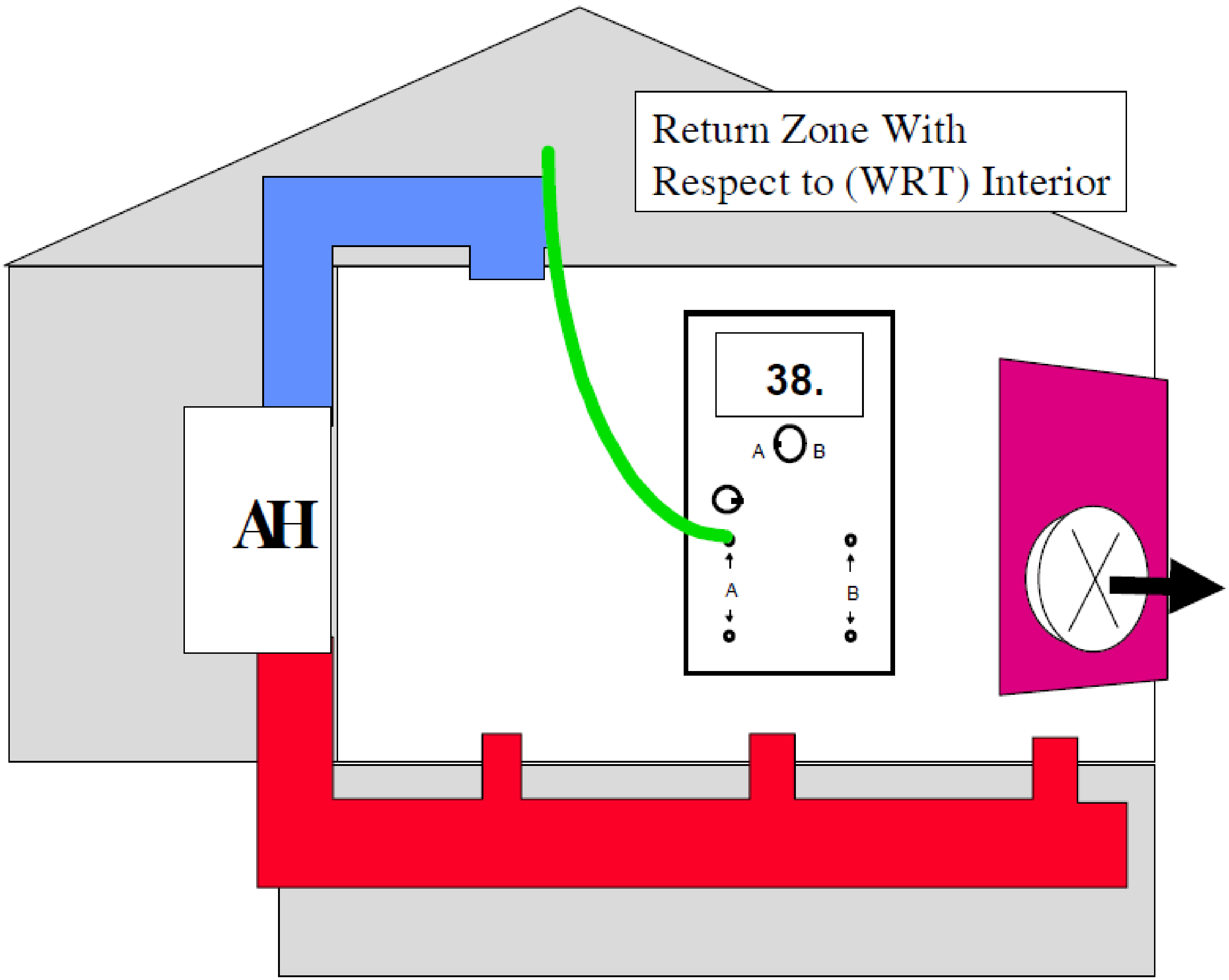
PTCS
Performance Tested
Comfort Systems

Zone Pressure Testing



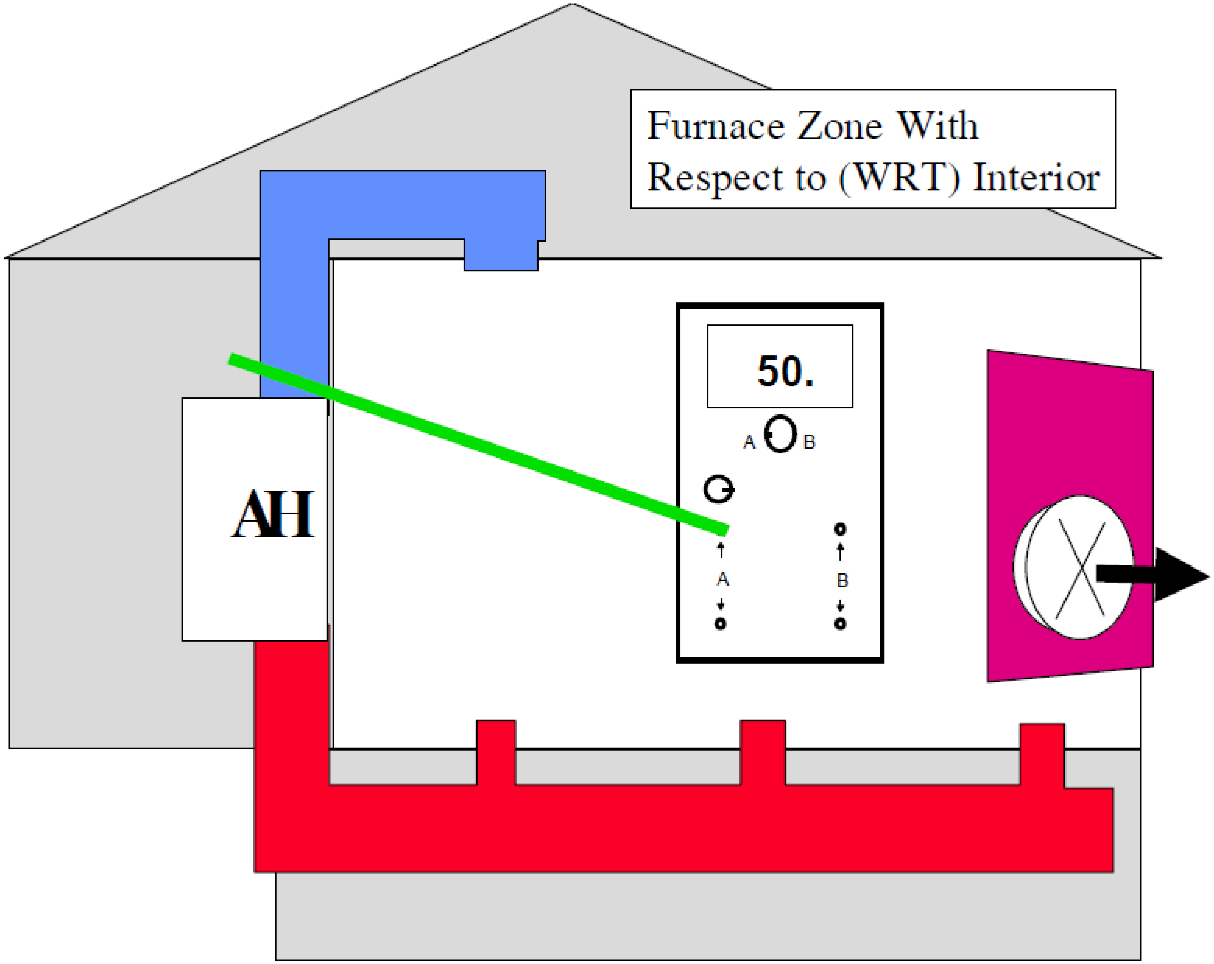
Set Up: Set up house for basic blower door test.

Zone Pressure Testing

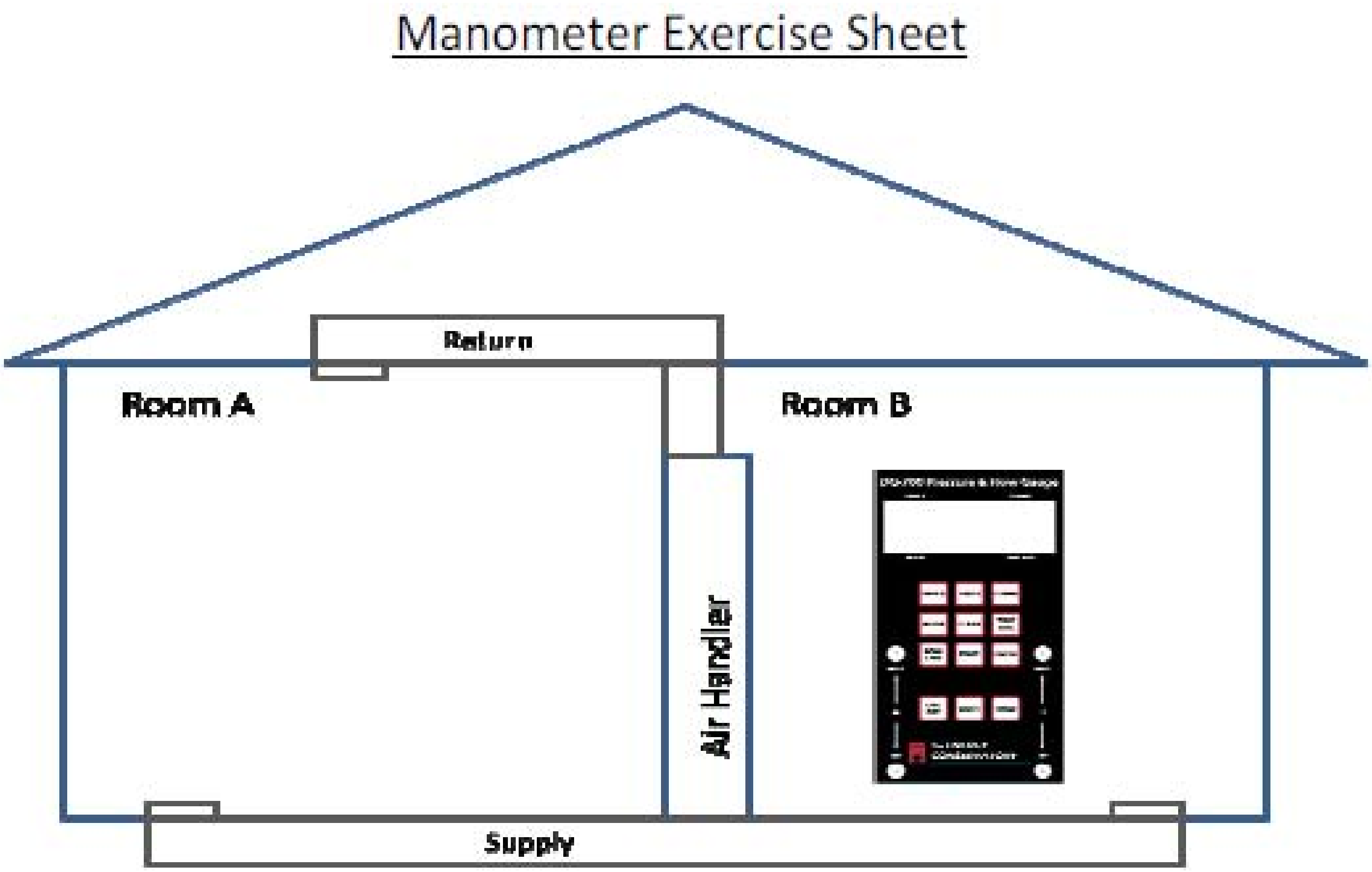


Read Zone Pressure

Example: This Air handler (AH) is totally outside the conditioned area of the house.

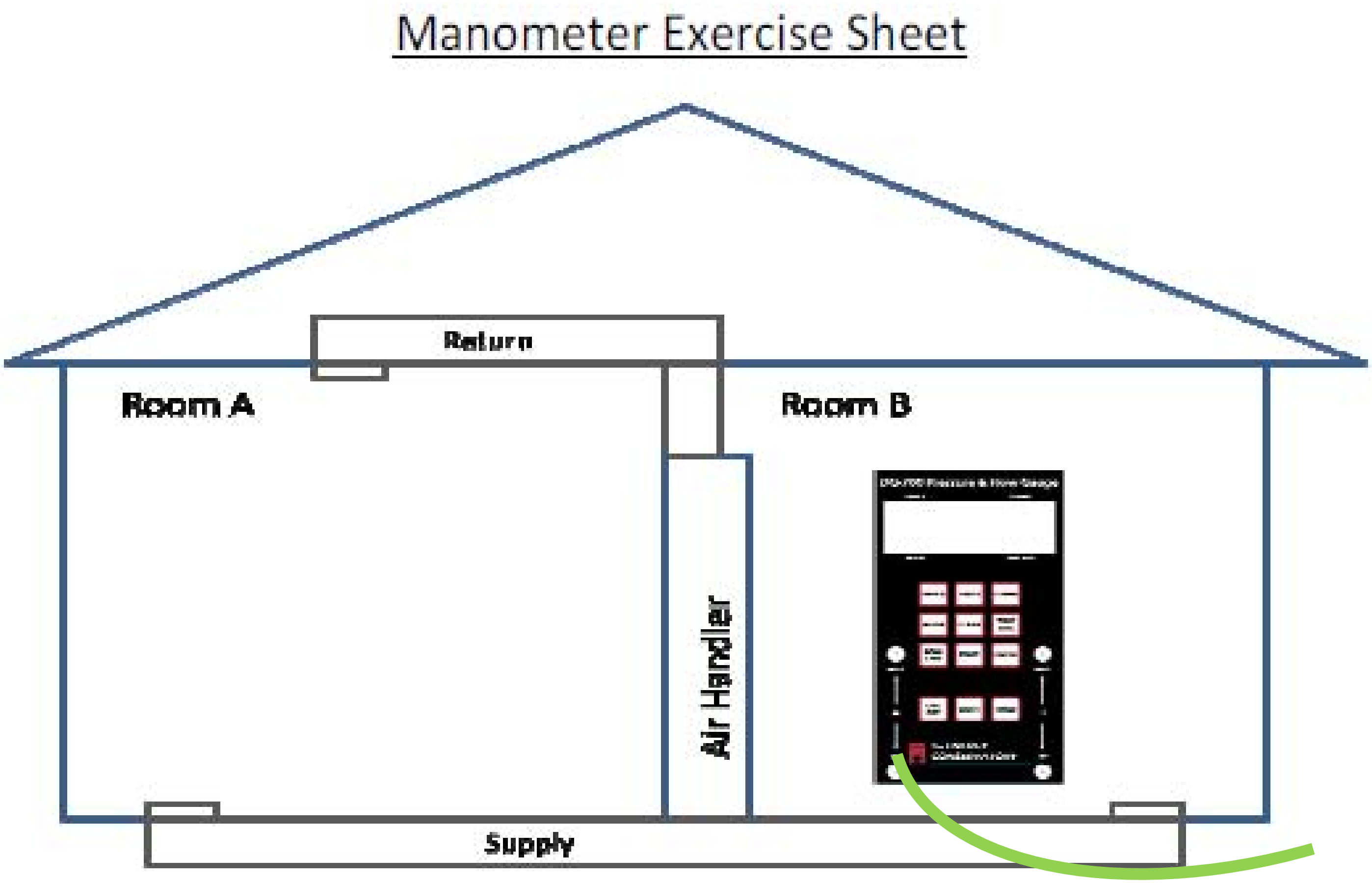


House WRT outside



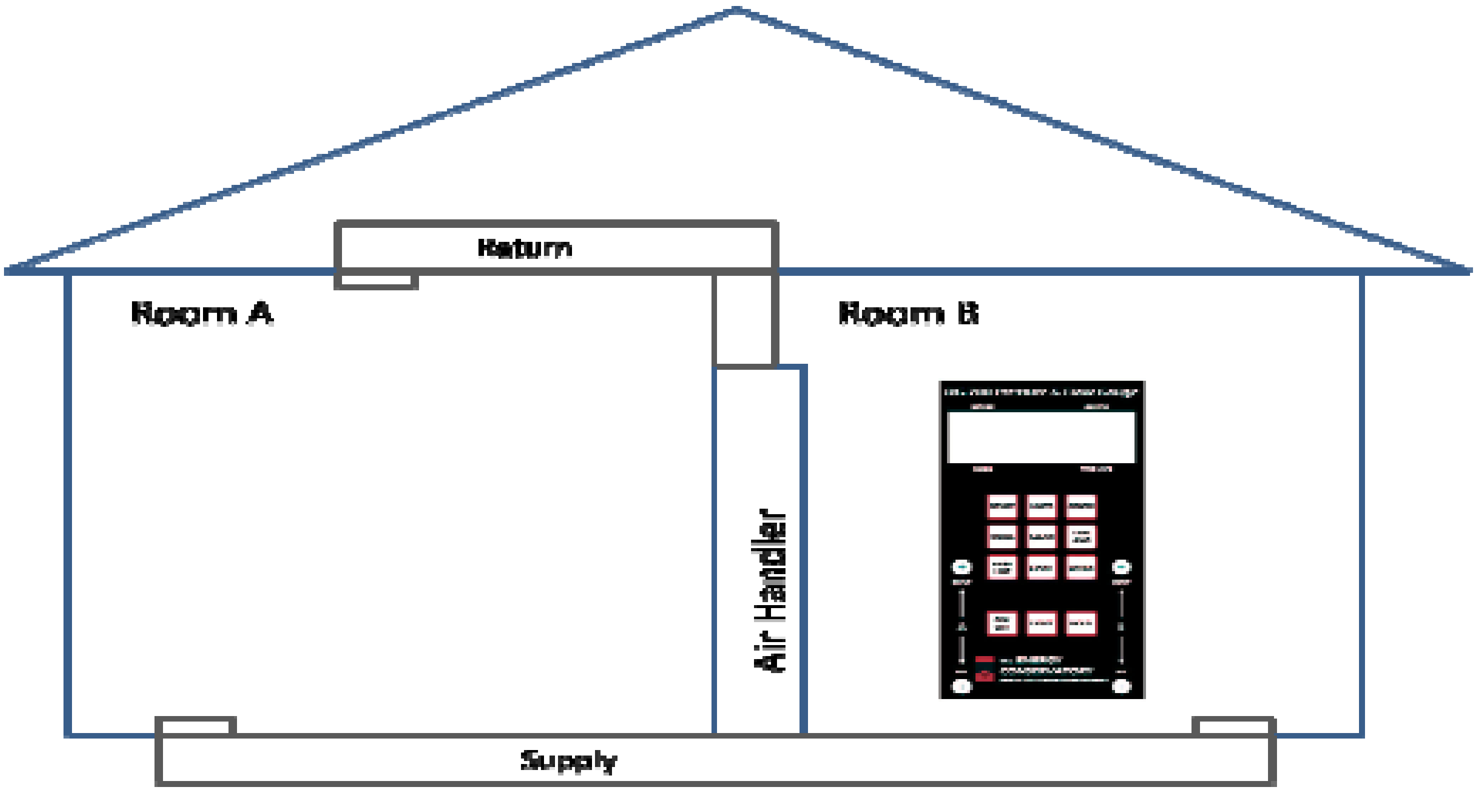
House with reference to outside

House WRT outside



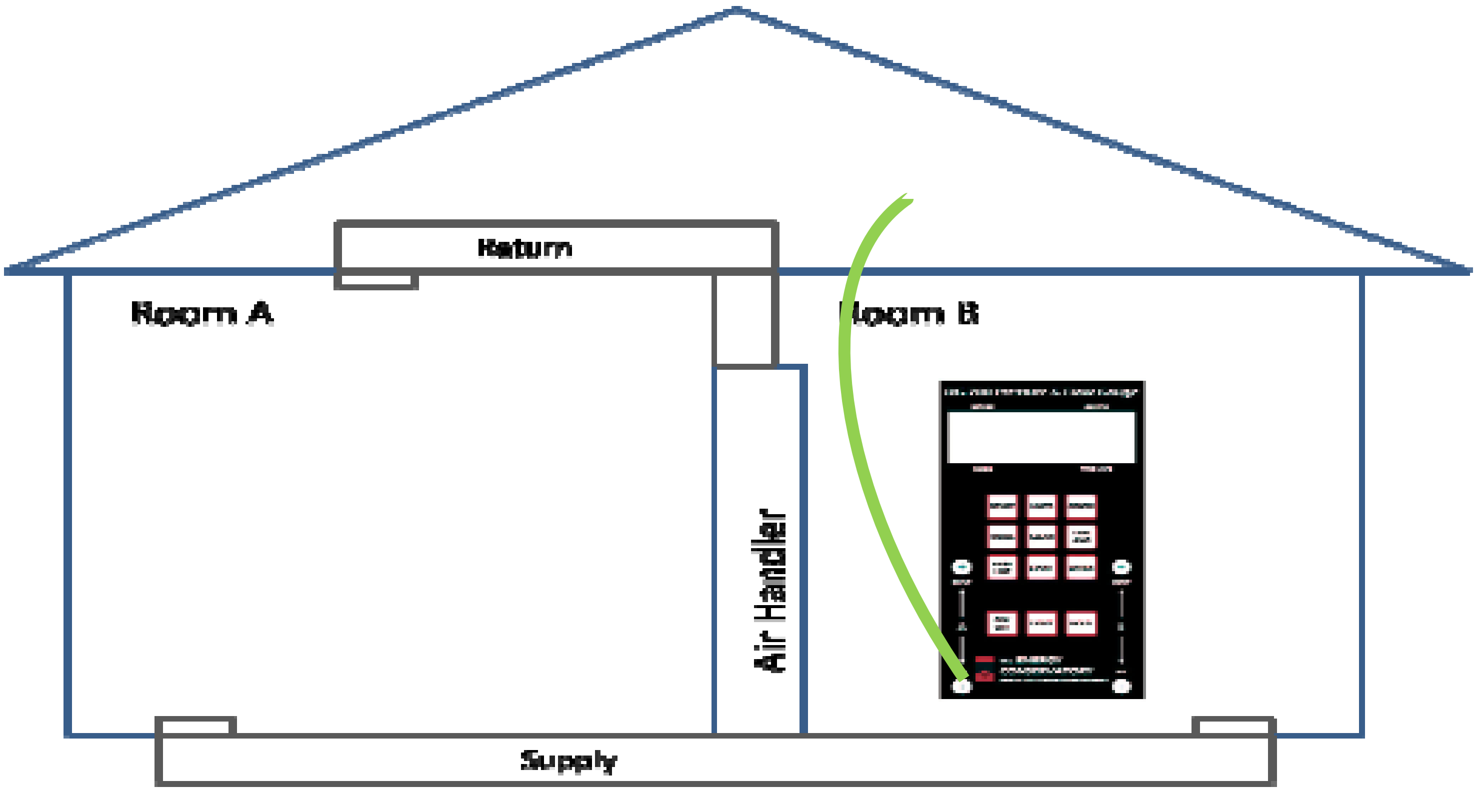
House with reference to outside

House WRT Attic



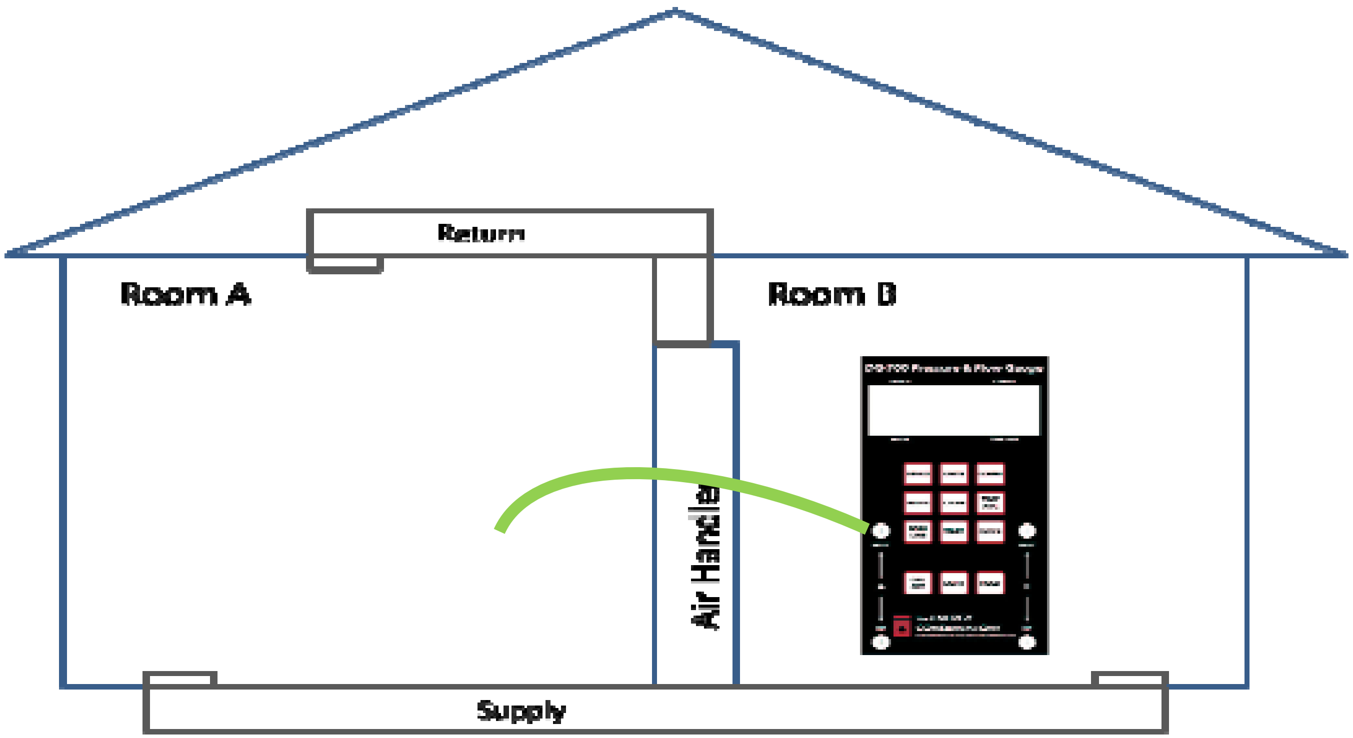
House with reference to attic

House WRT Attic



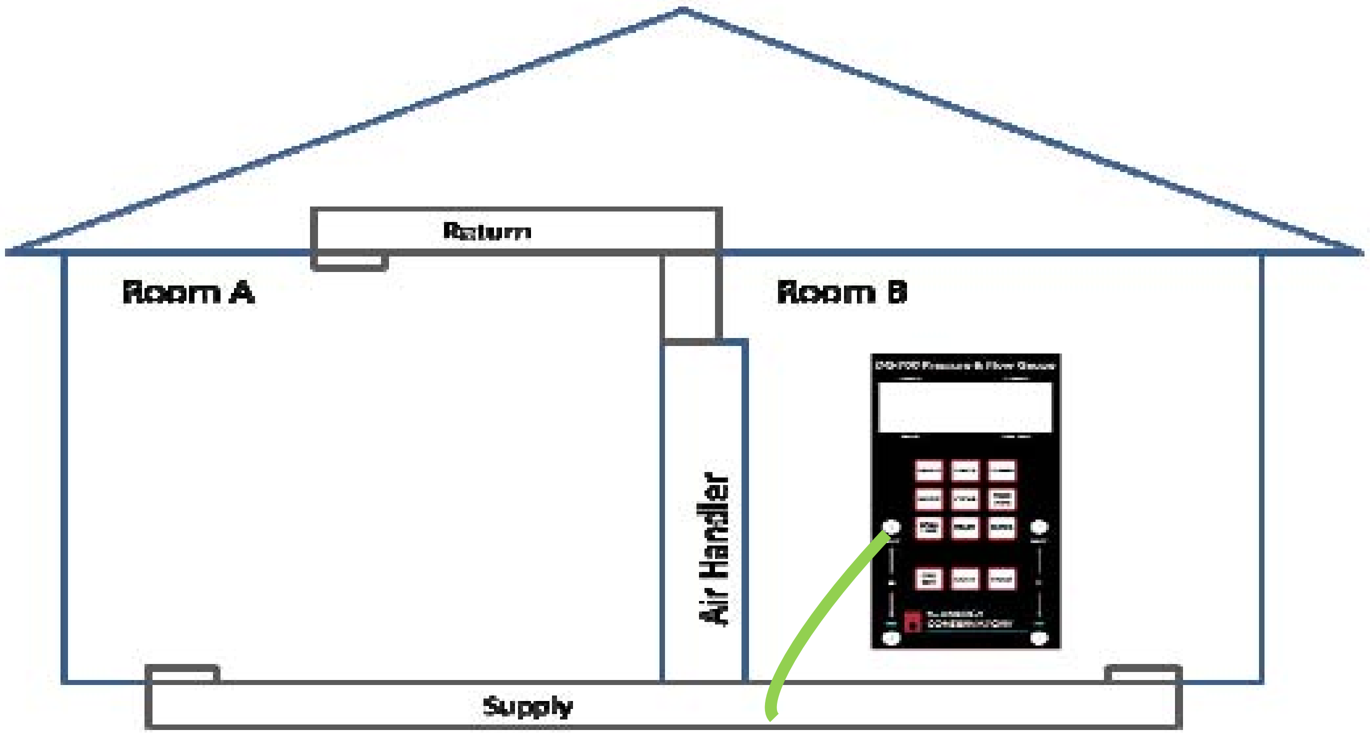
House with reference to attic

Room A wrt Room B



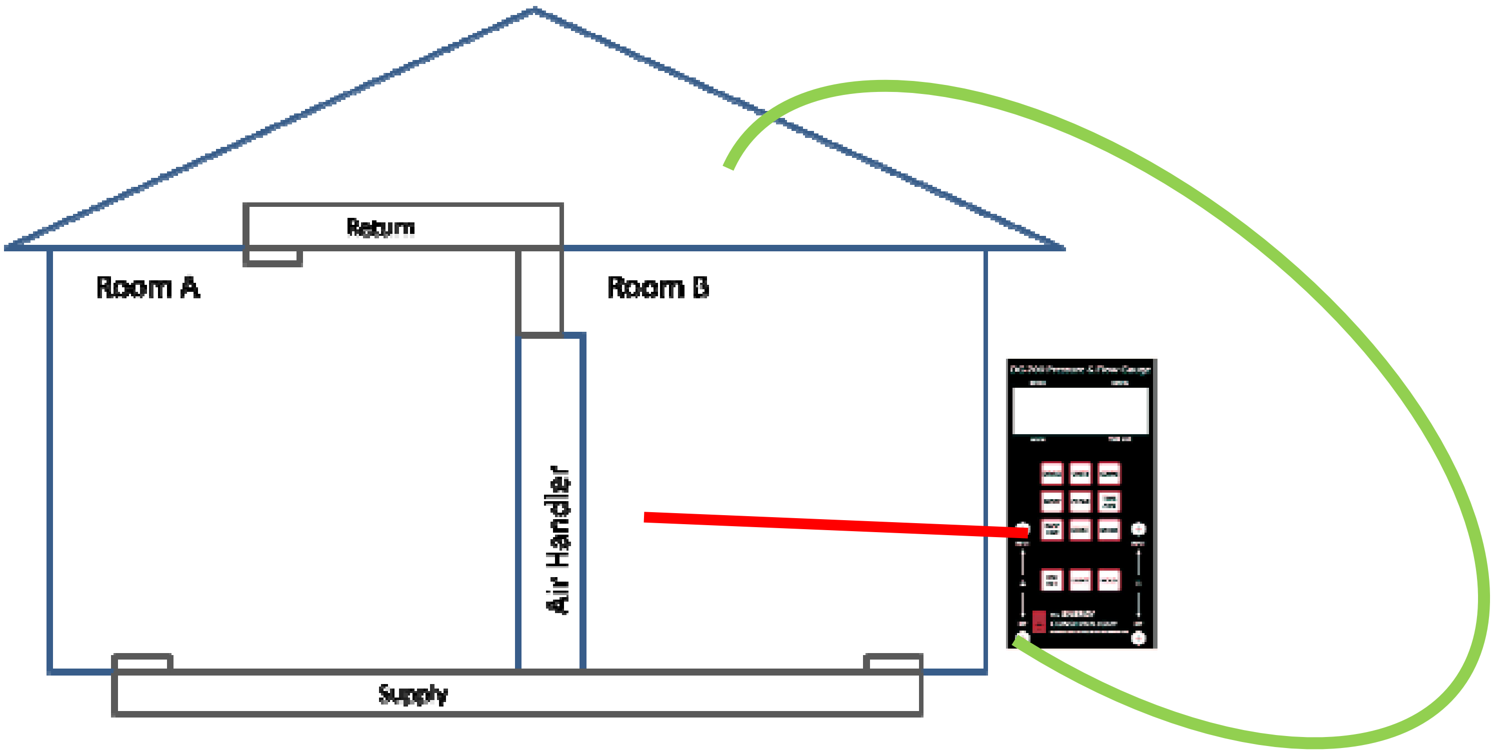
Room A with reference to room B

Supply ducts wrt house



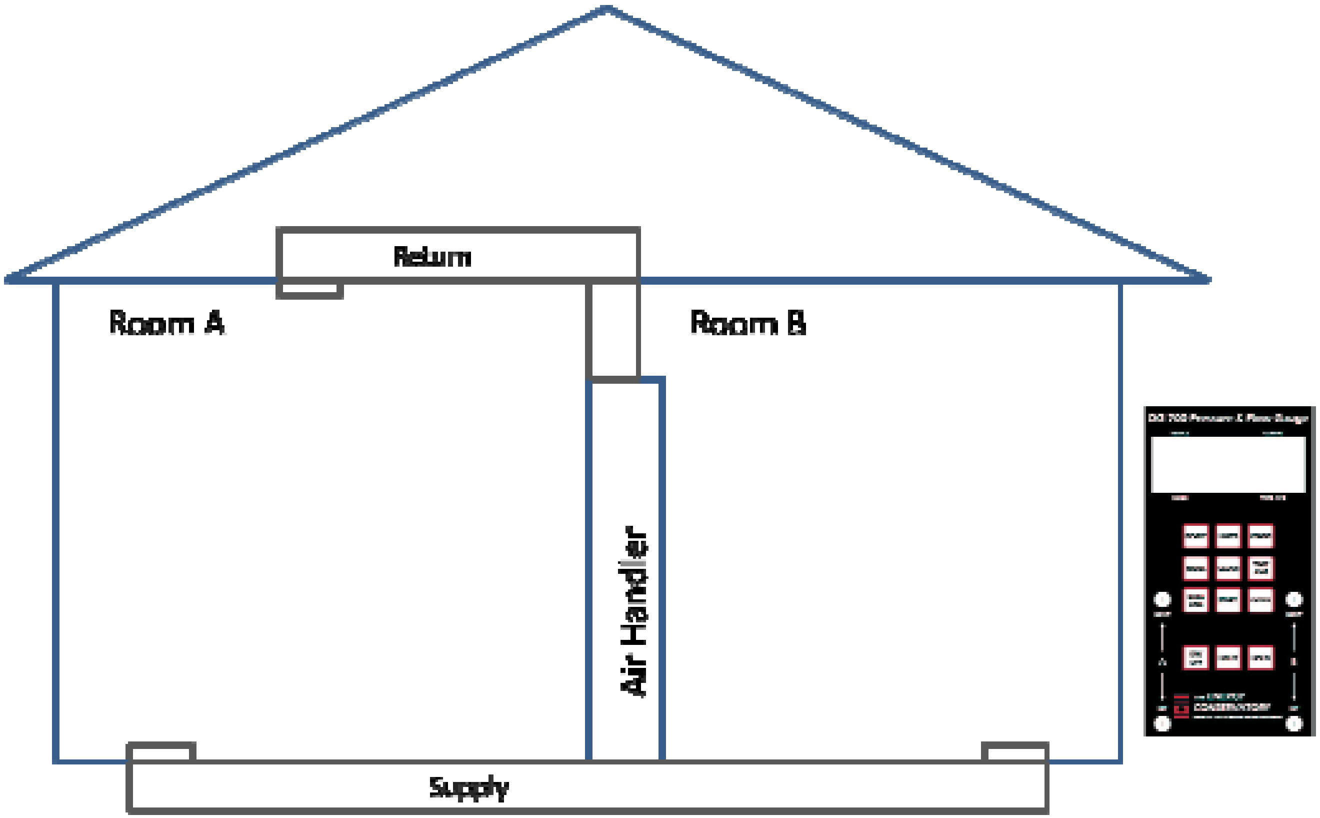
Supply ducts with reference to house

House wrt attic



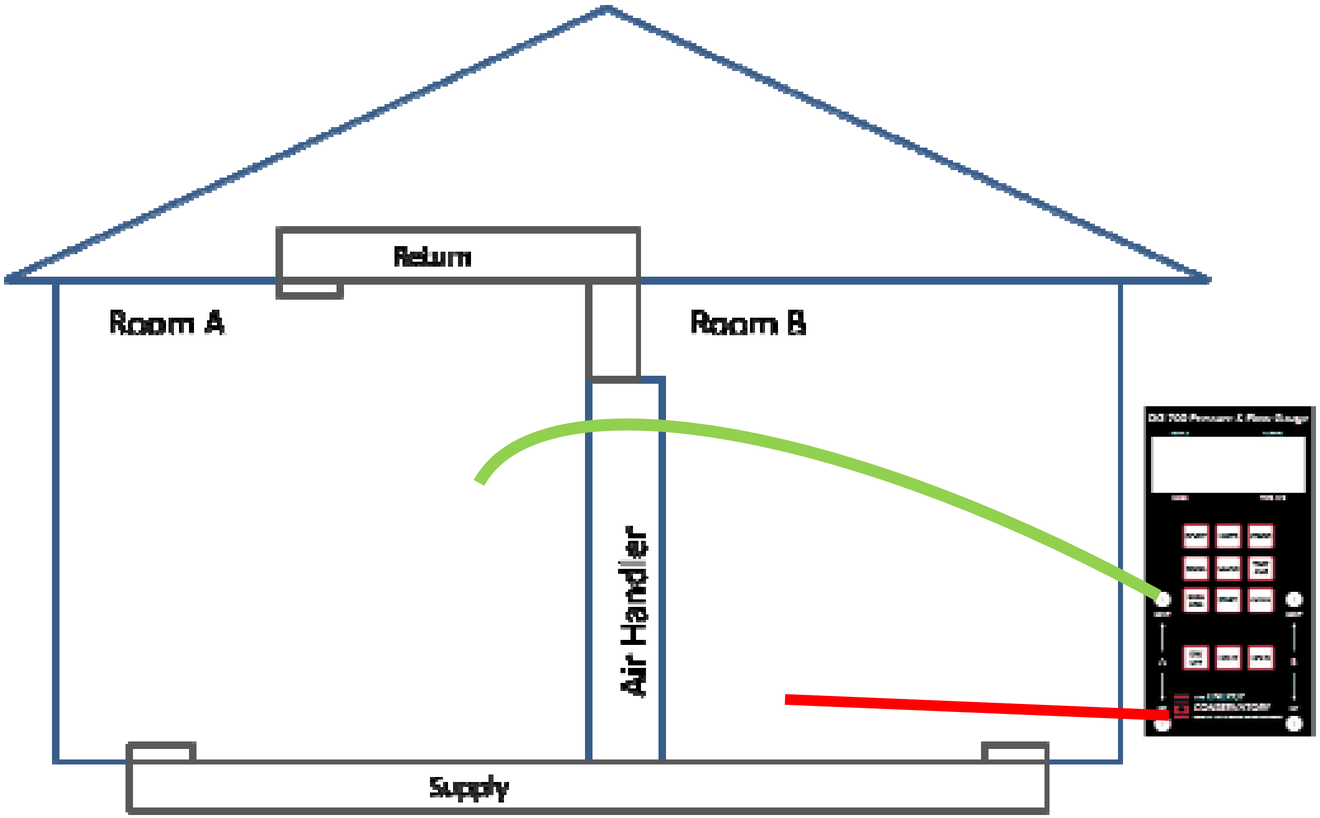
House with reference to attic

Room A WRT Room B



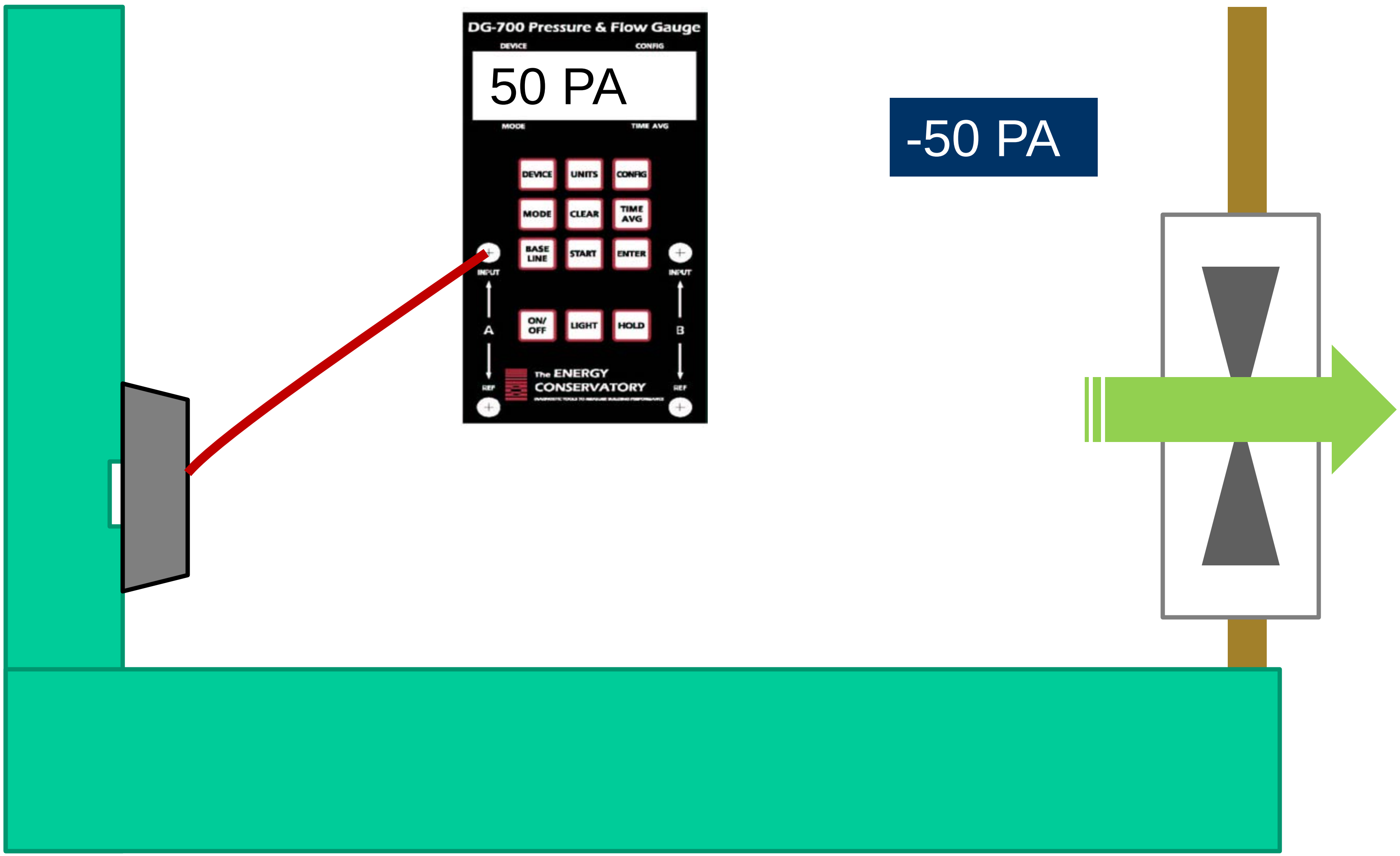
Room A with reference to Room B

Room A WRT Room B

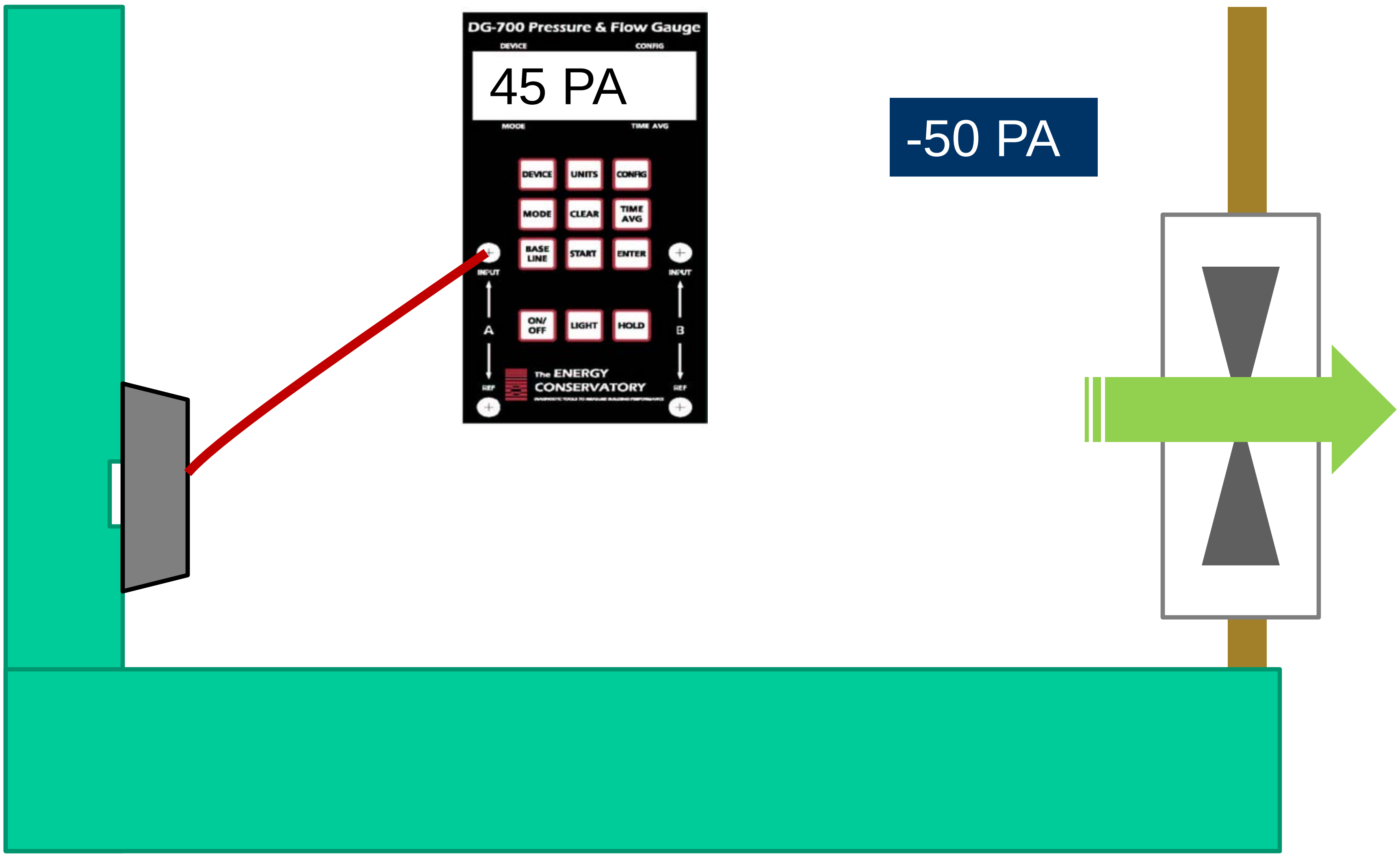


Room A with reference to Room B

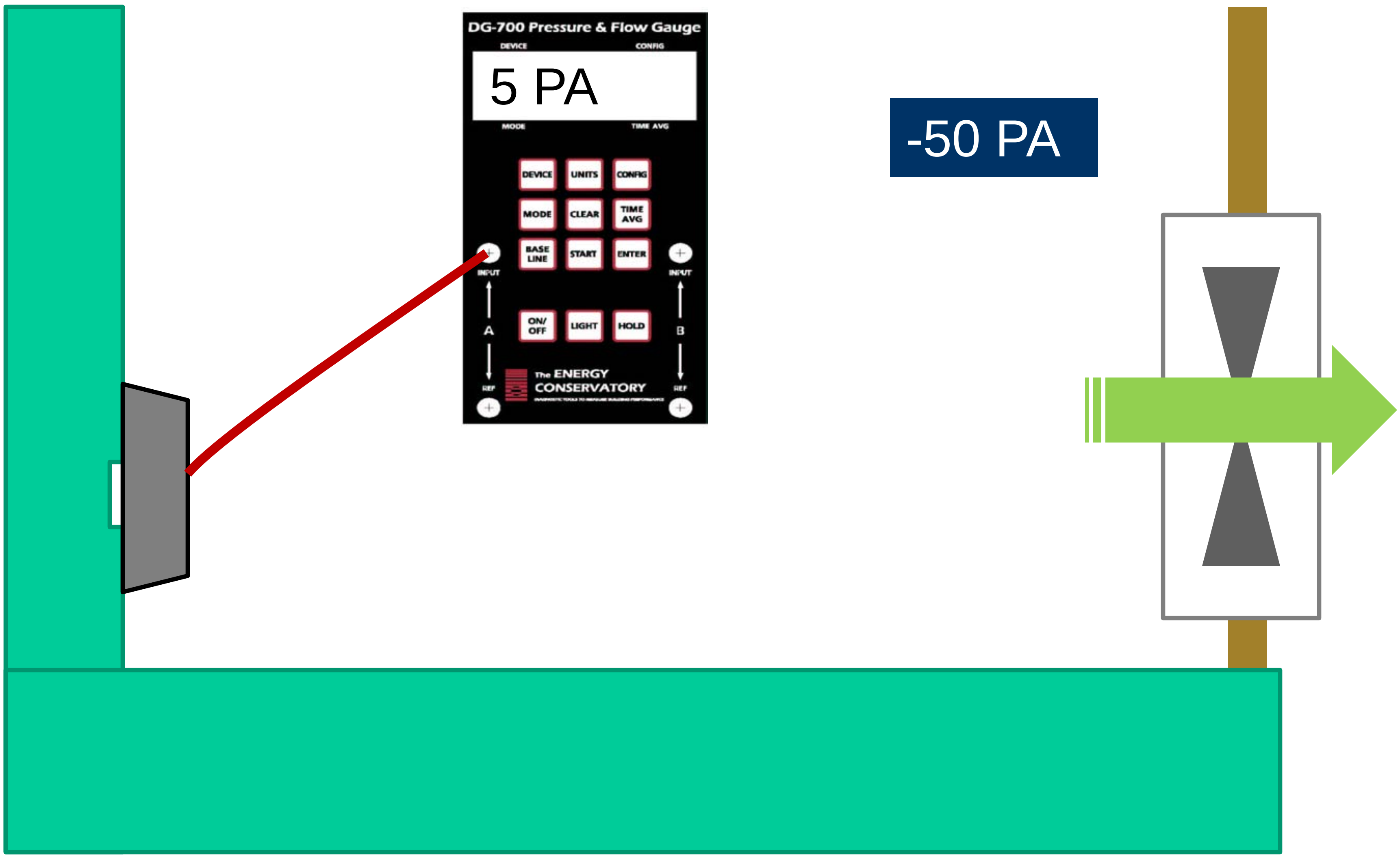
Pressure Pan Test



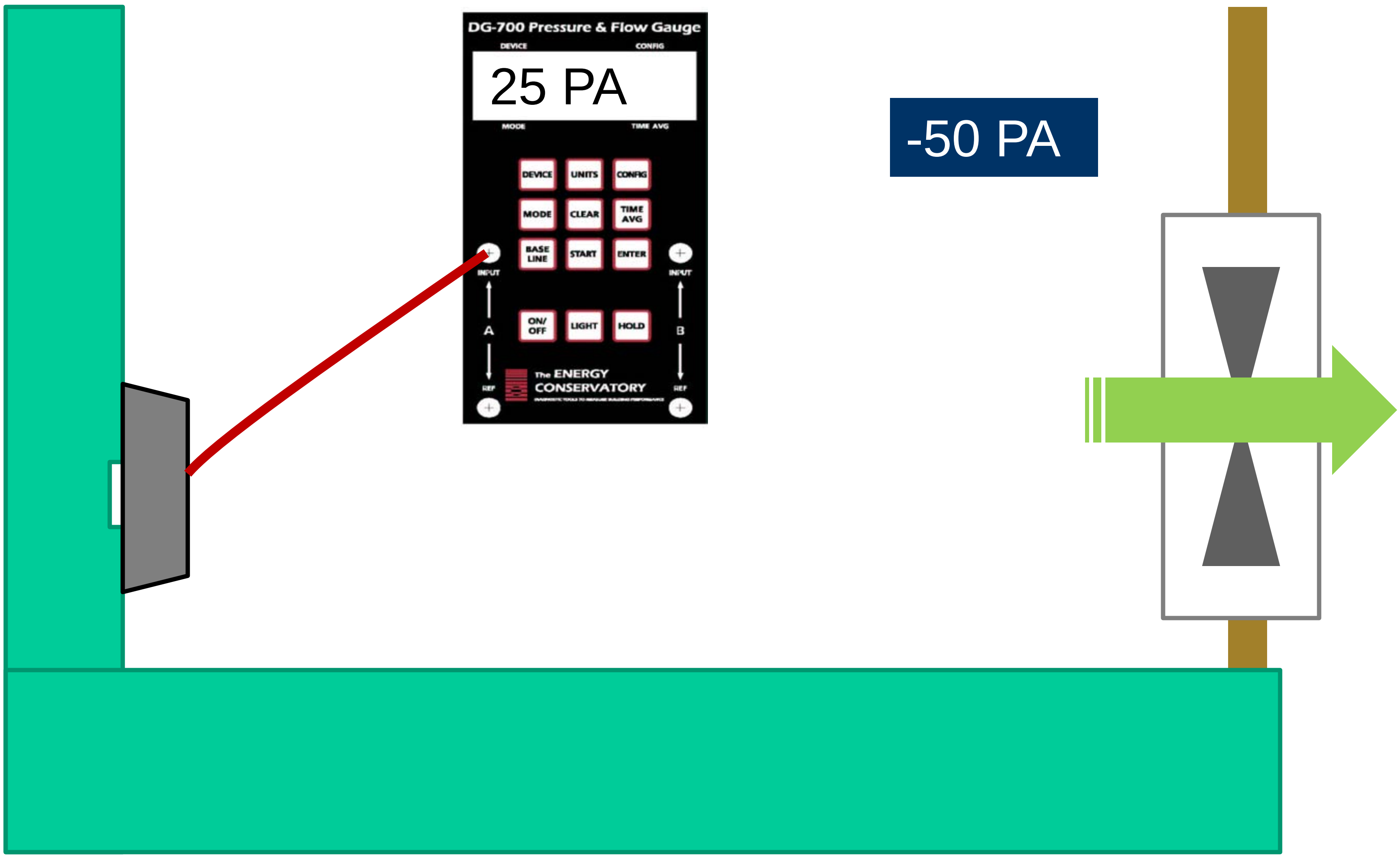
Pressure Pan Test



Pressure Pan Test



Pressure Pan Test



PTCS Duct Training – New Construction

Total Duct Leakage

A Code Required Test
(for some homes)

PTCS
Performance Tested
Comfort Systems

NCAT

Duct Blaster Parts

The Snorkel

The Rings

The Fan

Flow = Pressure x Size of Hole

You control the pressure with the fan speed controller.

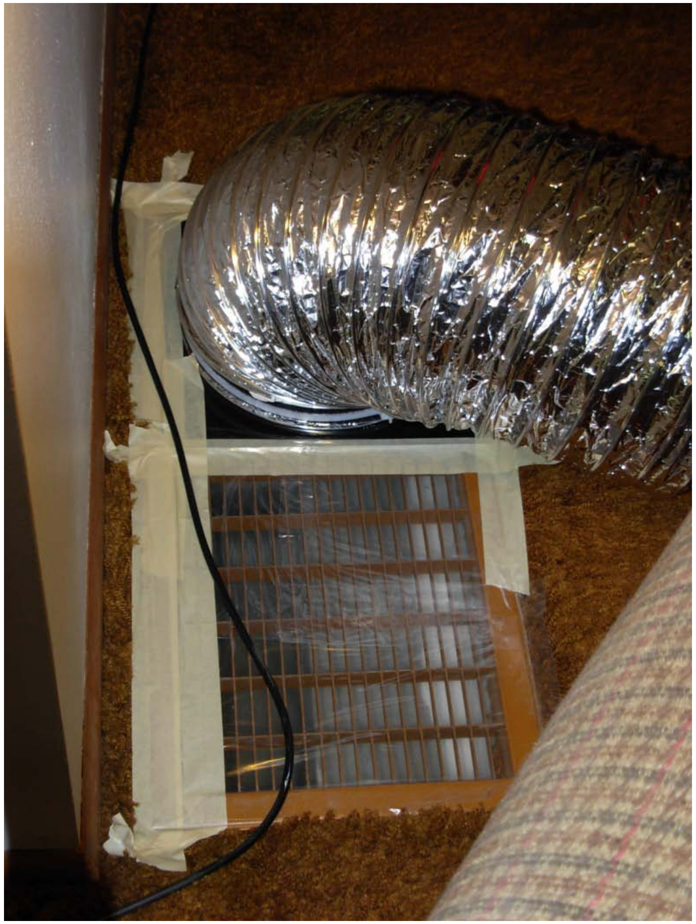
The rings change the size of the hole.

Ring CFM Capacity

Fan Configuration Flow Range (cfm) for Series B DB

Open (no ring)	1,500 – 600 cfm
Ring 1	800 – 225 cfm
Ring 2	300 – 90 cfm
Ring 3	125 – 10 cfm

Total Duct Leakage Test

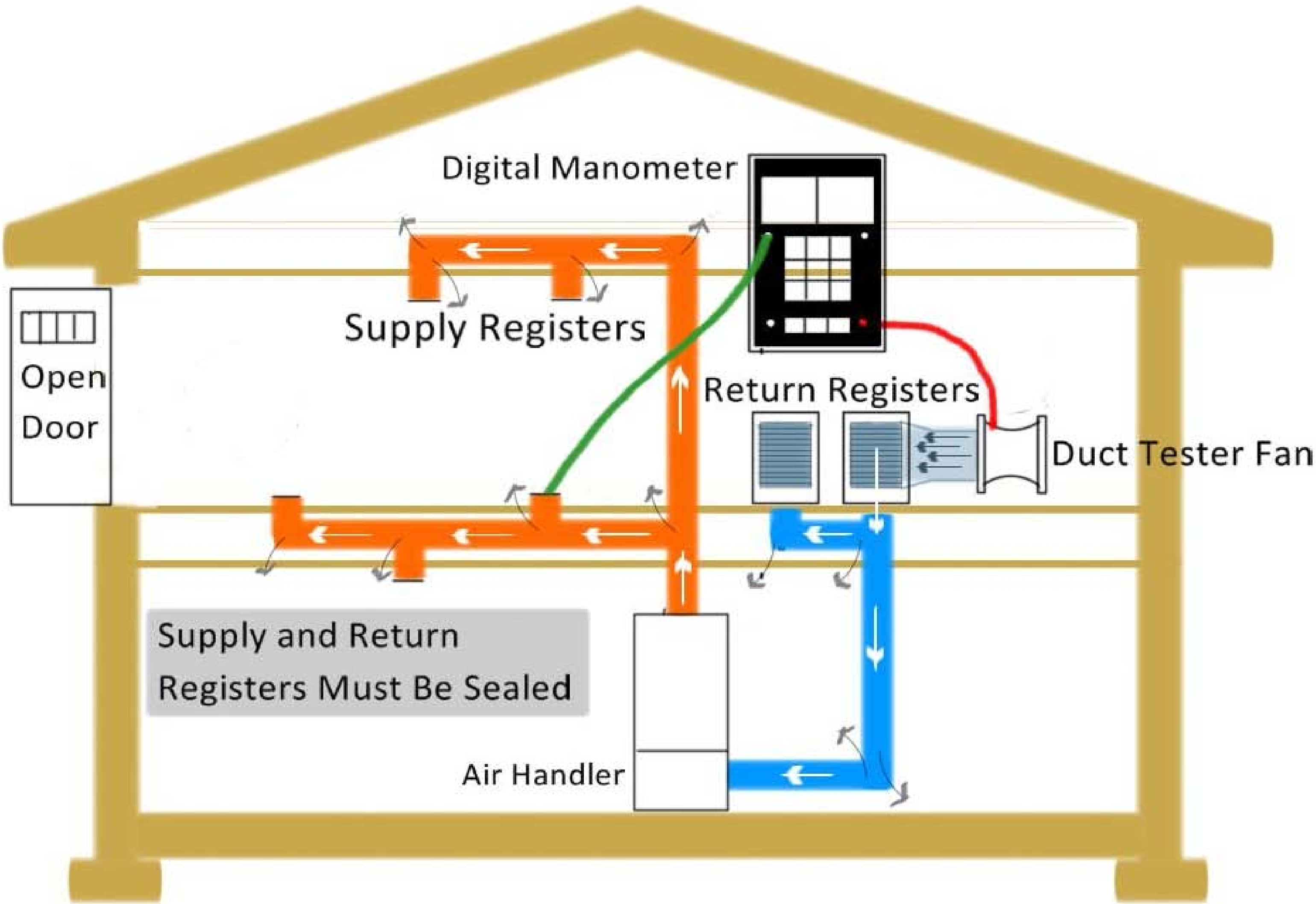


Duct blaster blows air into duct system (increases pressure)

Air blows out the leaks in the system (registers are blocked)

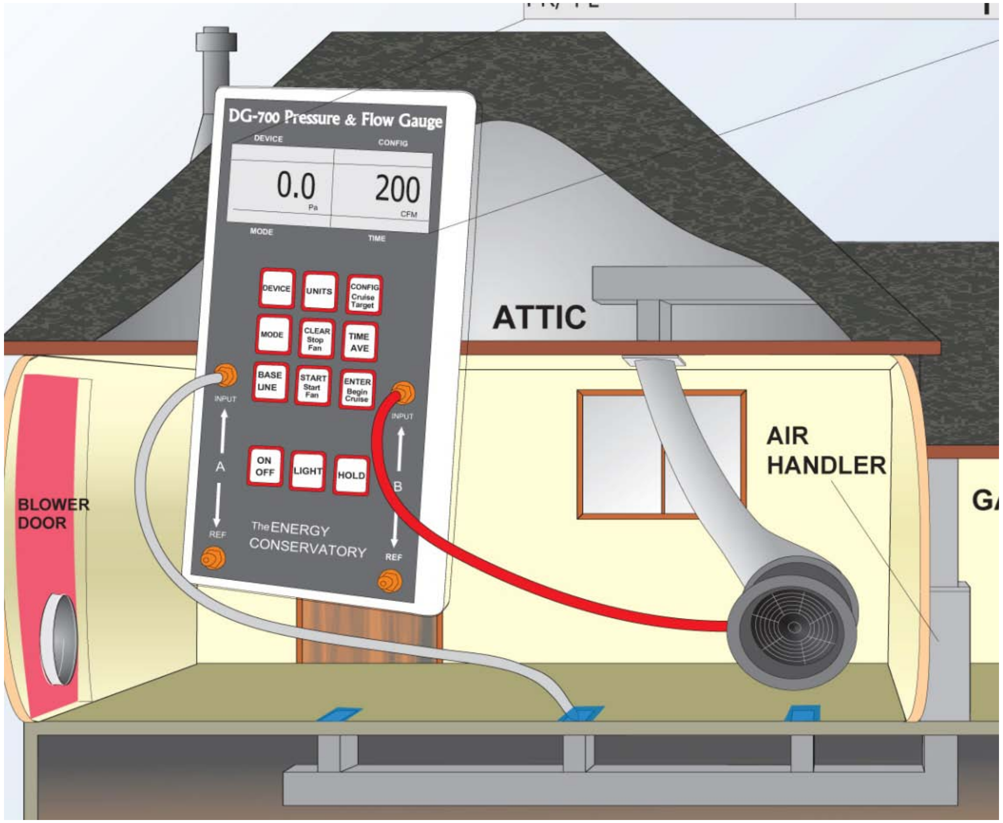
Air blowing *in* has to be blowing *out* (leaks)

Total Duct Leakage Test

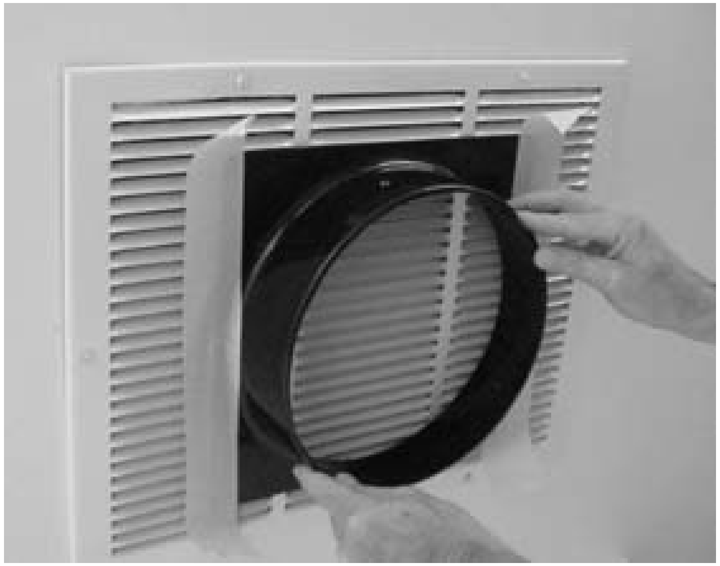


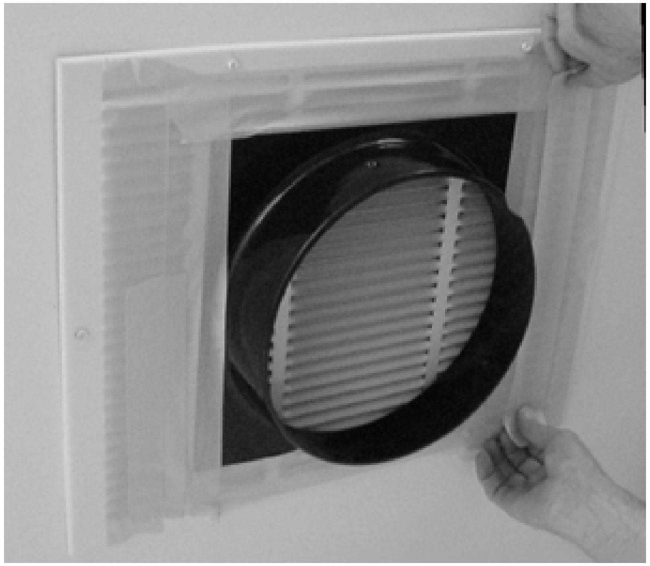
Total Duct Leakage Set Up

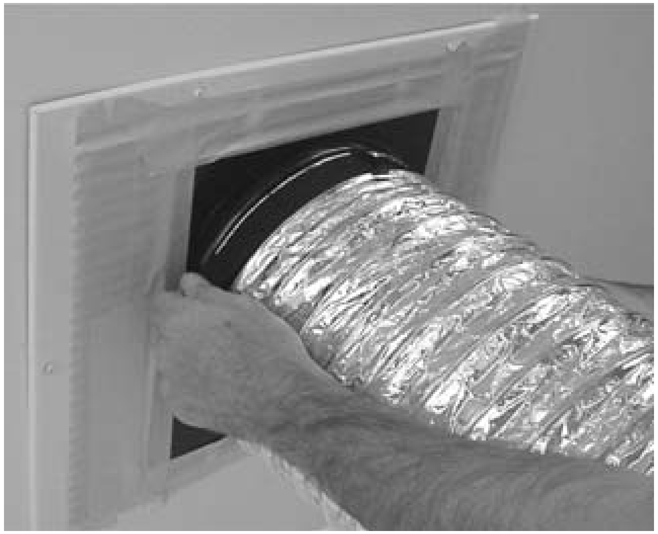
- Side A measures duct pressure
- Side B measures fan pressure, and manometer reflects it as CFM



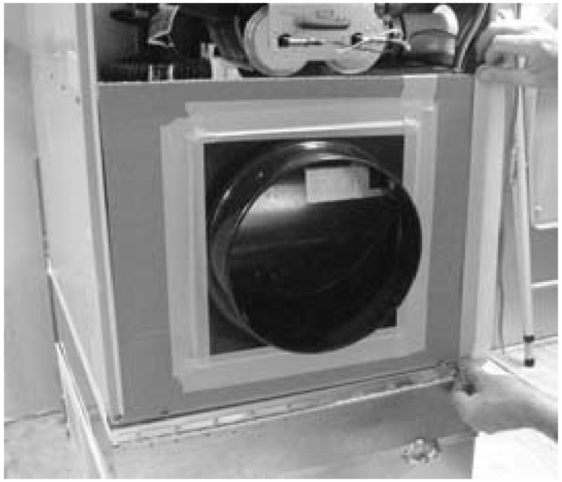
Attaching to the Return Grille



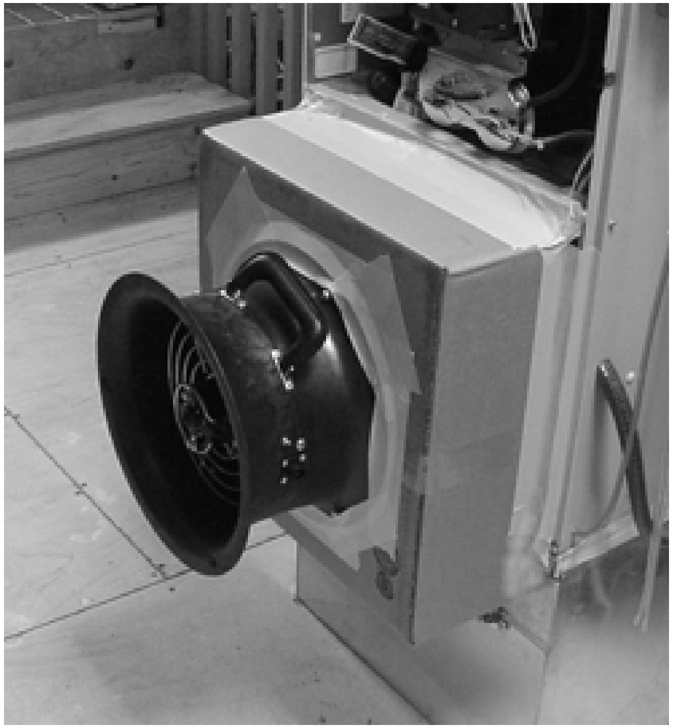




Attaching to the Air Handler

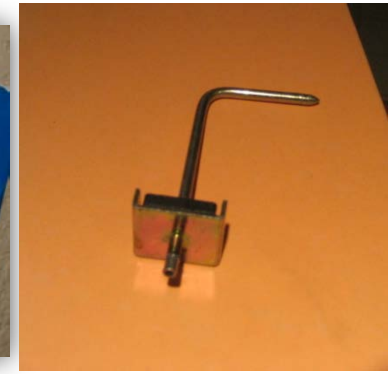


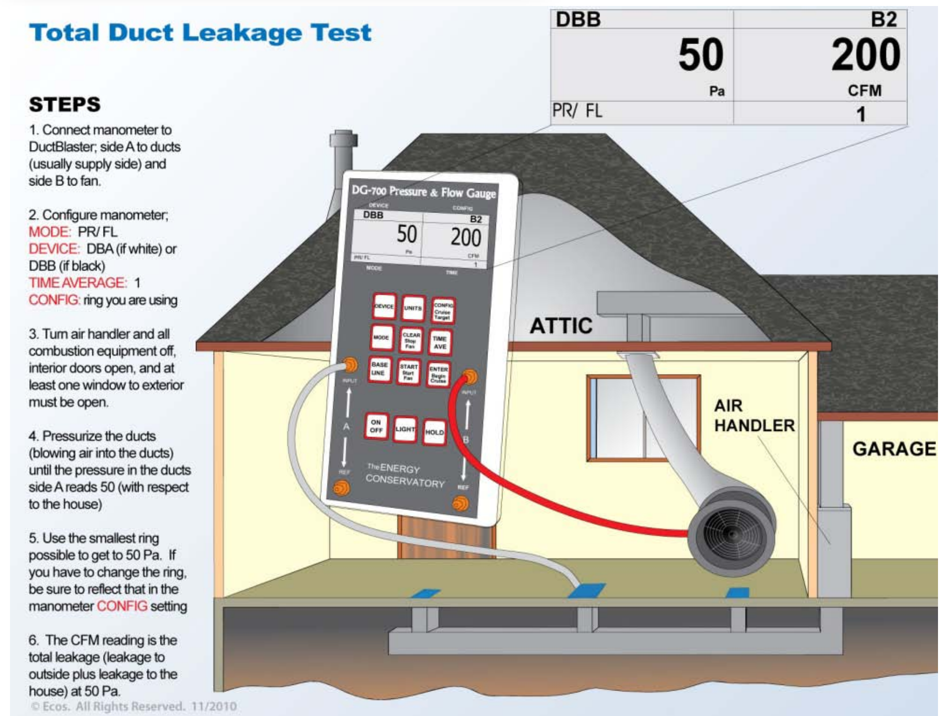
Direct Attachment to the Air handler



Steps for Total Duct Leakage Test

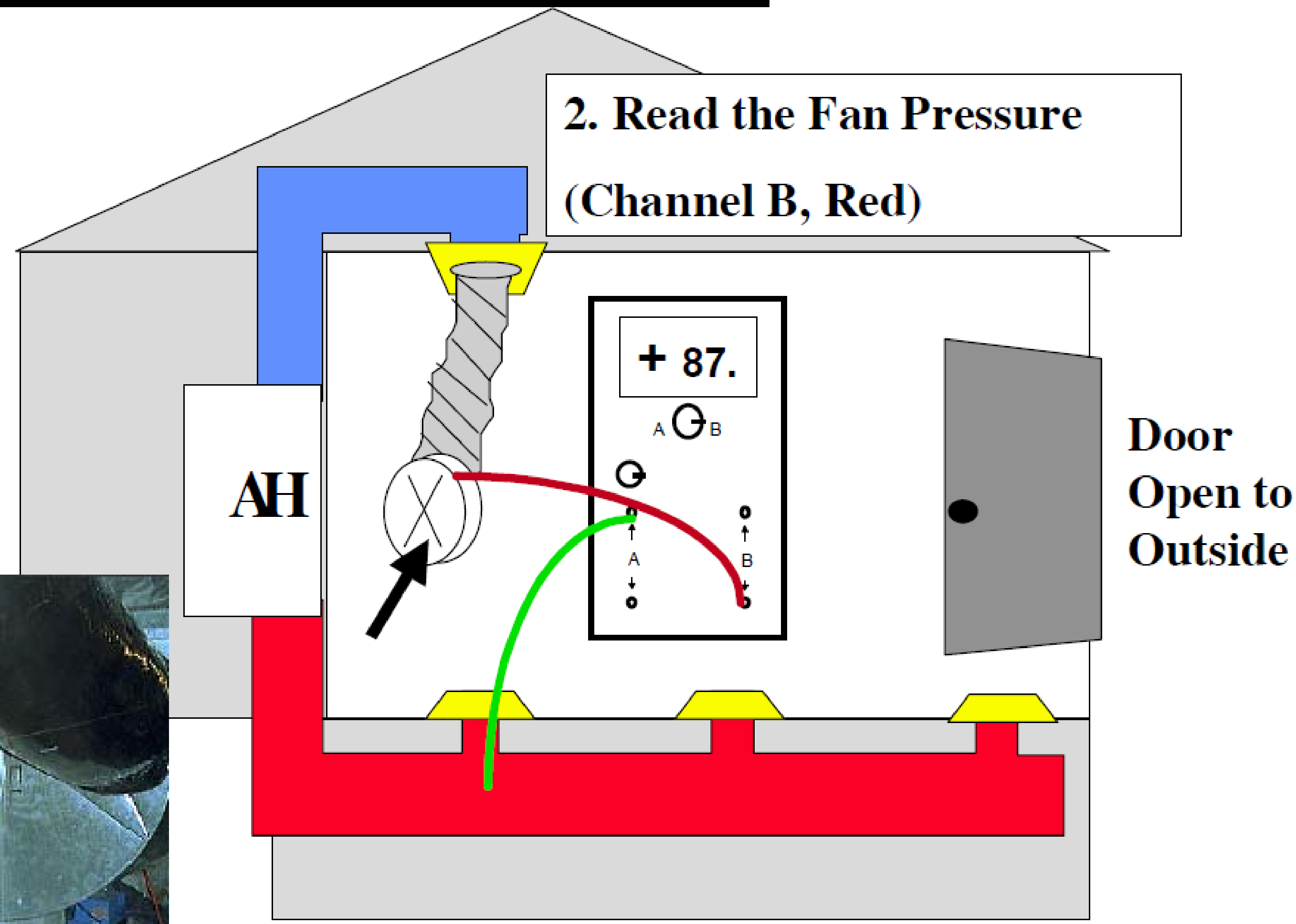
1. Seal Registers, Remove Filters
2. Connect duct blaster
3. Insert Pressure probe in one of the registers
4. Configure Manometer
5. Connect hose from register to manometer, and fan pressure fitting to the manometer



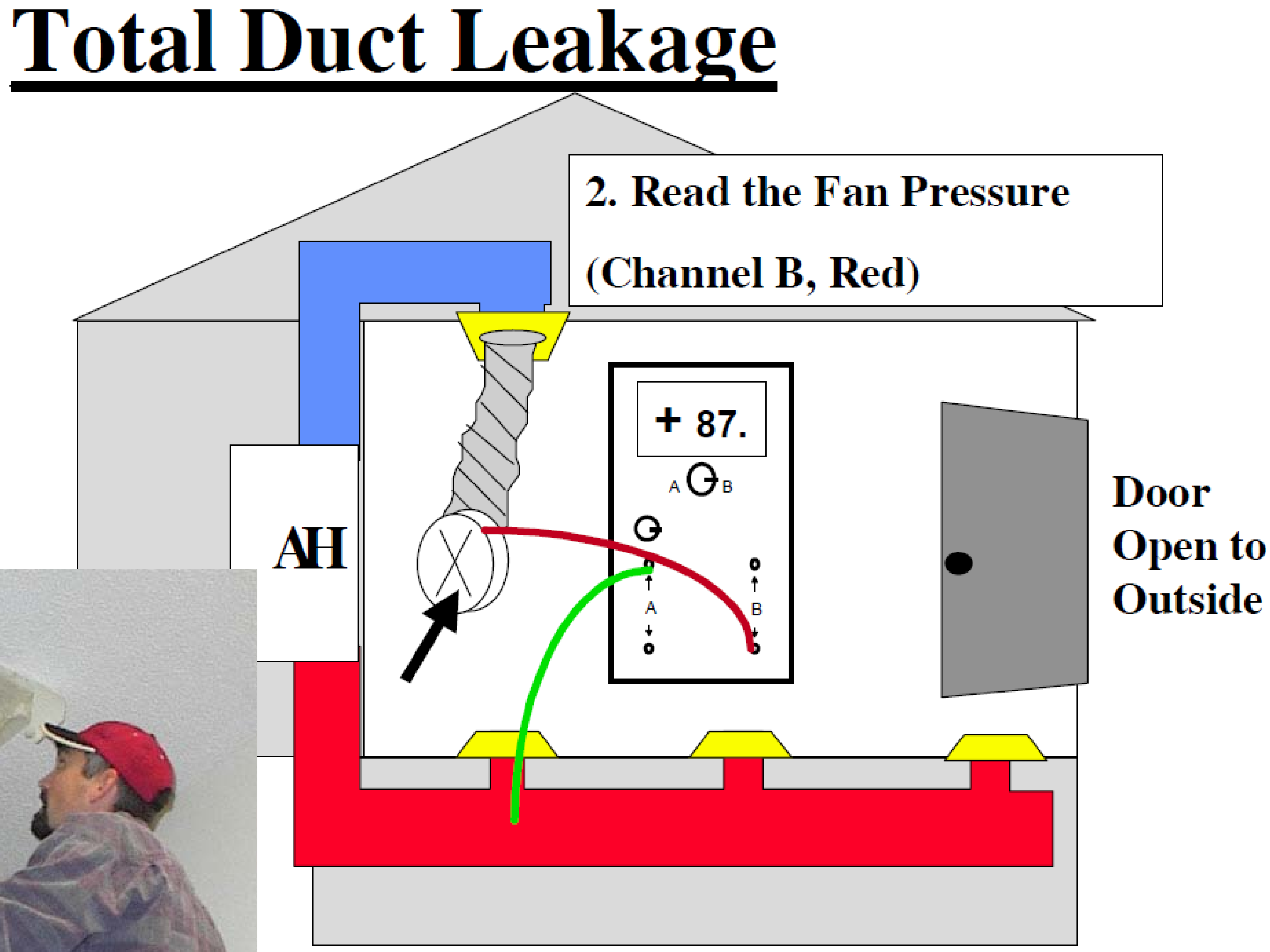


Total Duct Leakage Test

Total Duct Leakage



Total Duct Leakage Test



Can’t Reach Pressure (CRP) Correction Factors

Example: The results of the test show a leakage area of 275 CFM at a duct pressure of 35 Pa. The correction factor for a pressure of 35 Pa is 1.26.

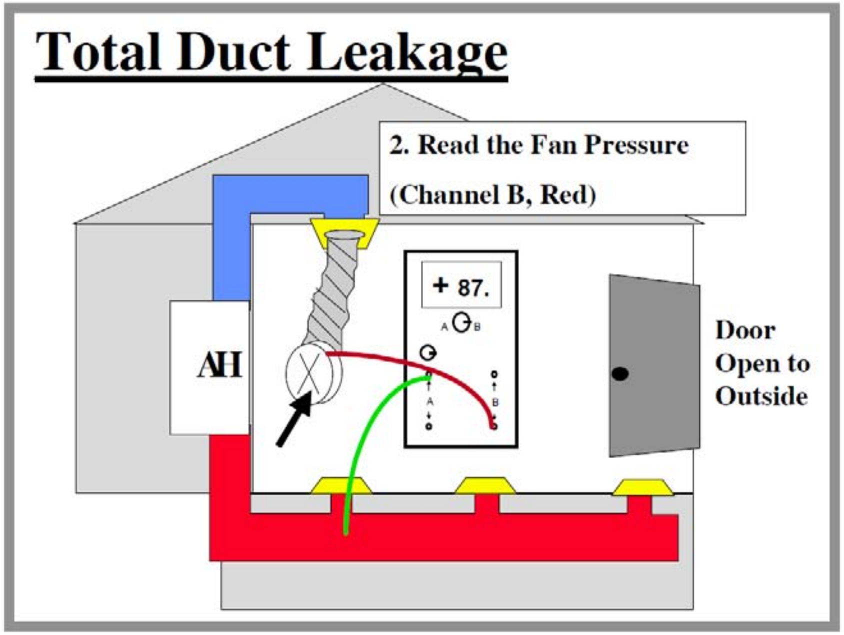
275 CFM35 X 1.26 = 346.5 CFM50

The test doesn’t give any indication of where to find the holes, just an estimate of the collected hole size. As CFM50 values get larger, they will tend to be less accurate.

Can’t Reach Pressure (CRP) Correction Factors

Reference Pressure	CRP Factor 50 PA
10	2.85
15	2.19
20	1.81
25	1.57
30	1.39
35	1.26
40	1.16
45	1.07

Total Duct Leakage Test



Interpreting Results:

The CFM50 is a measure of the total collected hole size in the system. As an approximation the CFM50 divided by 10 gives the total effective leakage area in square inches.

Example: 400 CFM50/10 = 40 square inches of total leakage area.

Using this approximation during sealing can help estimate how many and how big the holes are that you are looking to seal.

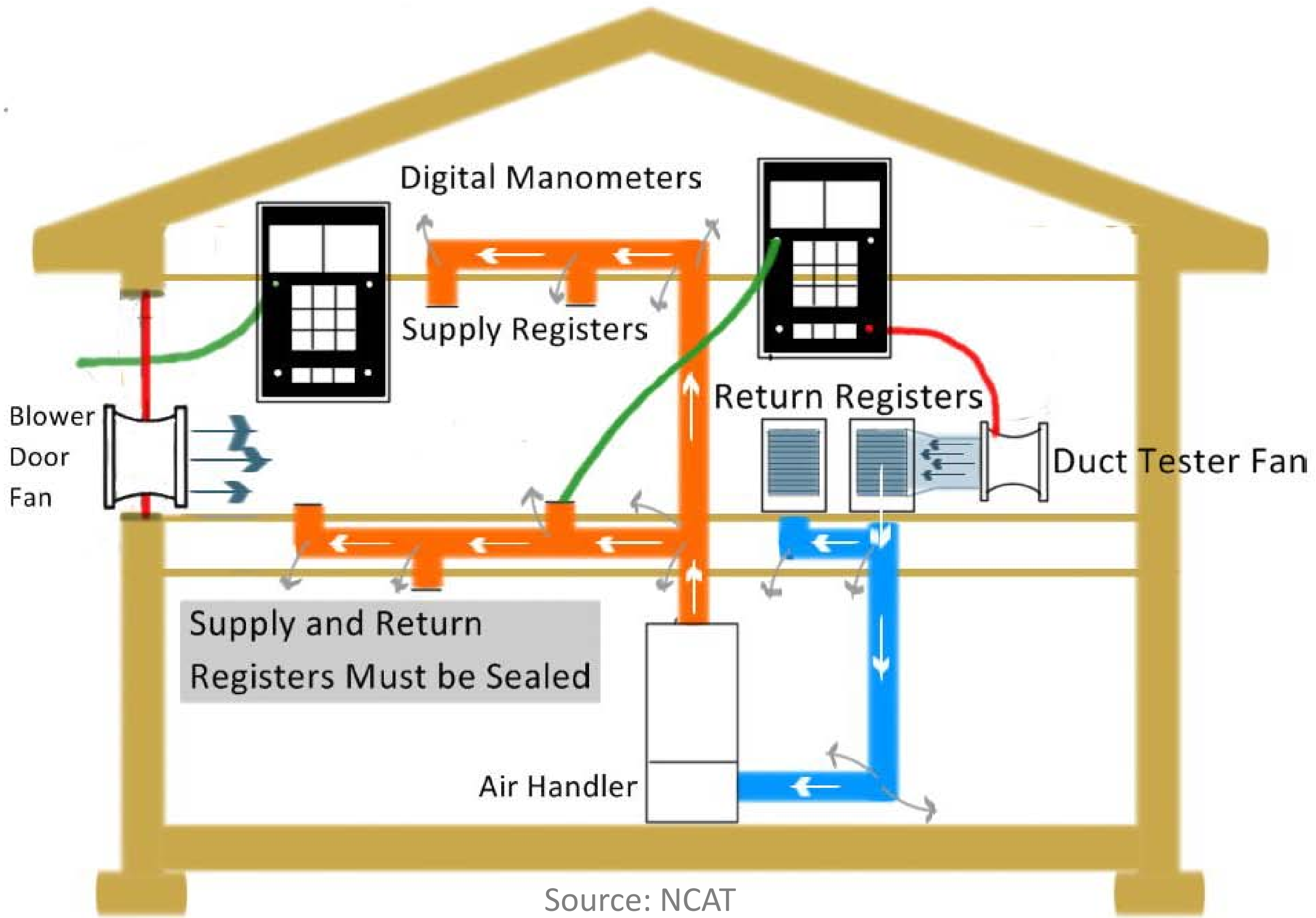
PTCS Duct Training – New Construction

Duct Leakage to the Outside

A Code Required Test
(for certain homes)

PTCS
Performance Tested
Comfort Systems

Duct Leakage to the Exterior



Source: NCAT

Standard New Construction: For certification, the measured CFM50 must not exceed 0.06 CFM50 x floor area served by the system (in square feet) or 75 CFM50 whichever is greater.

Duct Leakage to Outside Test
Part 1 Pressurize the House

STEPS

1. Install blower door with fan bringing air into house.

2. Turn OFF airhandler, dryer, all fans and combustion equipment.

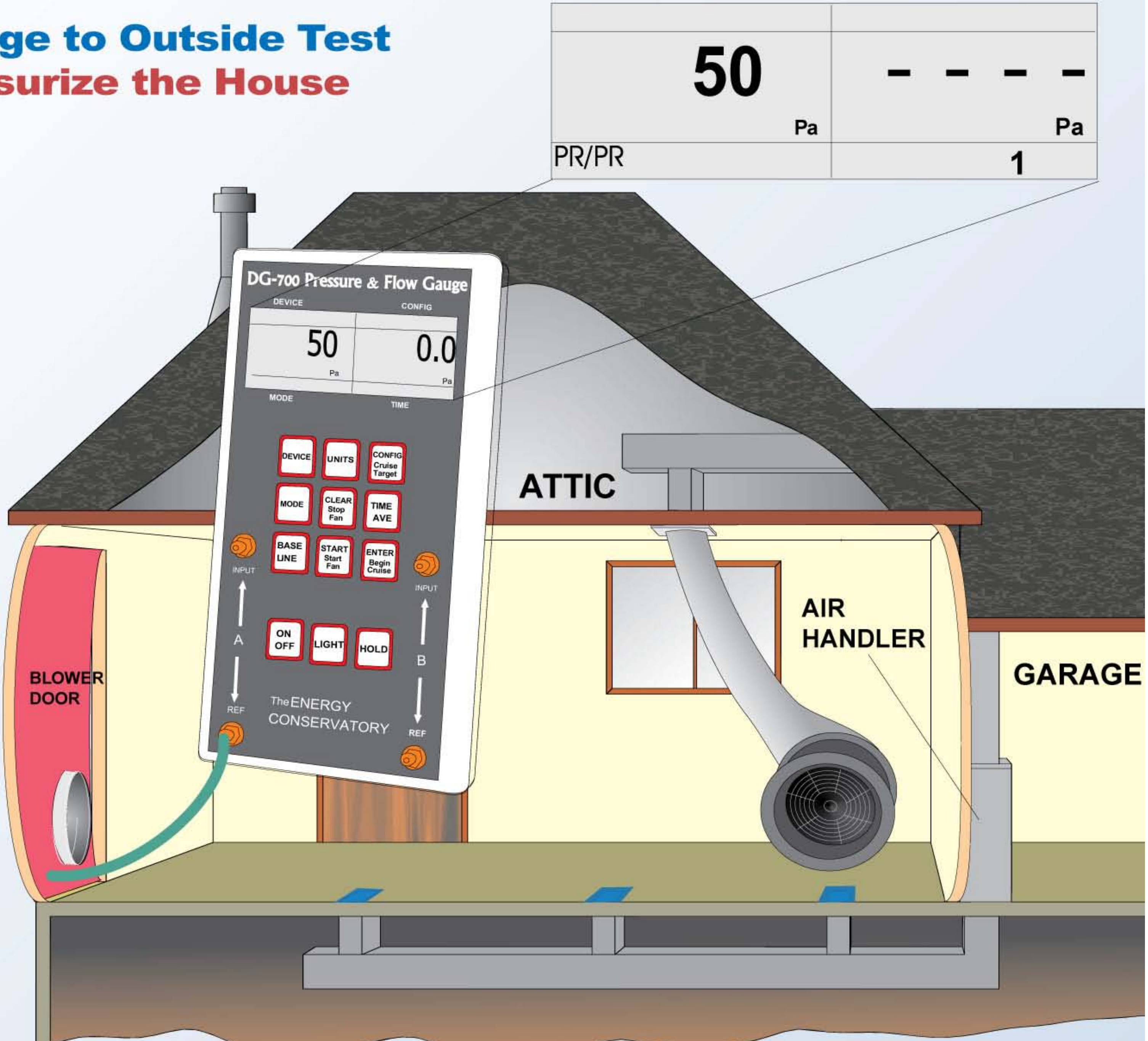
3. Tape off grilles/registers.

4. Open all interior doors. Close all exterior doors and windows.

5. Connect hose as shown (house wrt outside on Side A).

6. Manometer MODE should read PR/PR.

7.Turn on blower door, pressurize house to 50 Pascals (side A reading). Use cruise control if possible.



Duct Leakage to Outside Test
Part 2 Pressurize the Ducts

STEPS

8. Connect manometer to DuctBlaster; side A to ducts (usually supply side) and side B to fan.

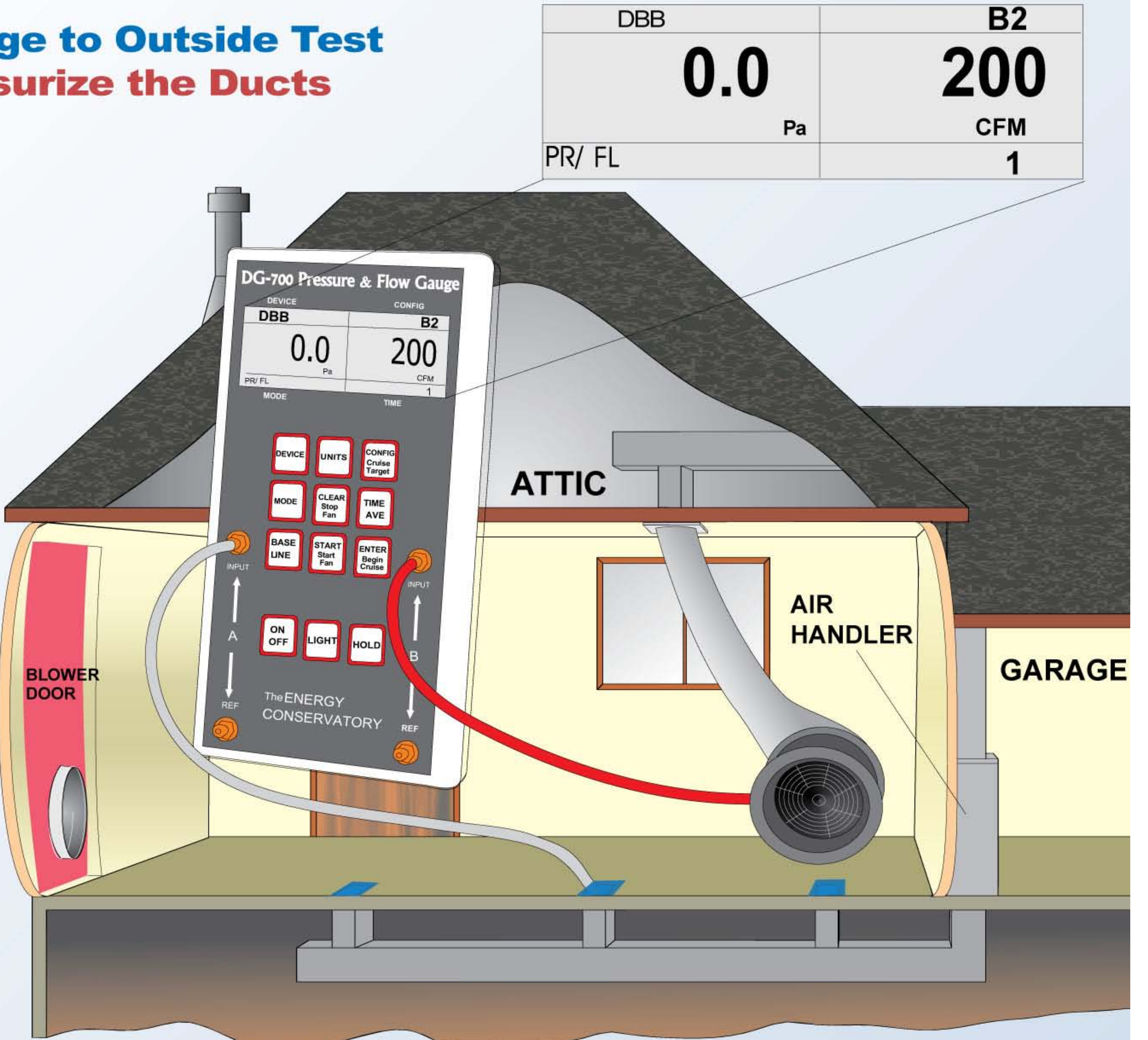
9. Configure manometer;
MODE: PR/ FL
DEVICE: DBA (if white) or DBB (if black)
TIME AVERAGE: 1
CONFIG: ring you are using

10. Pressurize the ducts (blowing air into the ducts) until the pressure in the ducts side A reads 0 (with respect to the house – which means the ducts and house are both at 50 Pa with respect to outside).

11. Use the smallest ring possible to get to 0 Pa. If you have to change the ring, be sure to reflect that in the manometer CONFIG setting

12. Check blower door reading (house pressure wrt outside). Readjust to 50 Pa if necessary.

13. Reconnect the manometer to the DuctBlaster. The CFM reading is the leakage to outside at 50 Pa.



Exhaust Fan Flow Test

Long or crimped exhaust fan ducts can significantly reduce actual exhaust flow.

Not a Code Required Test

PTCS New Construction Duct Leakage Limits

Allowable Leakage = 0.06 CFM50 x conditioned floor area or 75 CFM50, whichever is greater.

Example 1: What is the duct leakage limit for a 1000 SF house?

0.06 CFM50 x 1000 SF = 60 CFM, but since 75 CFM50 is greater the allowable leakage is 75 CFM50

Example 2: What is the duct leakage limit for a 3000 SF house?

0.06 CFM50 x 3000 SF = 180 CFM which is greater than 75 CFM so the allowable leakage is180 CFM

PTCS Minimum Ventilation Level

MVL Based on known occupancy:

MVL = (# of occupants) x (15 cfm/occupant)

MVL Based on bedrooms:

MVL = (3 of bedrooms + 1) x (15 cfm/bedroom)

MVL Based on ACH and Volume

MVL = (0.35 ACHnat x House Volume in ft^3) / 60 minutes

Most Restrictive Should be Applied.