Contractors' Intro to
Duct and Envelope Tightness (DET)

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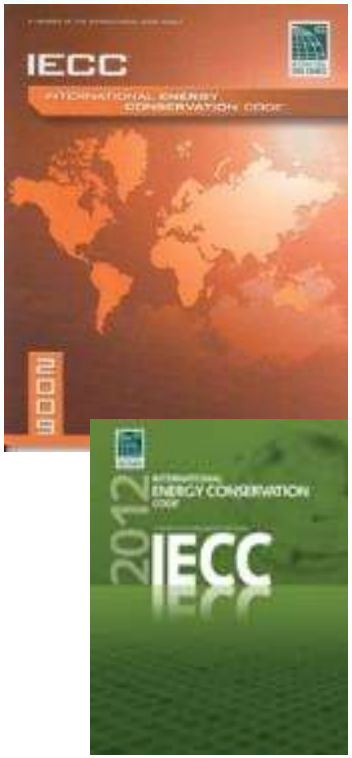
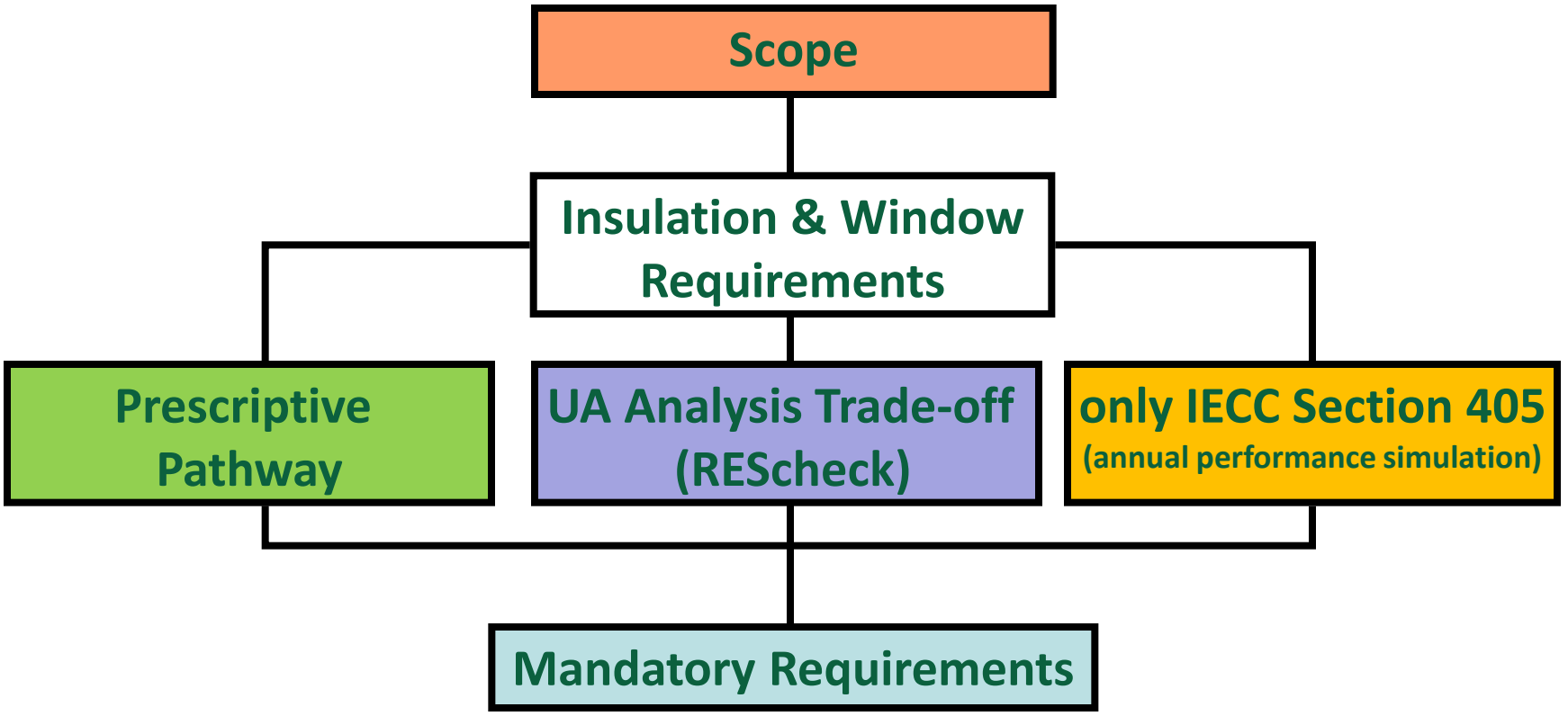
Benefits of Energy Codes



- ✓**Saves energy** - Buildings consume 40% of energy in U.S.; energy codes increase energy security, reduce air pollution, lower need or new power plants.
- ✓**Saves money -** energy costs continue to rise and energy codes help keep money within local economy
- ✓**Additional benefits:**
  - ✓Increases **comfort, health and durability** of homes
  - ✓Increases **home values** in local community
  - ✓**Reduces liability** for builder and subcontractors

Energy Code Compliance Pathways



Building Science Fundamentals

- **Heat**
  - Conduction
  - Convection
  - Radiation
- **Air**
  - Wind
  - Stack Effect
  - Mechanical Fans
- **Moisture**
  - Bulk
  - Capillarity
  - Diffusion
  - Infiltration
- **Ventilation**
  - Exhaust
  - Balanced
  - Positive
- **Comfort**
  - Temperature
  - Surfaces
  - Humidity
  - Airflow
- **Performance / Diagnostic Tools**
  - Blower Door
  - Duct Tester
  - Flow Hood

A House is a System

of *dynamic*, interacting systems…

Thermal Envelope System ⟺ Air Barrier System

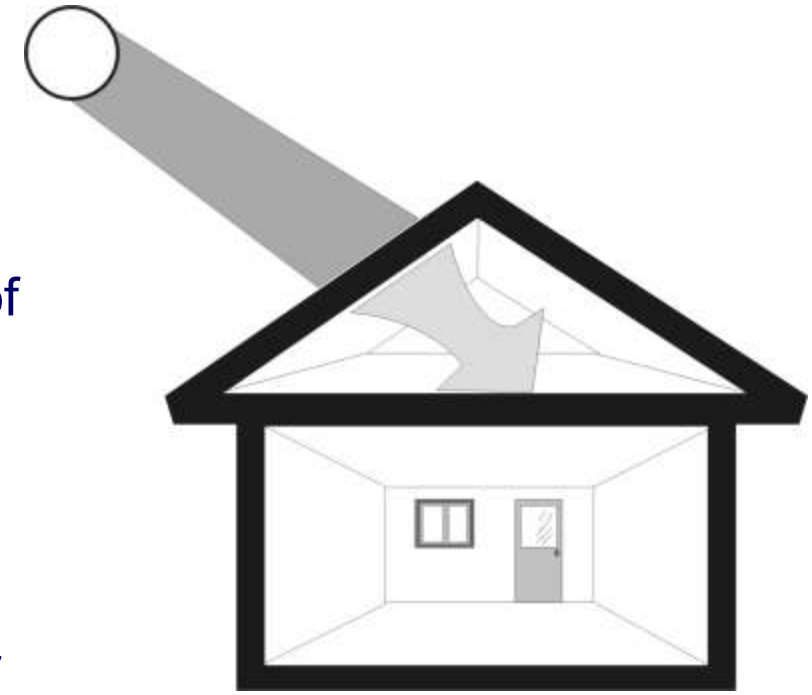
HVAC System ⟺ Moisture Control System

Plumbing System ⟺ Electrical System

How Heat Flows

Radiation

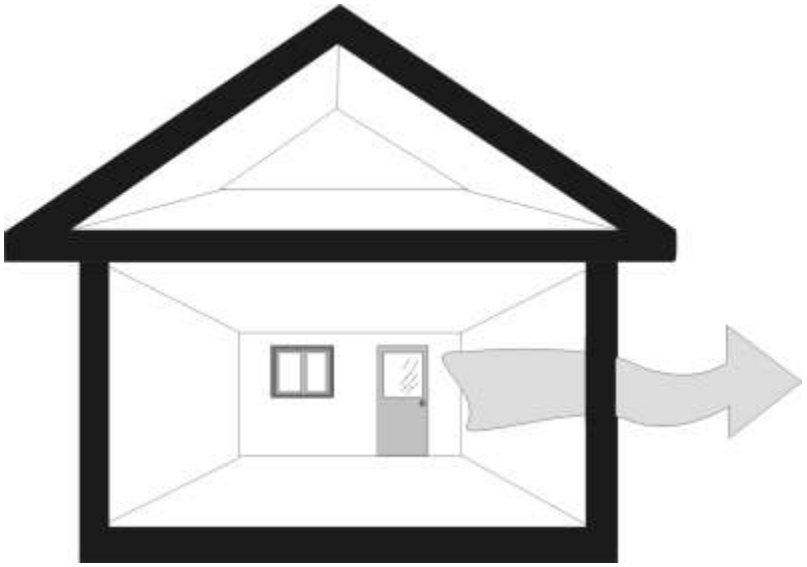
- Movement of **radiant energy** ***across empty space*** from warmer to cooler objects.
- Examples:
  - **Sunshine** (solar heat) heats roof deck and brick veneer.
  - **Hot roof** deck radiates to attic floor; **brick veneer** to wall.
  - Solar and radiant heat from **pavement** passes through clear glass, heats floor.



How Heat Flows

Conduction

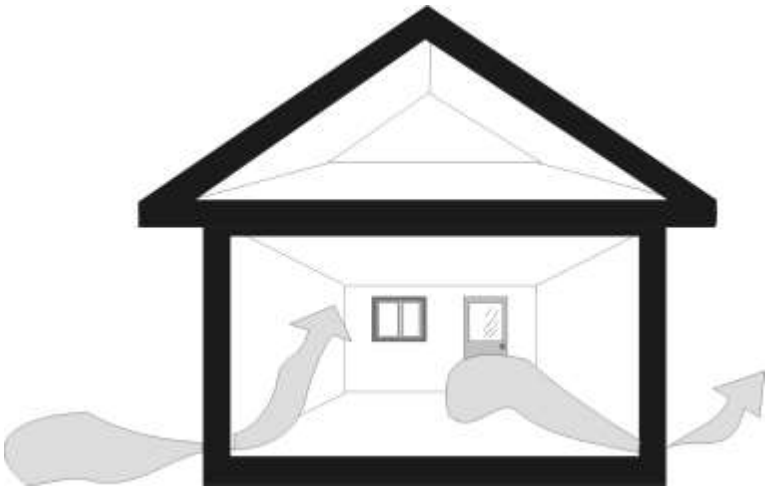
- The transfer of heat **through solid objects.**
- **Insulation**, layers of glass with air space in windows, slows conduction.



How Heat Flows

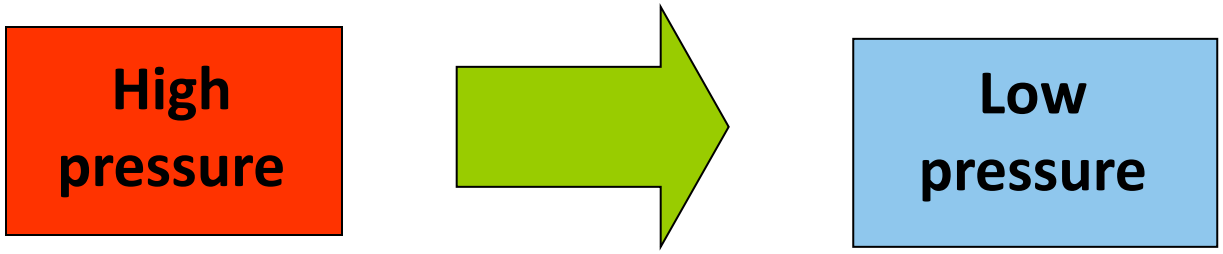
Convection

- Flow of heat by **currents of air.**
- As air warms, it rises; as it cools, it gets heavier and sinks.
- Air flow into a home is *infiltration*;
- Outward flow is called *exfiltration.*
- ***Air leakage*** is both.



Air leakage

Air Flow

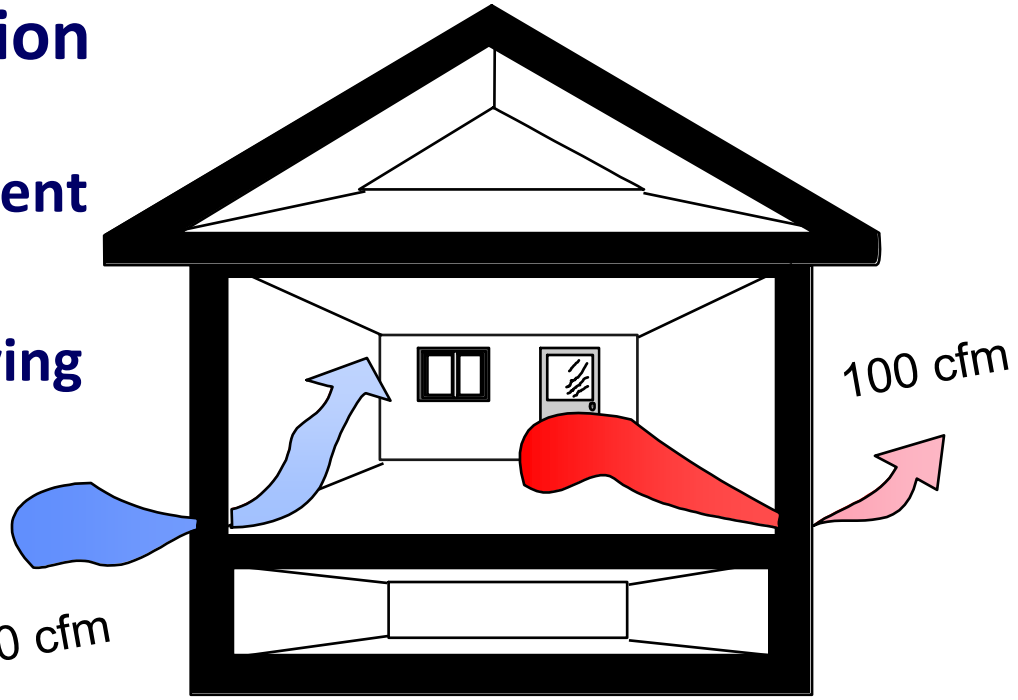


Conditions for Air Infiltration

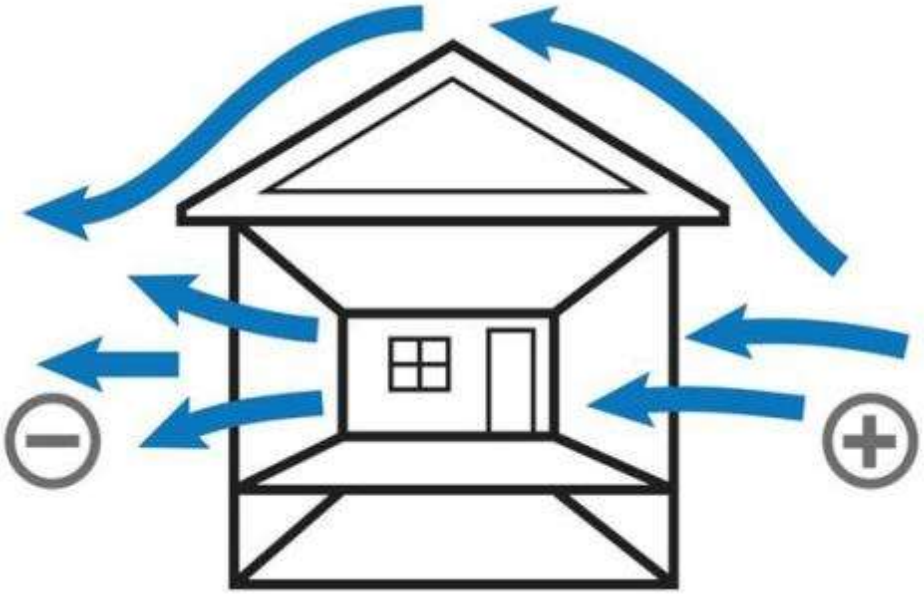
(both must be present at the same time)

- **Pathways for air movement (hole)**
- **Pressure difference (driving force)**

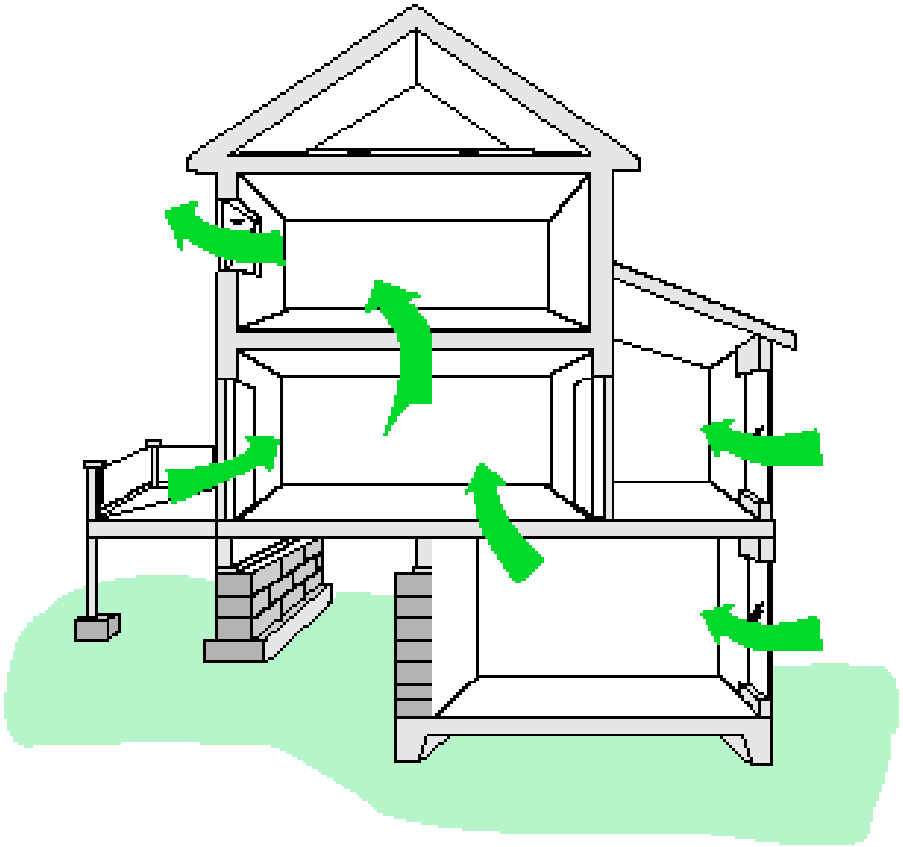
Quantity of air out
= quantity of air in



Natural Driving Forces for Infiltration



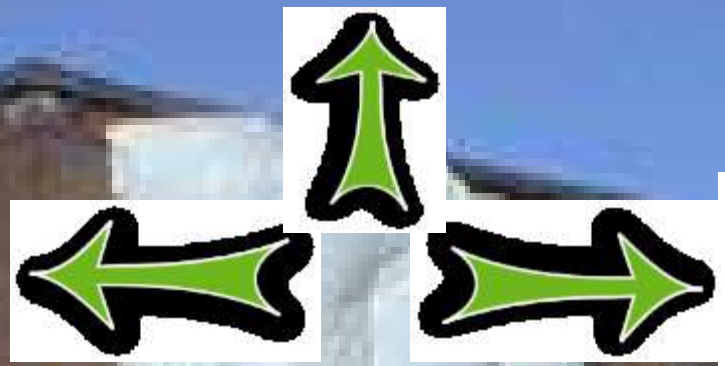
Wind



Stack Effect

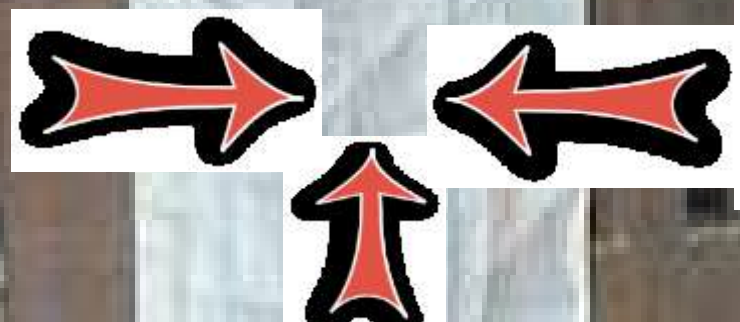
Stack Effect

•David Keefe
Vermont Energy
Investment Corp.



Positive pressure (with reference to outside)

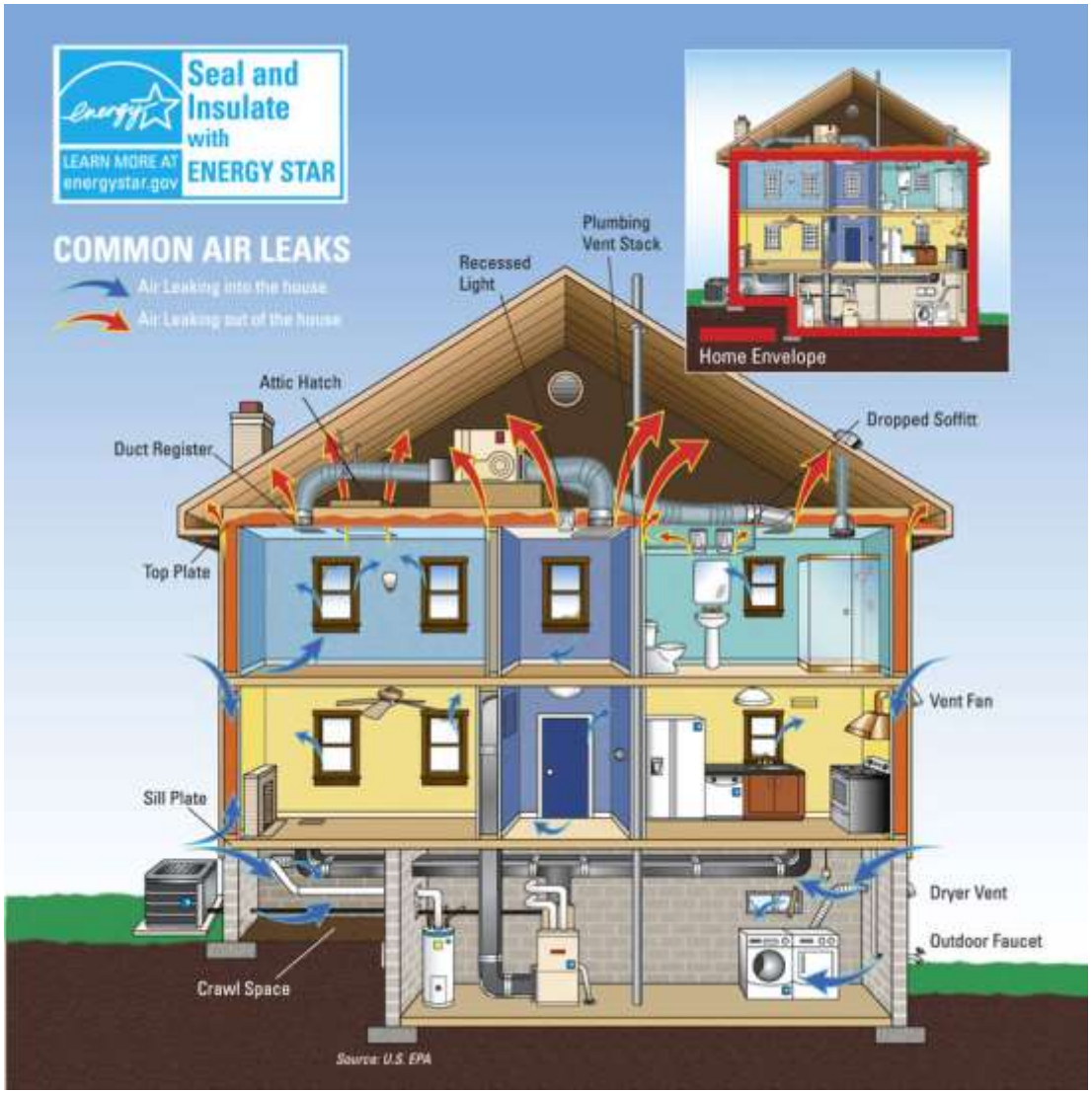
Neutral pressure plane



Negative pressure (with reference to outside)

Typical Envelope Leaks

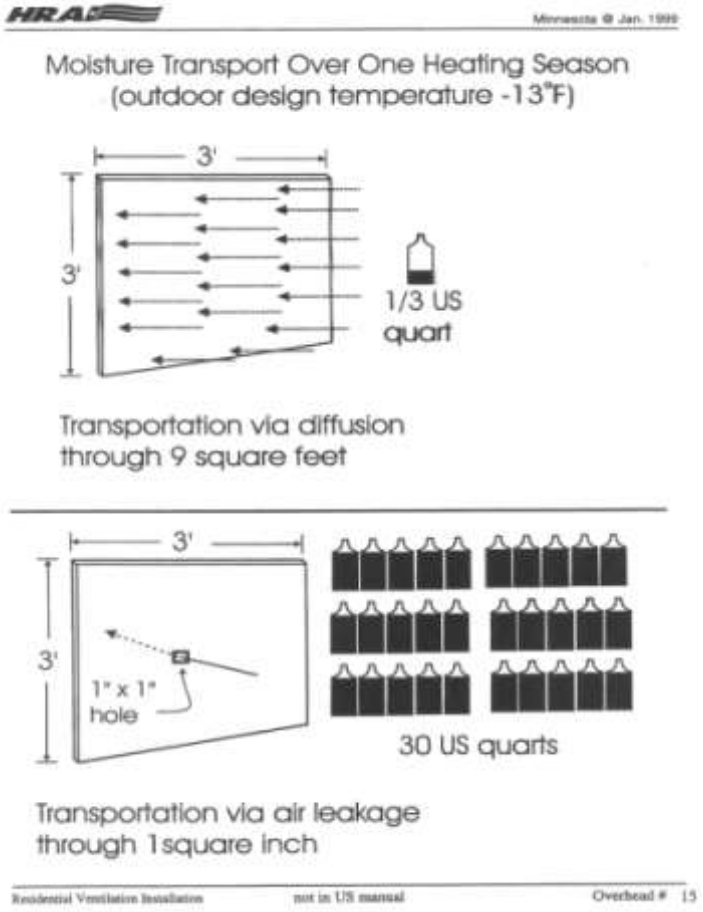
mostly *to and from attic and crawl space!*



A *Continuous* Air Barrier

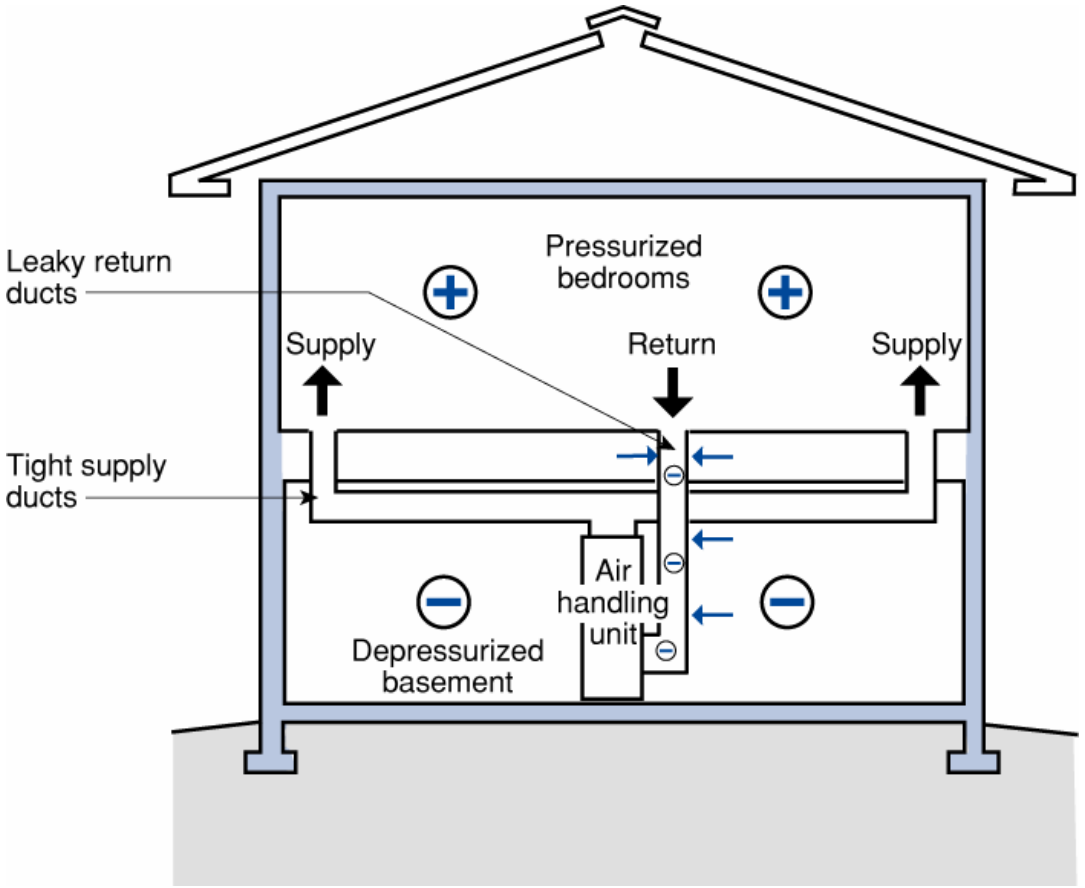
Why so important?

- **Saves energy**
  - insulation effectiveness
- **Saves money**
  - low utility bills
- **Increases comfort**
  - No cold drafts, hot spots
- **Controls air quality**
  - Reduce pollutants & dust from attic, crawl space, wall cavities, garage
- **Reduces moisture into building cavities**
  - Prevent hidden mold and decay



FANS! - Driving Forces for Infiltration

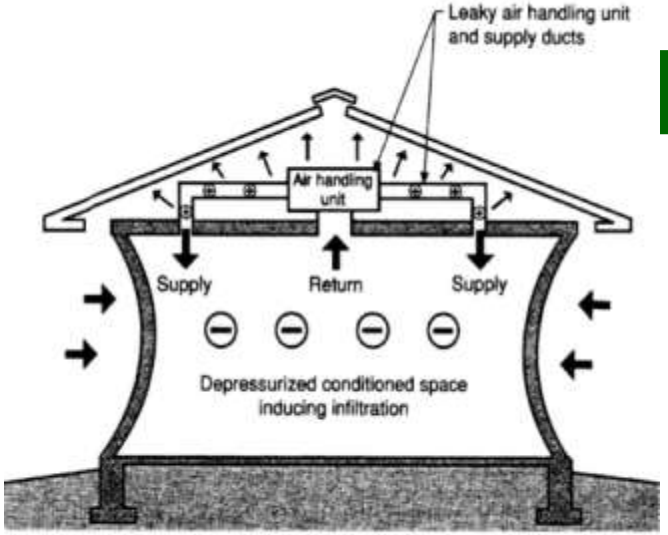
Device	CFM
Bath	50
Range hood	150
Downdraft hood	500
"Emeril" Hood	1500
Dryer	200
Air Handler	400 / ton



A bigger deal (than wind or stack) in southern homes!

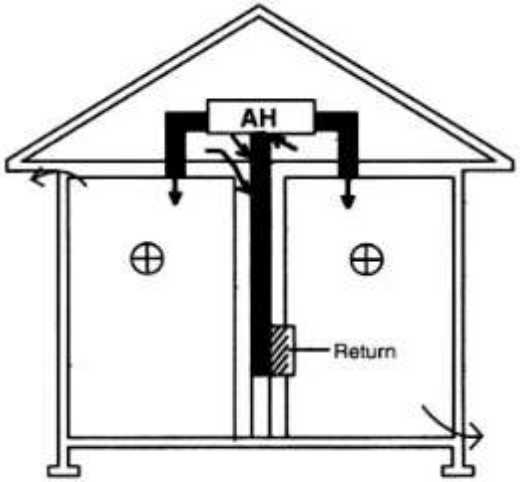
"Natural Ventilation" via leaky house & ducts

Is this good or bad "*ventilation*"?



Negative Pressure Caused by Leaky Ducts

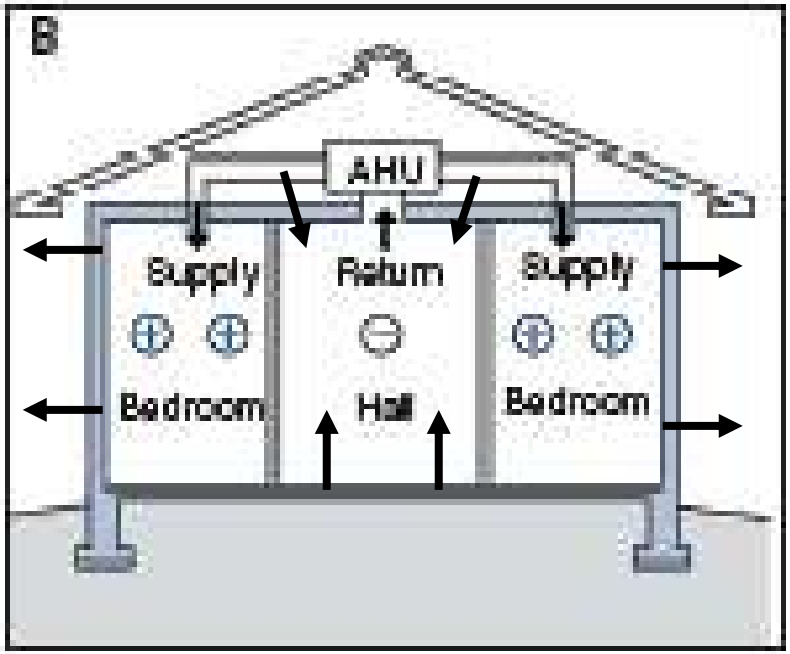
Why?



Leaky Return Air Plenum

"Natural Ventilation" via leaky house & ducts

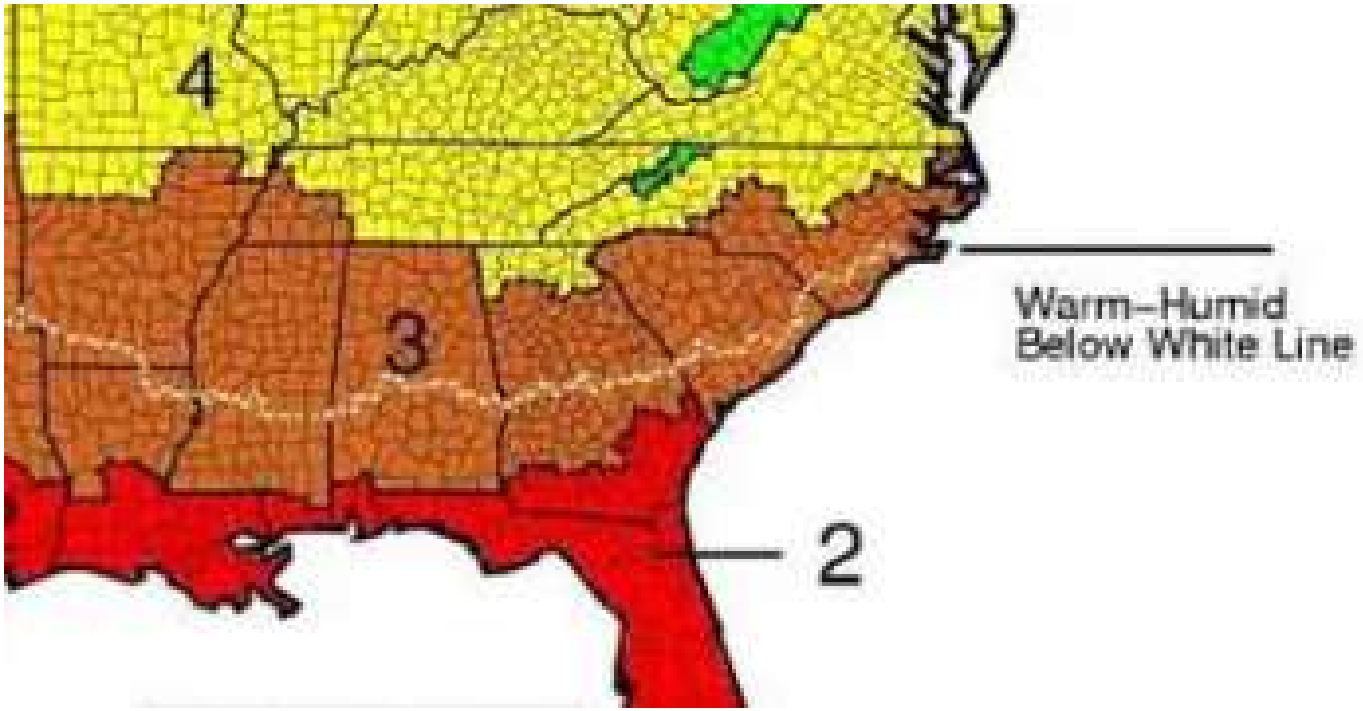
Is this good or bad "*ventilation*"?



Duct systems leaks in both supply and return can cause air leakage rates to increase up to 300%!

2009 IRC chapter 11- Section 1102.1

- One prescriptive “answer” for how to build in each climate zone (CZ: 2 and 3, warm-humid)
- Includes lots of footnotes

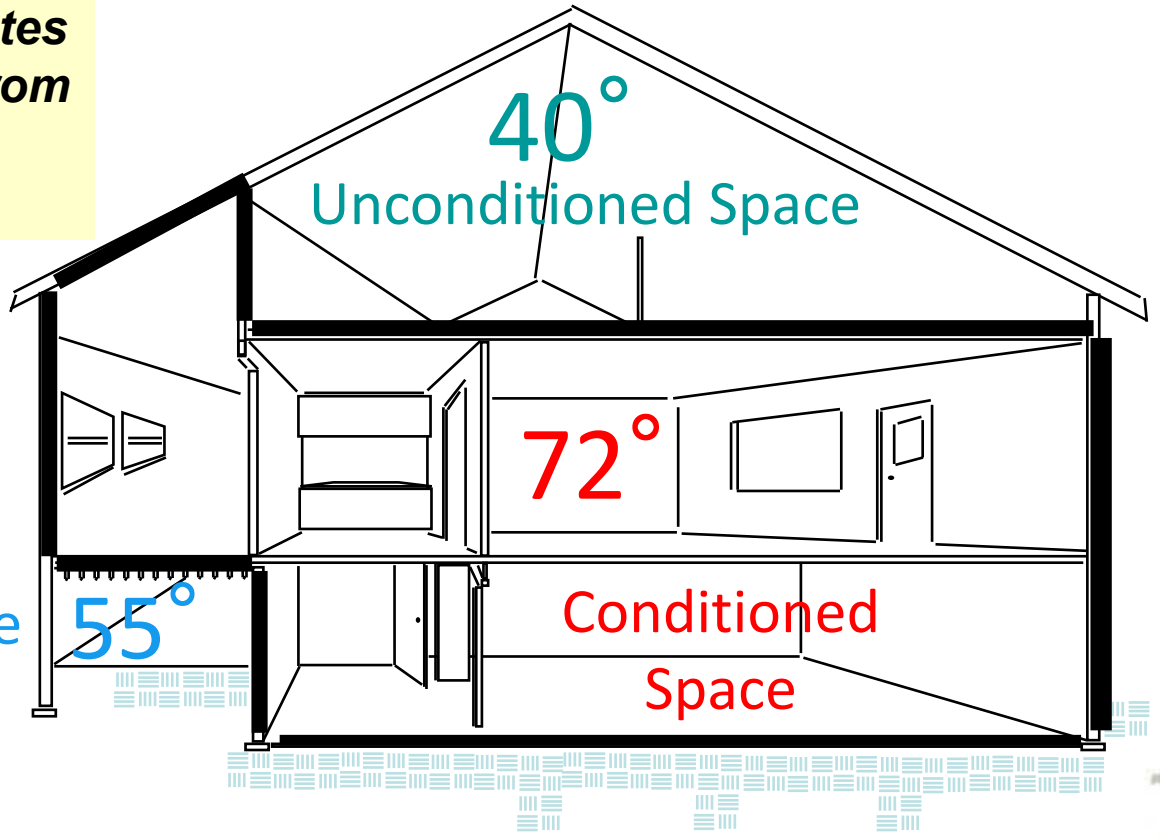


Building Thermal Envelope Definition

Building Thermal Envelope — The basement walls, exterior walls, floor, roof, and any other building element that enclose conditioned space. This boundary also includes the boundary between conditioned space and any exempt or unconditioned space. *—2009 IECC*

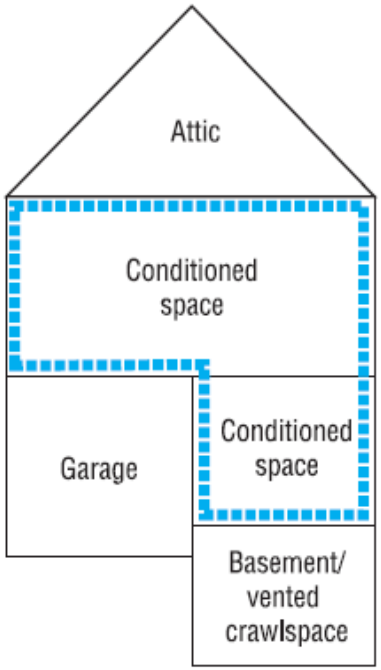
The *building thermal envelope* is the barrier that separates the conditioned space from the outside or unconditioned spaces. The building envelope consists of two parts - an air barrier and a thermal barrier that must be both continuous and contiguous (touching each other). In a typical residence, the building envelope consists of the roof, walls, windows, doors, and foundation. Examples of unconditioned spaces include attics, vented crawlspaces, garages, and basements with ceiling insulation and no HVAC supply registers.

…the barrier that separates the conditioned space from the outside or unconditioned space.

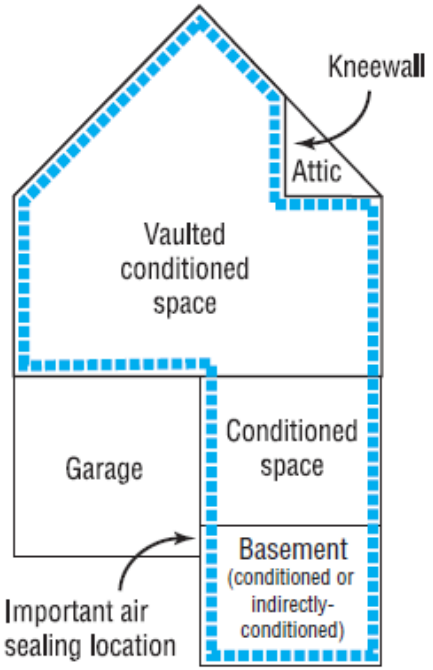


Determining the Building Thermal Envelope

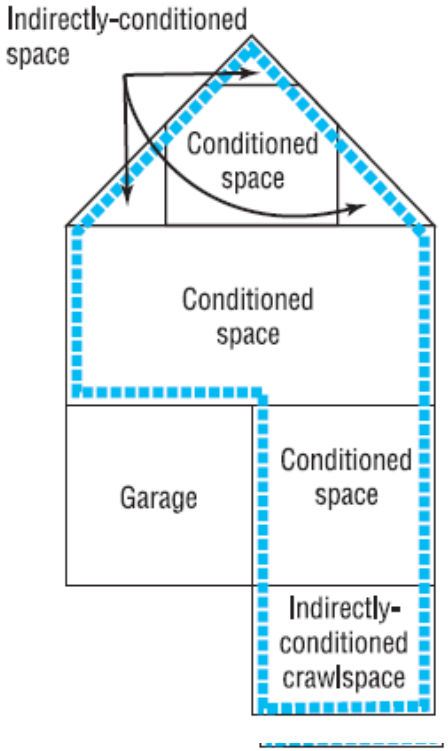
Example 1



Example 2



Example 3



- Although these 3 homes look identical from outside, **each has a different building thermal envelope**
- This results in significantly <u>different conditioned volumes</u>

Generic Prescriptive Code: 2009 IRC

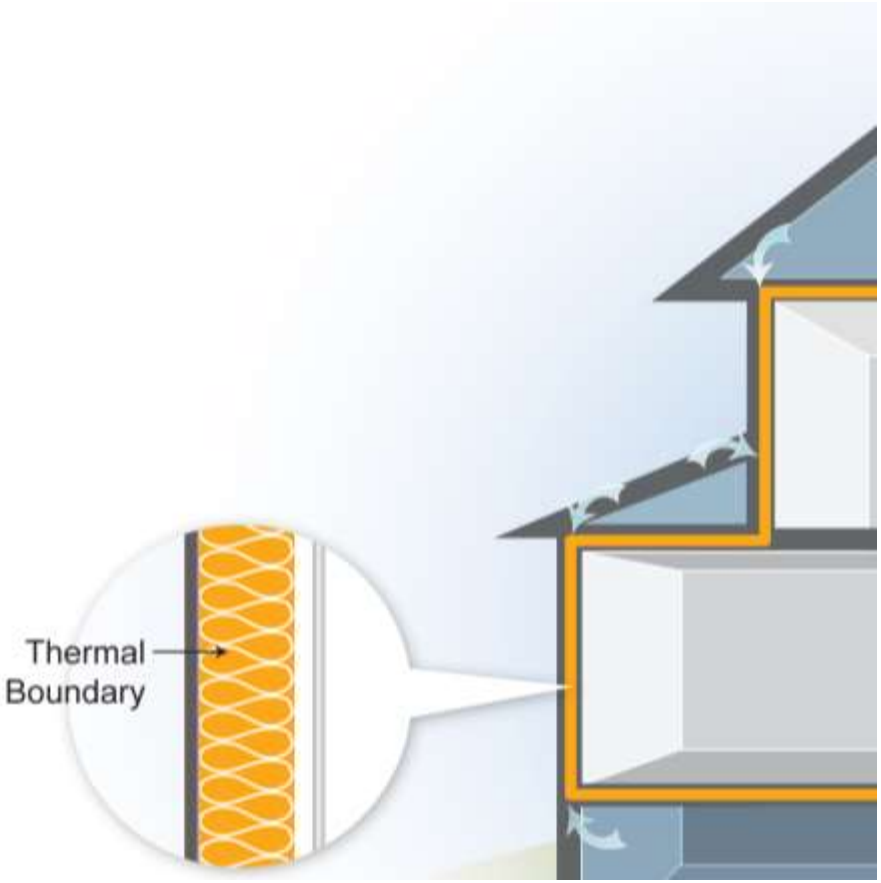
Insulation & Fenestration by Climate Zone

Table 1102.1
Insulation and Fenestration Requirements by Component[a]

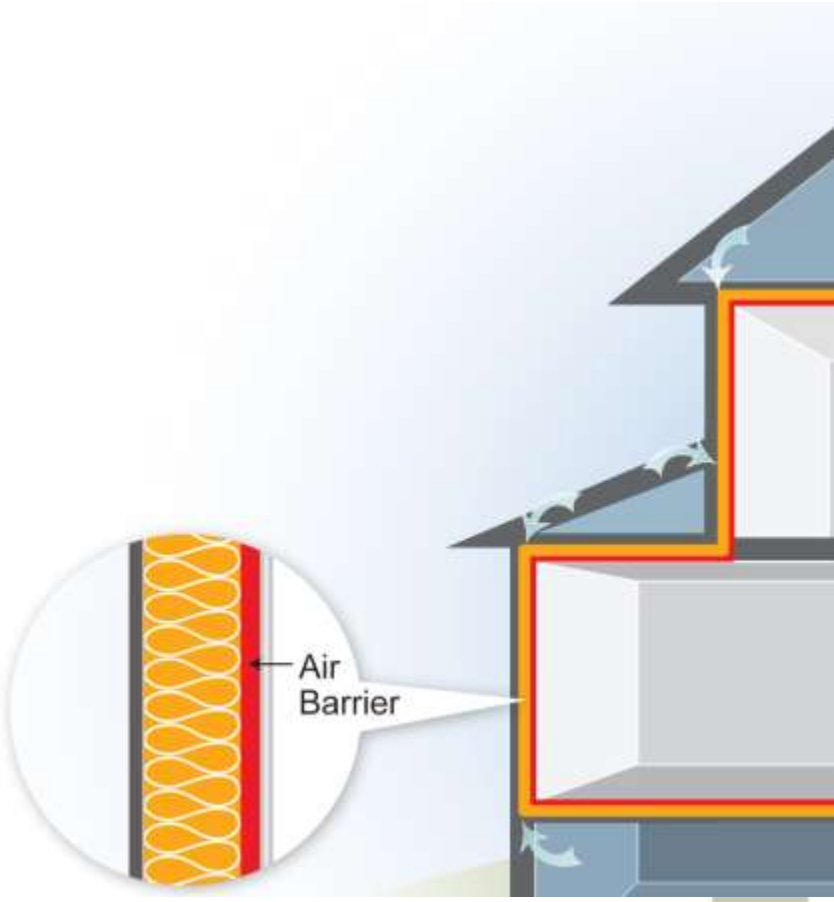
CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION[b,e] SHGC	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c] WALL R-VALUE
1	1.20	0.75	0.30	30	13	3 / 4	13	0	0	0
2	0.65[j]	0.75	0.30	30	13	4 / 6	13	0	0	0
3	0.50[j]	0.65	0.30	30	13	5 / 8	19	5 / 13[f]	0	5 / 13
4 except Marine	0.35	0.60	NR	38	13	5 / 10	19	10 / 13	10, 2ft	10 / 13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5[h]	13 / 17	30[g]	10 / 13	10, 2 ft	10 / 13
6	0.35	0.60	NR	49	19 or 13+5[h]	15 / 19	30[g]	15 / 19	10, 4 ft	10 / 13
7 and 8	0.35	0.60	NR	49	21	19 / 21	38[g]	15 / 19	10, 4 ft	10 / 13

[a] *R*-values are minimums, *U*-factors and SHGC are maximums, R-19 batts compressed into a nominal 2 x 6 framing cavity such that the *R*-value is reduced by R-1 or more shall be marked with the compressed batt *R*-value in addition to the full thickness *R*-value.
[b] The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
[c] "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
[d] R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.
[e] There are no SHGC requirements in the Marine Zone.
[f] Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.
[g] Or insulation sufficient to fill the framing cavity, R-19 minimum.
[h] "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
[i] The second *R*-value applies when more than half the insulation is on the interior of the mass wall.
[j] For impact rated fenestration complying with Section R301.2.1.2 of the *IRC* or Section 1608.1.2 of the *IBC*, maximum *U*-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.

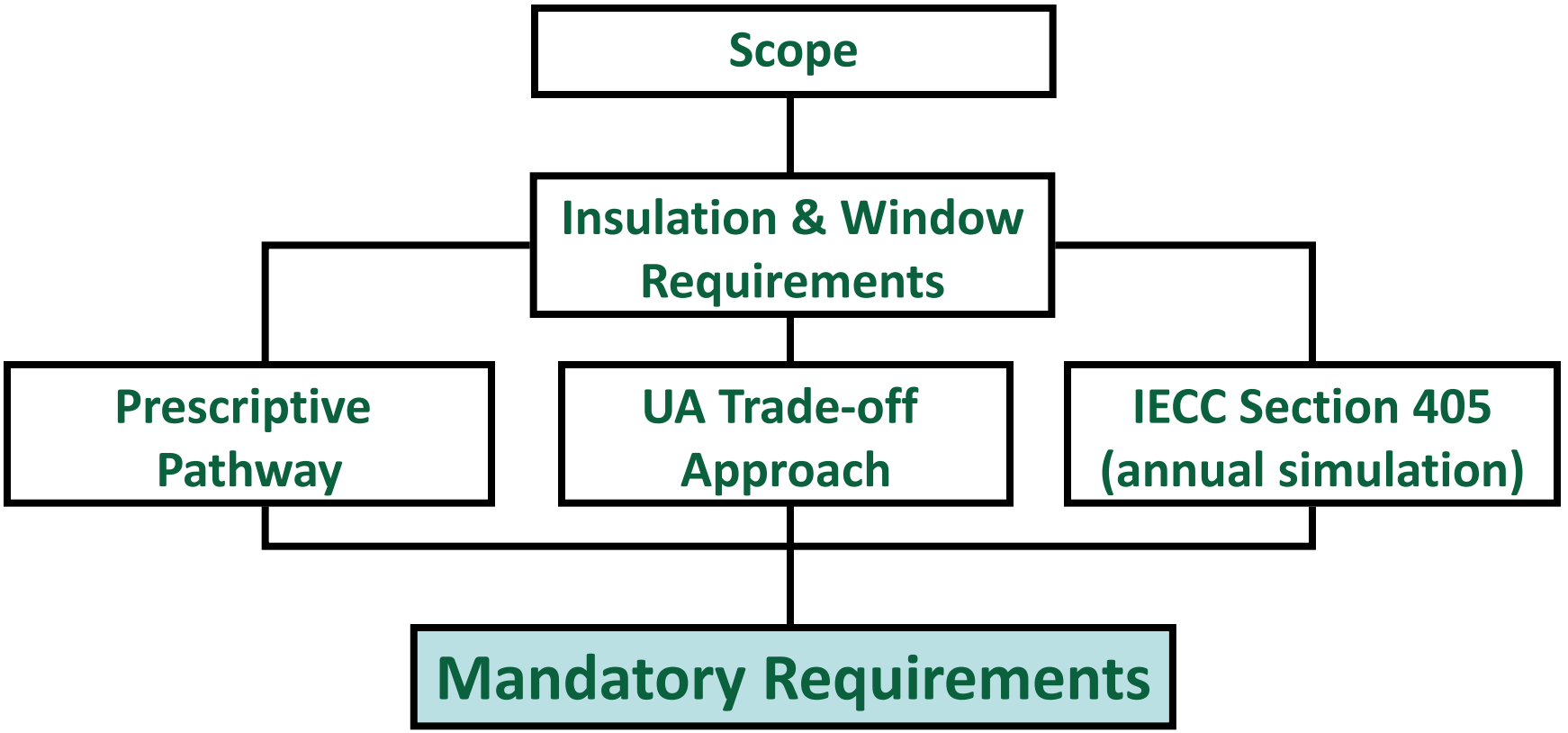
Where is the thermal boundary of conditioned space?



The thermal (insulation) and air barrier boundaries must be in direct contact.



Energy Code Compliance Pathways



2009 IRC Section N1101.9

Mandatory Requirement

Certificate - "Nutritional Label" on main electrical panel showing:

- **R-values** – ceiling, walls, ducts
- **Glazing U-factor, SHGC**
- **HVAC and DWH equipment efficiency ratings**
- Optional features:
  - *Envelope Testing Results*
  - *Duct Testing Results*
  - *Load calculation*

Sample Energy Efficiency Certificate

Energy Efficiency Certificate

Insulation Rating		R-Value		R-Value
Ceiling /Roof	Attic	R- 38	Vaulted	R- 30
Walls	Frame	R- 20	Mass	R- N/A
	Basement	R- 10	Crawl space	R- 10
Floors	Over unconditioned space	R- 19	Slab edge	R- 10
Ducts	Attic	R- 8	Other	R- N/A

Air Leakage Test Results				
Blower door	3.0	ACH/50 Pa.	Duct testing	6.0 Cfm/100 ft²

Fenestration Rating	NFRC U-Factor	NFRC SHGC
Window	U- 0.32	0.60
Opaque door	U- 0.32	N/A
Skylight	U- 0.55	0.60

Equipment Performance	Type	Efficiency	
Heating system	Gas forced-air	90%	AFUE
Cooling system	Central AC	15	SEER
Water heater	Gas (Storage-type)	0.57	EF

Indicate if the following have been installed (an efficiency shall not be listed)

☐ electric furnace ☐ gas-fire unvented room heater ☐ baseboard electric heater

Designer/builder

Code edition 2012 IRC Date 01/2/2013

For sale from **shop.iccsafe.org**
Search "energy certificate stickers"

Wood burning fireplaces N1102.4.3

La Amended – Fireplaces: New wood-burning fireplaces shall have **outdoor combustion air**.

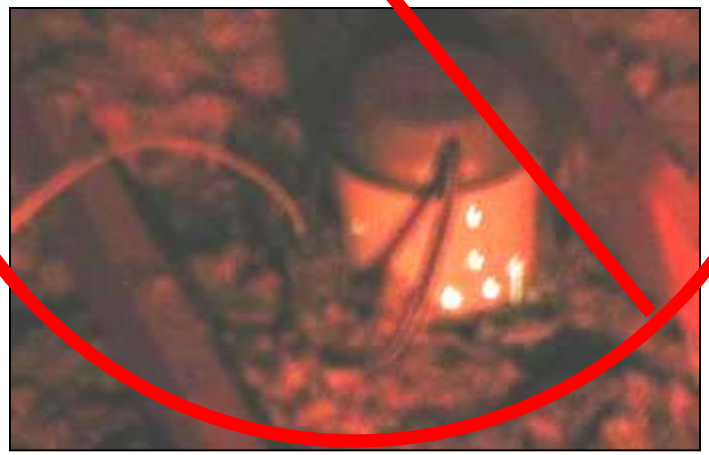
IRC requirement for **gasketed door** on masonry fireplaces was removed in amendment, yet is a recommended best practice for indoor air quality (health) and energy savings

Recommended

Required

Recessed Lighting N1102.4.5

Standard Can Light



Air-tight and IC-Rated (ICAT)

402.4.5 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the *conditioned space* to the ceiling cavity. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

1102.4.2 Building Envelope Air Leakage

Mandatory Requirement

Durable Air Sealing

- **Detailed air barrier & insulation list**
- **Fireplace: outside combustion air**
- **Fenestration** (windows, doors)
- **Recessed lighting: ICAT and sealed**

Details of methods online @

402.4.1 Building thermal envelope. The *building thermal envelope* shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material:

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating a garage from conditioned spaces.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Attic access openings.
11. Rim joist junction.
12. Other sources of infiltration.

2009 IRC Section 1102.4.2

TWO options to prove building air tightness:

1. Testing of house leakage by certified verifier (RESNET, BPI or DET)

- Blower door result must be **< 7 ACH_{50}**

$$ACH_{50} = \frac{CFM50 \times 60}{Volume}$$

2. Or, visual inspection by code official

- **Code Checklist: *Air Barrier and Insulation Inspection*** (thermal bypass)
- **Requires multiple inspections**
  1. Framing stage
  2. Pre-drywall – post-insulation
  3. Final

NUMBER	COMPONENT	CRITERIA
1	Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material. Air-permeable insulation is inside of an air barrier.
2	Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
3	Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
4	Windows and doors	Space between window/door jambs and framing is sealed.
5	Rim joists	Rim joists are insulated and include an air barrier.
6	Floors (including above-garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of insulation.
7	Crawl space walls	Insulation is permanently attached to walls. Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.
8	Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
9	Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
10	Garage separation	Air sealing is provided between the garage and conditioned spaces.
11	Recessed lighting	Recessed light fixtures are air tight, IC rated, and sealed to drywall. Exception—fixtures in conditioned space.
12	Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
13	Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
14	Electrical/phone box on exterior walls	Air barrier extends behind boxes or air sealed-type boxes are installed.
15	Common wall	Air barrier is installed in common wall between dwelling units.
16	HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
17	Fireplace	Fireplace walls include an air barrier.

Exceptions: Renovations that do not touch entire building envelope and/or air distribution system

2009 IRC Section 1103.2.2 Duct Sealing

- **Ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed.**
- **Joints and seams shall comply with M1601.4.**
- **Duct tightness shall be verified.**

Exception: Duct tightness test is not required if the air handler and all ducts are located within *conditioned space*.

Diagnostic/Verification Tools

Blower Door

Duct Blower or
Duct Leakage Tester
(*Duct Blaster®*)

Duct and Envelope Tightness (DET) Verifier

***DET Verifier* designation was created by Southface**

in 2010 to train individuals to perform mandated testing of energy code (IRC/IECC 2009)**.**

Certified DET code verifier can be <u>either</u>:

- **Certified as:**
  - **RESNET HERS Rater**
  - **BPI Building Analyst or IDL**
- **Or, pass a Southface DET Verifier course**
  - **2-day class**: Discuss air flow principles and testing protocol; explain and practice calculations for ACH_{50} and % duct leakage.
  - Complete and pass **Field Exam** on equipment (setup and use blower door and duct tester; calculate and fill in results form)
  - Pass **Concepts Exam** – 25 Questions (1 hour) – min. score 76%
- **In La., equipment manufacturer certification is allowable <u>ONLY for duct testing</u>** (limited to *total duct leakage* test method; cannot use *leakage to outside* option)

Generic Test Results Form

Blower Door Test Result

Visual Inspection Checklist results:

Duct Testing Results:

Louisiana Residential Energy Code - Duct and Envelope Testing Results*

Address: 1234 Sample House Lane

Builder/Designer: Bill D. Home Phone: 222-333-4444

Envelope Summary: Building Envelope Tightness (BET)

BET test conducted by: Joe Tester Phone: 222-555-6666

Fan Flow at 50 Pascals = 1,844 CFM_{50} Total Conditioned Volume = 22,600 ft^3

ACH_{50} = CFM_{50} x 60 / Volume= 4.9 ACH_{50} (must be less than 7 ACH_{50})

Visual Inspection Option (may be conducted by an approved third-party instead of the BET test)

Visual Inspection Conducted by: Phone:

AIR BARRIER AND INSULATION INSPECTION

Y-N-n/a	COMPONENT	CRITERIA
	Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material.
	Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
	Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
	Windows and doors	Space between window/door jambs and framing is sealed.
	Rim joists	Rim joists are insulated and include an air barrier.
	Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of floor.
	Crawlspace walls	Insulation is permanently attached to walls. Exposed earth in unvented crawlspaces is covered with Class I vapor retarder with overlapping joints taped.
	Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
	Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
	Garage separation	Air sealing is provided between the garage and conditioned spaces.
	Recessed lighting	Recessed light fixtures are airtight, IC rated and sealed to drywall. Exception—fixtures in conditioned space.
	Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
	Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
	Electrical/phone box on exterior wall	Air barrier extends behind boxes or air sealed type boxes are installed.
	Common wall	Air barrier is installed in common wall between dwelling units.
	HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
	Fireplace	Fireplace walls include an air barrier.

Mechanical Summary: Duct Tightness Verification (DTV)

DTV Test Conducted by: Jane Tester Phone: 777-888-9999

Tool used to conduct the duct tightness test: duct blower (**DB**), blower door subtraction method (**BDS**), or flow hood (**FH**).

Unless all ducts are located within conditioned space, must verify one of the following:

- Post-construction duct leakage to outdoors (**PCO**) is ≤ 8%,
- Post-construction total duct leakage (**PCT**) is ≤ 12%
- Rough-in total duct leakage (**RIT**) with air handler installed is ≤ 6%
- Rough-in total duct leakage with no air handler installed (**RITnah**) is ≤ 4%

% Duct Leakage Result = CFM_{25} x 100 / Conditioned floor area served

System	Tool (DB, BDS, FH)	Test (PCO, PCT, RIT, RITnah)	CFM_{25}	Area served (ft^2)	Result (%)
1 Main	DB	PCO	165	2,300	7.2%
2					
3					

*Note: This document to be posted on or in the electrical distribution panel.

Table 1102.4.2 Air Barrier and Insulation Inspection

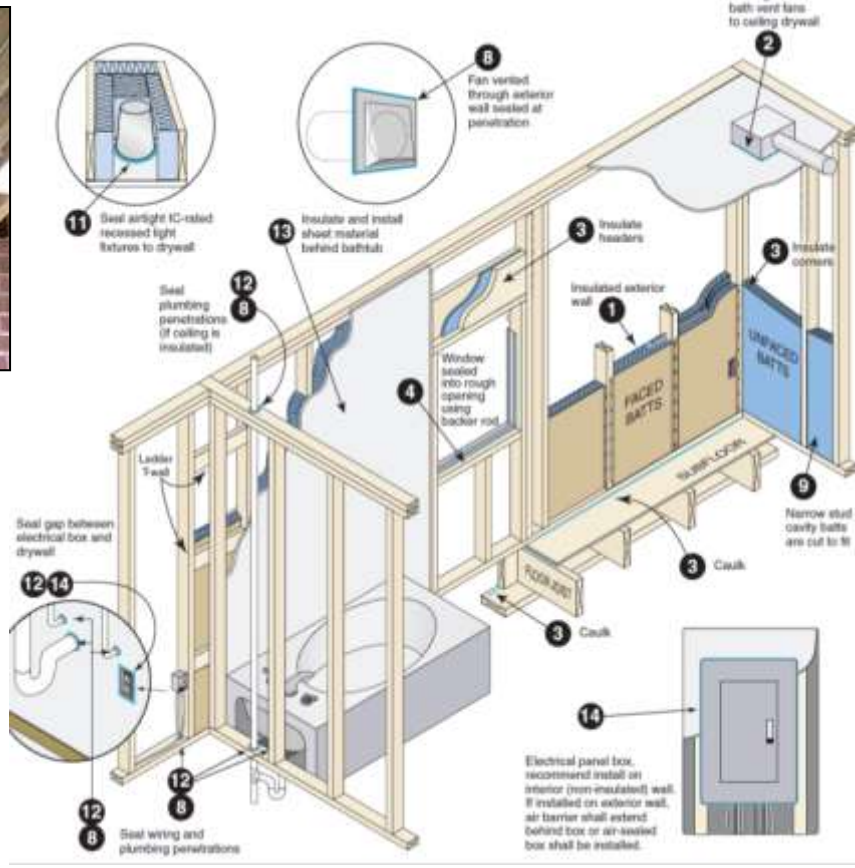
NUMBER	COMPONENT	CRITERIA
1	Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material. Air-permeable insulation is inside of an air barrier.
2	Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
3	Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
4	Windows and doors	Space between window/door jambs and framing is sealed.
5	Rim joists	Rim joists are insulated and include an air barrier.
6	Floors (including above-garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of insulation.
7	Crawl space walls	Insulation is permanently attached to walls. Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.
8	Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
9	Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
10	Garage separation	Air sealing is provided between the garage and conditioned spaces.
11	Recessed lighting	Recessed light fixtures are air tight, IC rated, and sealed to drywall. Exception—fixtures in conditioned space.
12	Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
13	Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
14	Electrical/phone box on exterior walls	Air barrier extends behind boxes or air sealed-type boxes are installed.
15	Common wall	Air barrier is installed in common wall between dwelling units.
16	HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
17	Fireplace	Fireplace walls include an air barrier.

Visual Inspection Option

Official inspection of 2009 IRC checklist may be used instead of a blower door test.

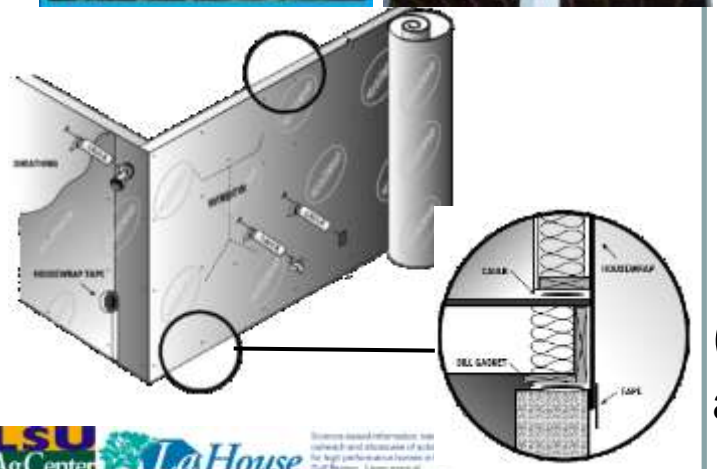
But must meet **ALL criteria** to pass code.

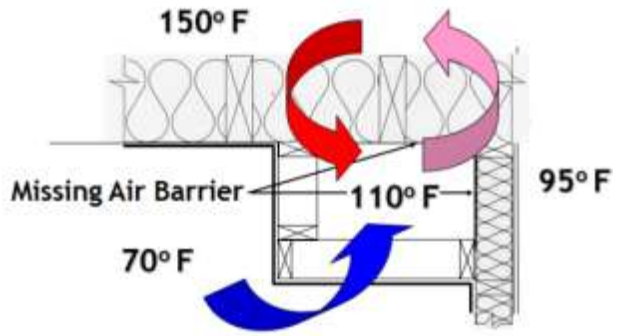
Here's how…



(1) Air barrier, thermal barrier:

Insulation **in full contact** with air barrier. Joints in air barrier are sealed. Air-permeable insulation **not** used as air barrier.

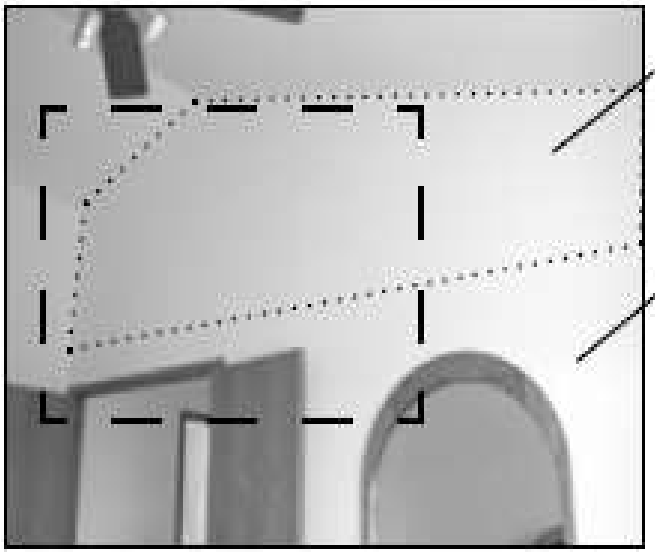




(2) Ceiling/attic: Air barrier in **dropped ceiling** aligned with insulation. Vented **attic access** sealed.

Find the Flaw

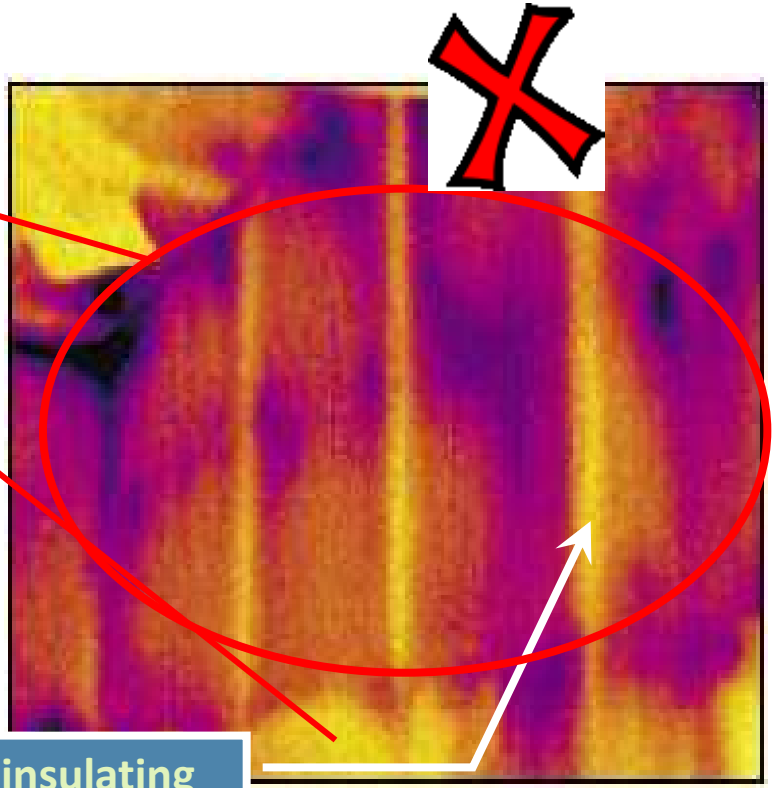
Knee Walls



Knee wall to attic space

Partition wall to another heated space

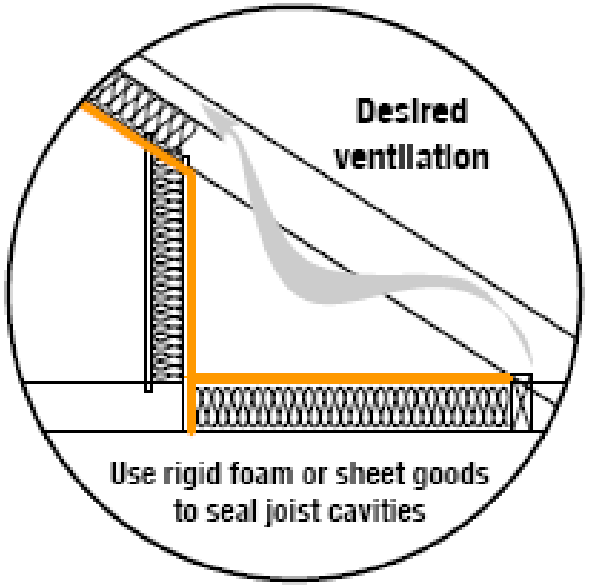
(c)

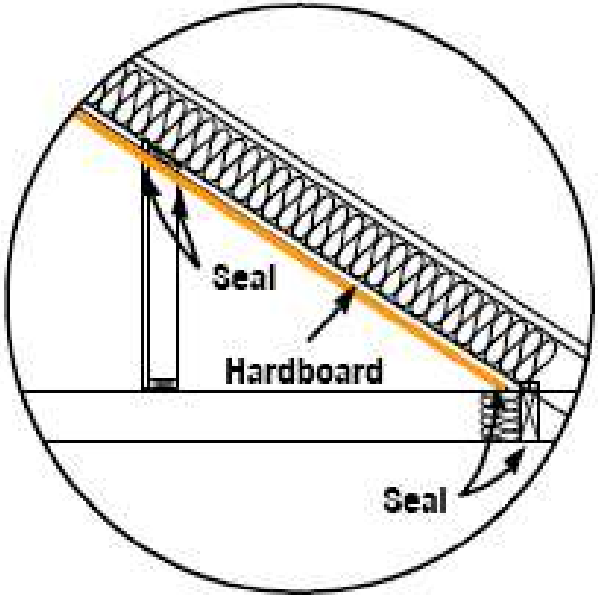


Wood studs provide more insulating value than poorly installed insulation with no air barrier on attic side

Images Courtesy: U.S. EPA

Knee Wall Options, Cantilevers





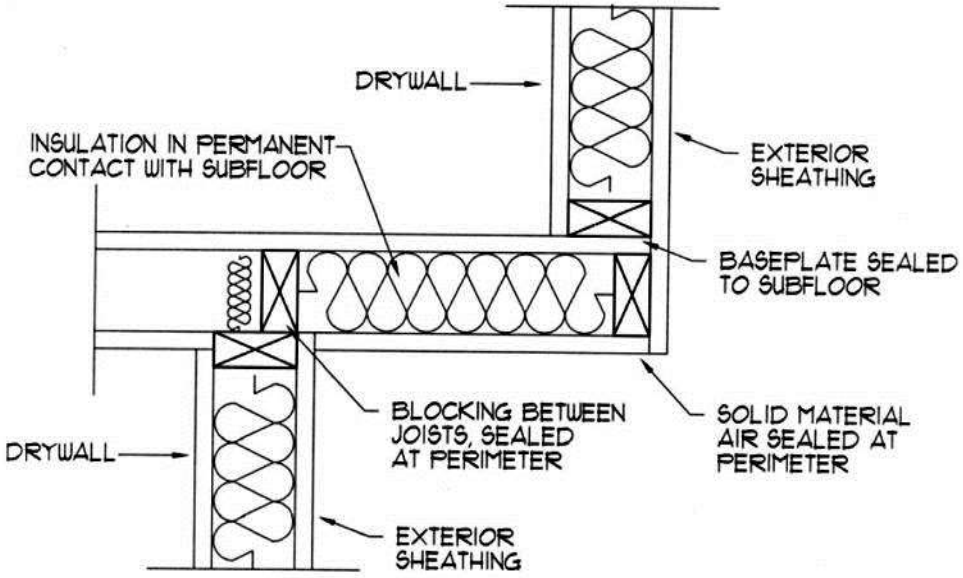
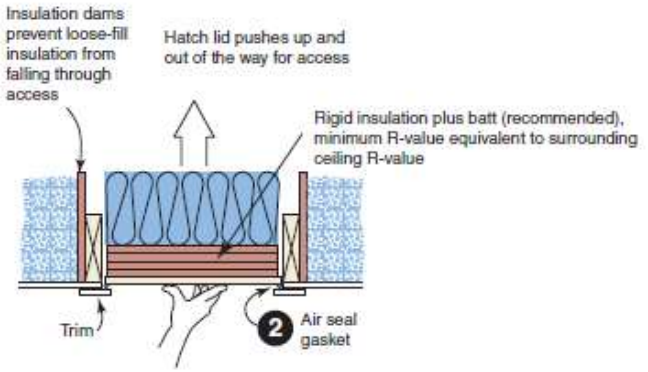


Image Courtesy: Building America

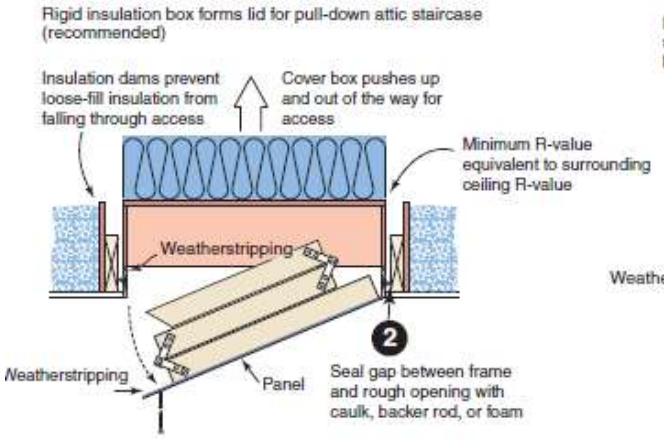
Best Practice: Insulating Attic Access

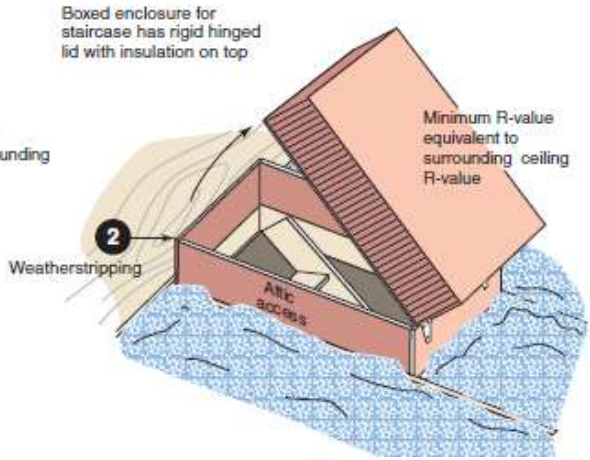
beyond R-4 (La. amendment), to same R-value as rest of ceiling

Attic scuttle



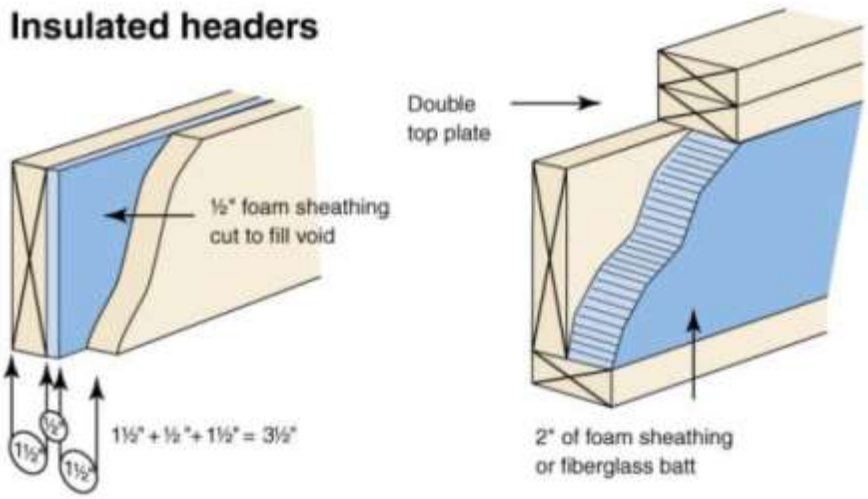
Attic pull-down stairs

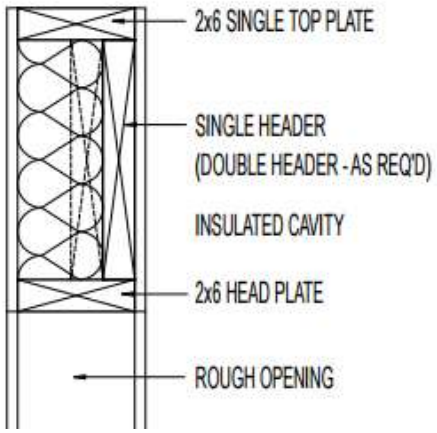


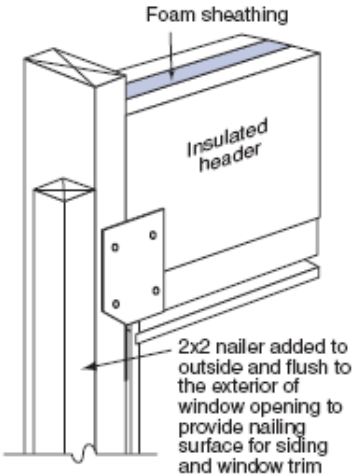


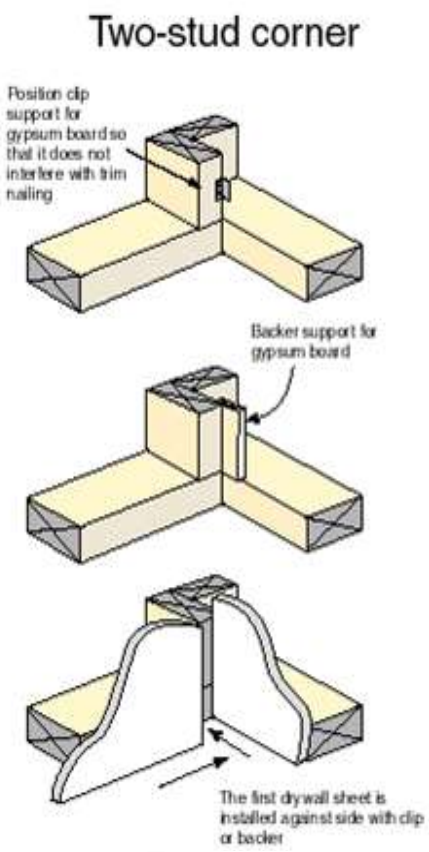
Advanced Framing Details

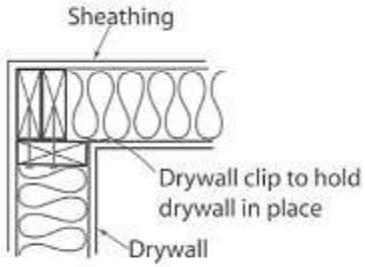
(3) Walls: Corners, headers insulated. Sill sealed to foundation.



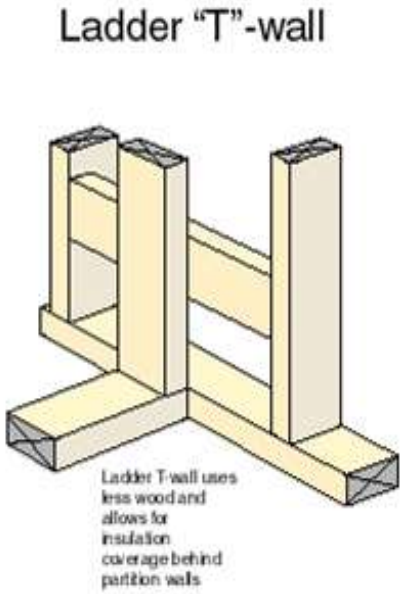




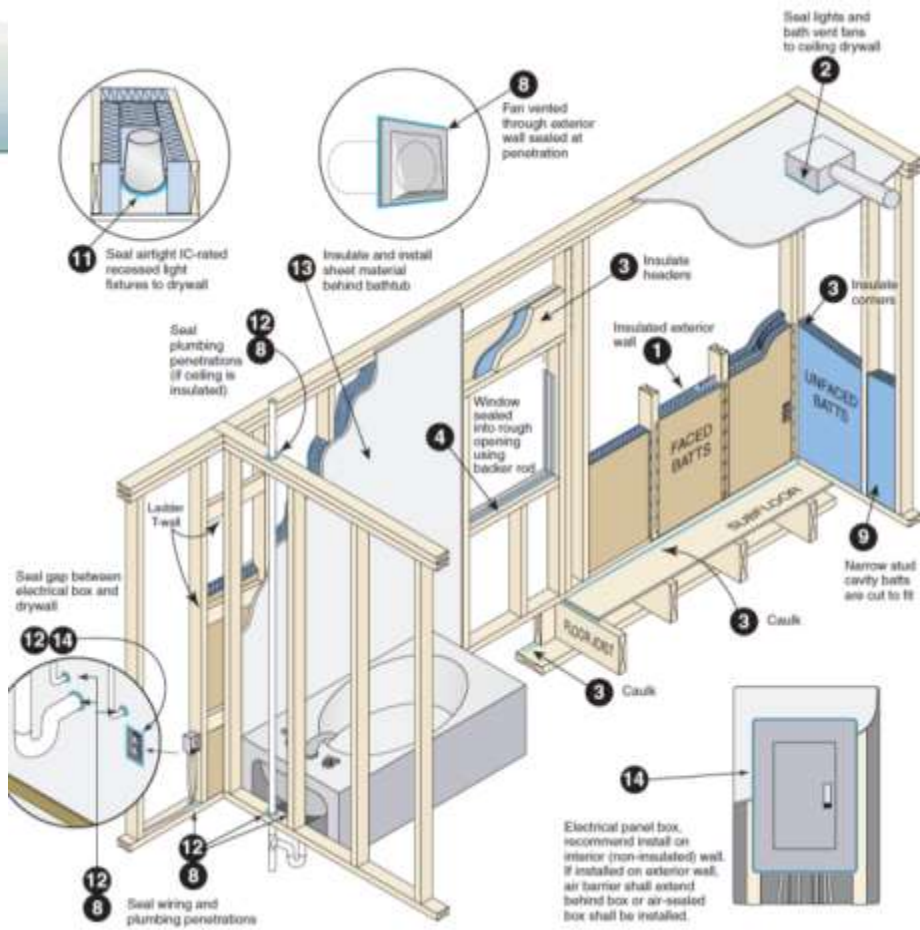




Three-stud corner



Sill gasket under bottom plate.

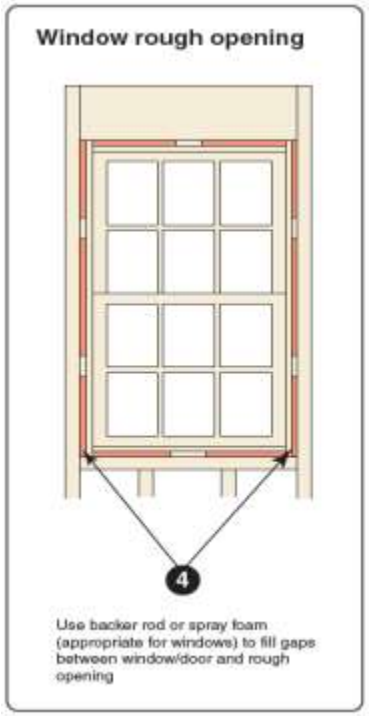


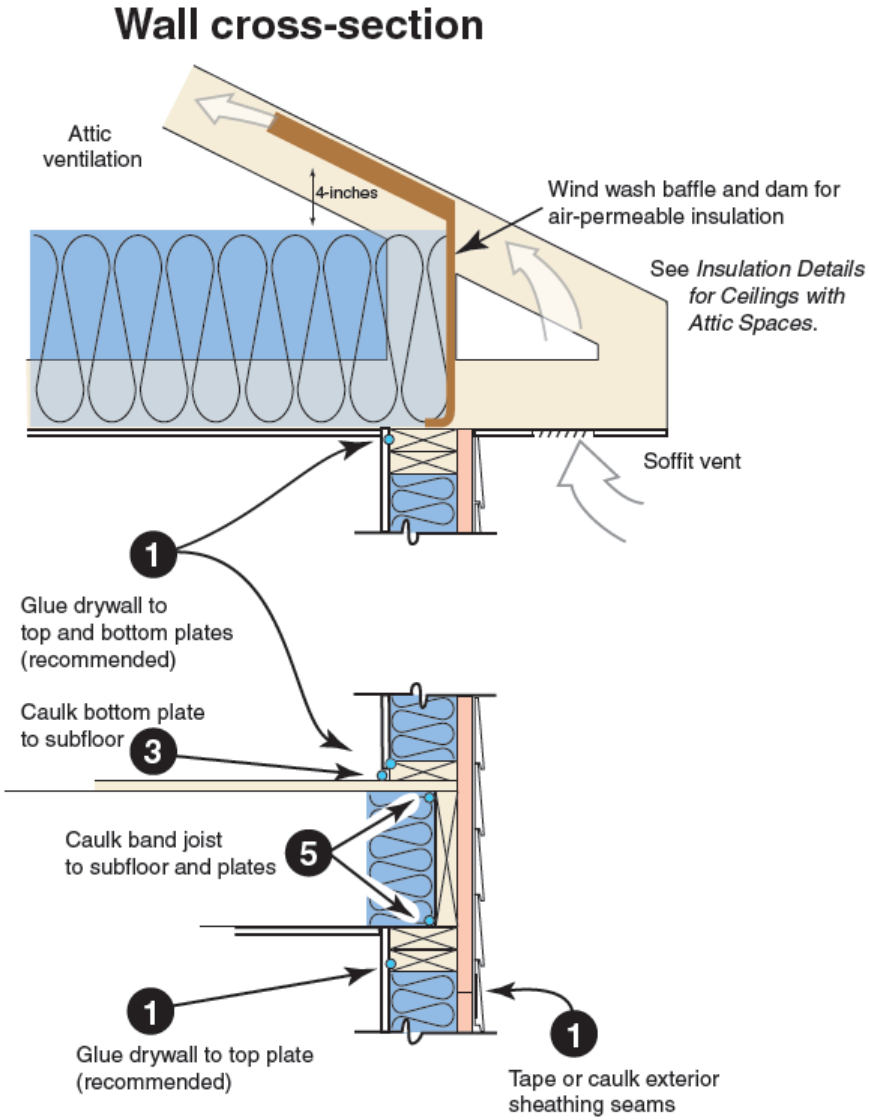
(4) Windows, doors: Jambs sealed to framing.

(5) Rim joists
insulated, with air barrier.

Best Practices

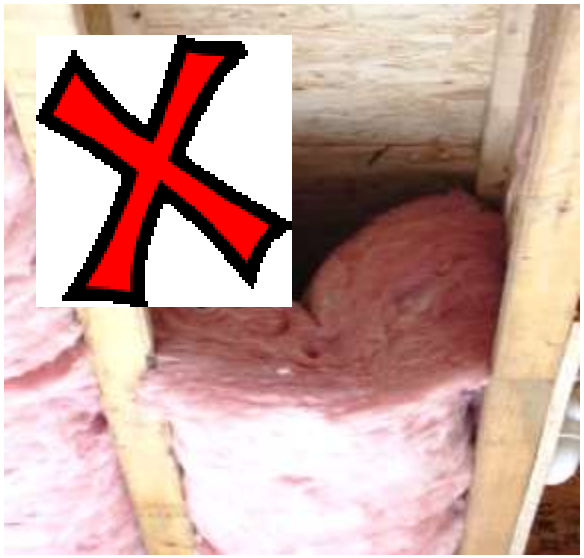
Airtight Windows & Rim Joists; Attic Insulation Baffles

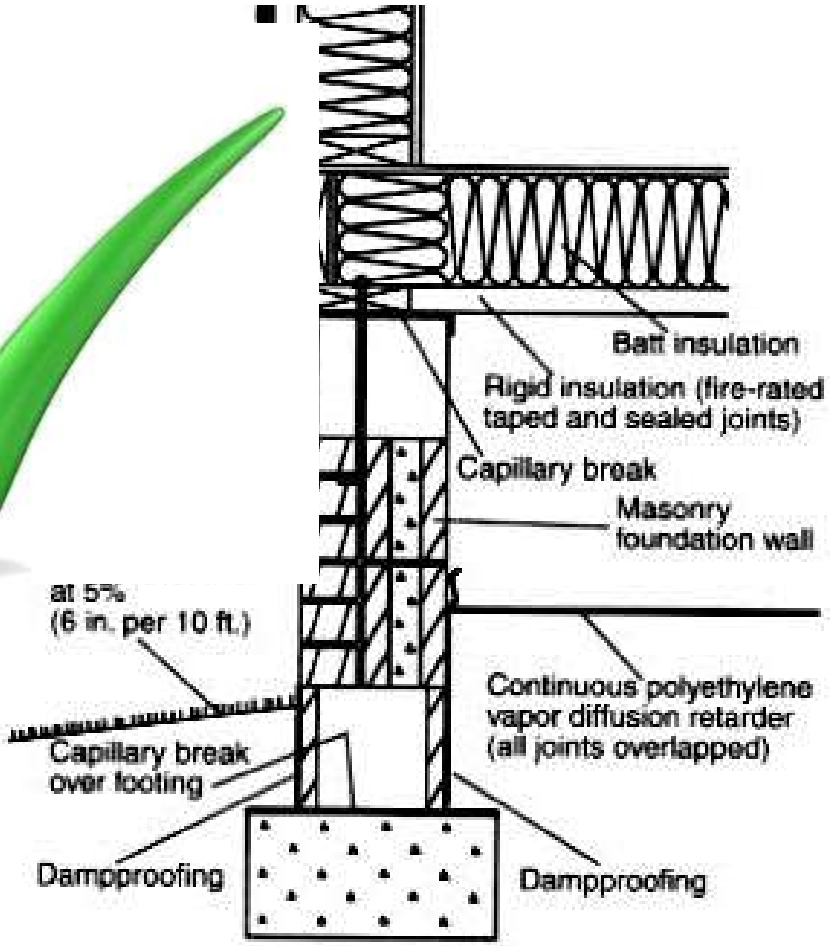




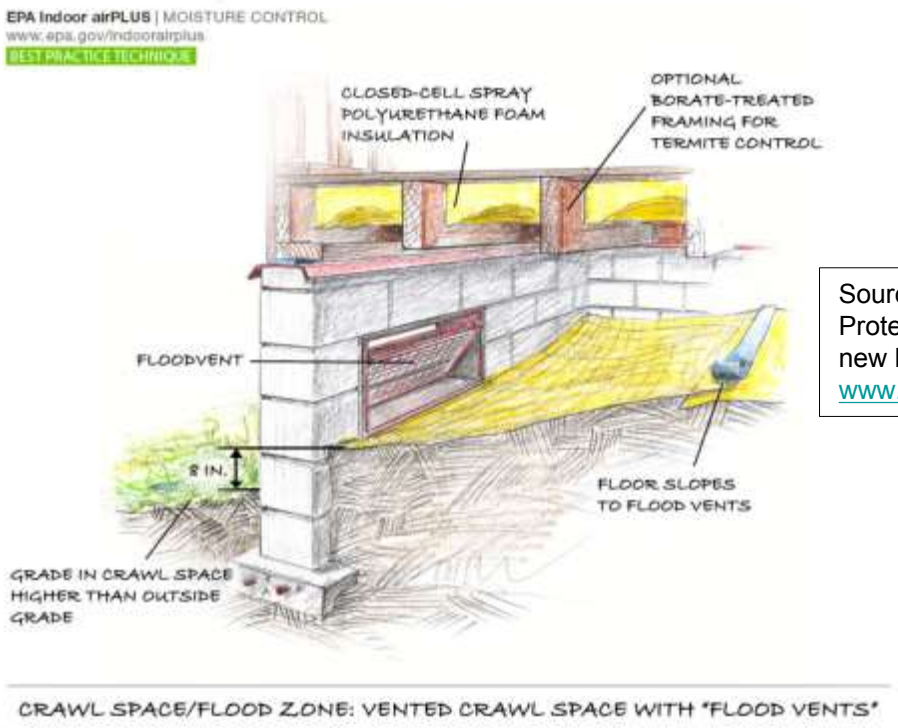
Windows, skylights and doors ≤ 0.3 cfm/s.f.,
Swinging doors ≤ 0.5 cfm/s.f.
Exception: site built

(6) Floors: **Insulation** in permanent contact with "subfloor decking" (air barrier). **Air barrier at edge.**





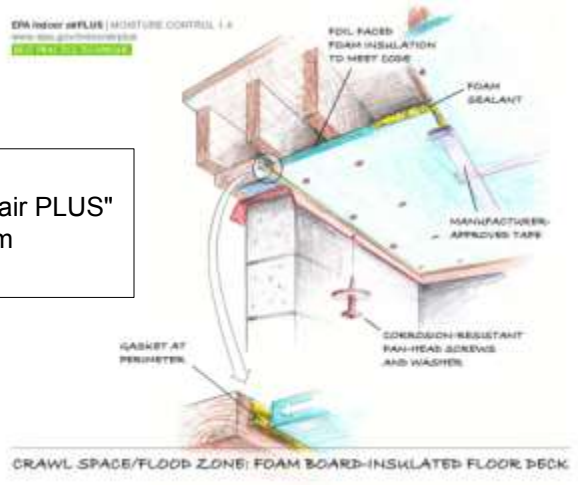
(6) Best Practice in Hot, Humid Climate



CRAWL SPACE/FLOOD ZONE: VENTED CRAWL SPACE WITH "FLOOD VENTS"

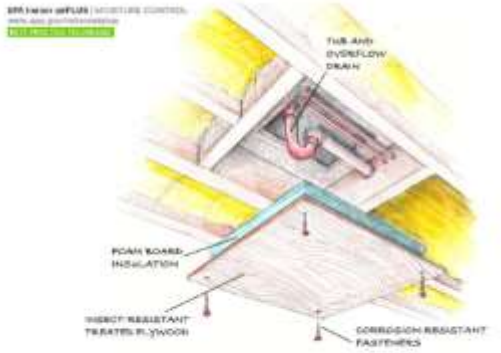
to prevent wet subflooring – causing buckled floors, decay, mold, $$$$ loss

Source: U.S. Environmental Protection Agency's "Indoorair PLUS" new homes labeling program www.epa.gov/indoorairplus

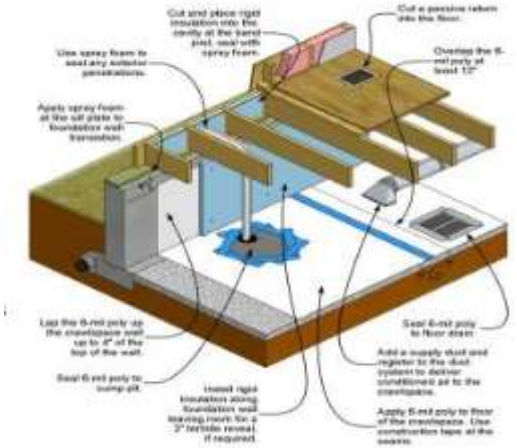


CRAWL SPACE/FLOOD ZONE: FOAM BOARD-INSULATED FLOOR DECK

Note: Wording of code seems to disallow above. Fill with batts if code official uses literal interpretation.

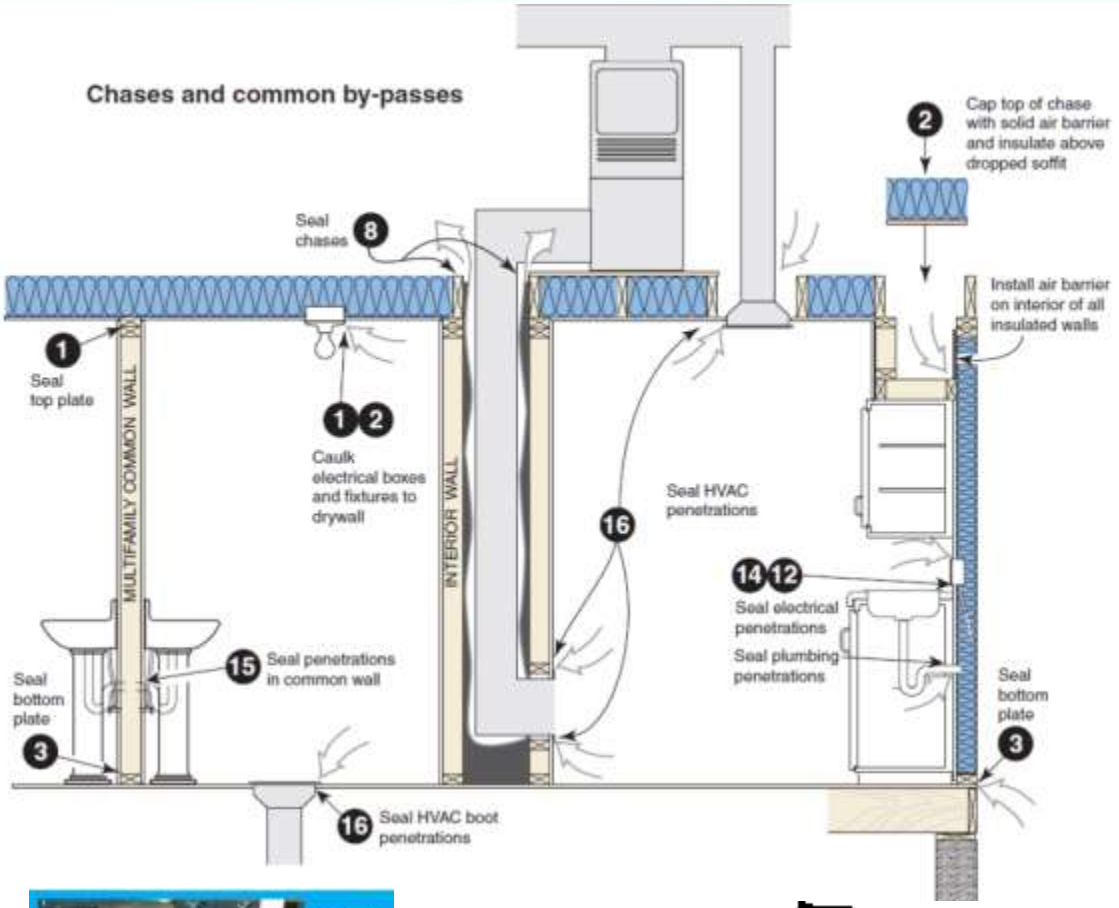


CRAWL SPACE/FLOOD ZONE: ACCESS HATCH BENEATH TUB

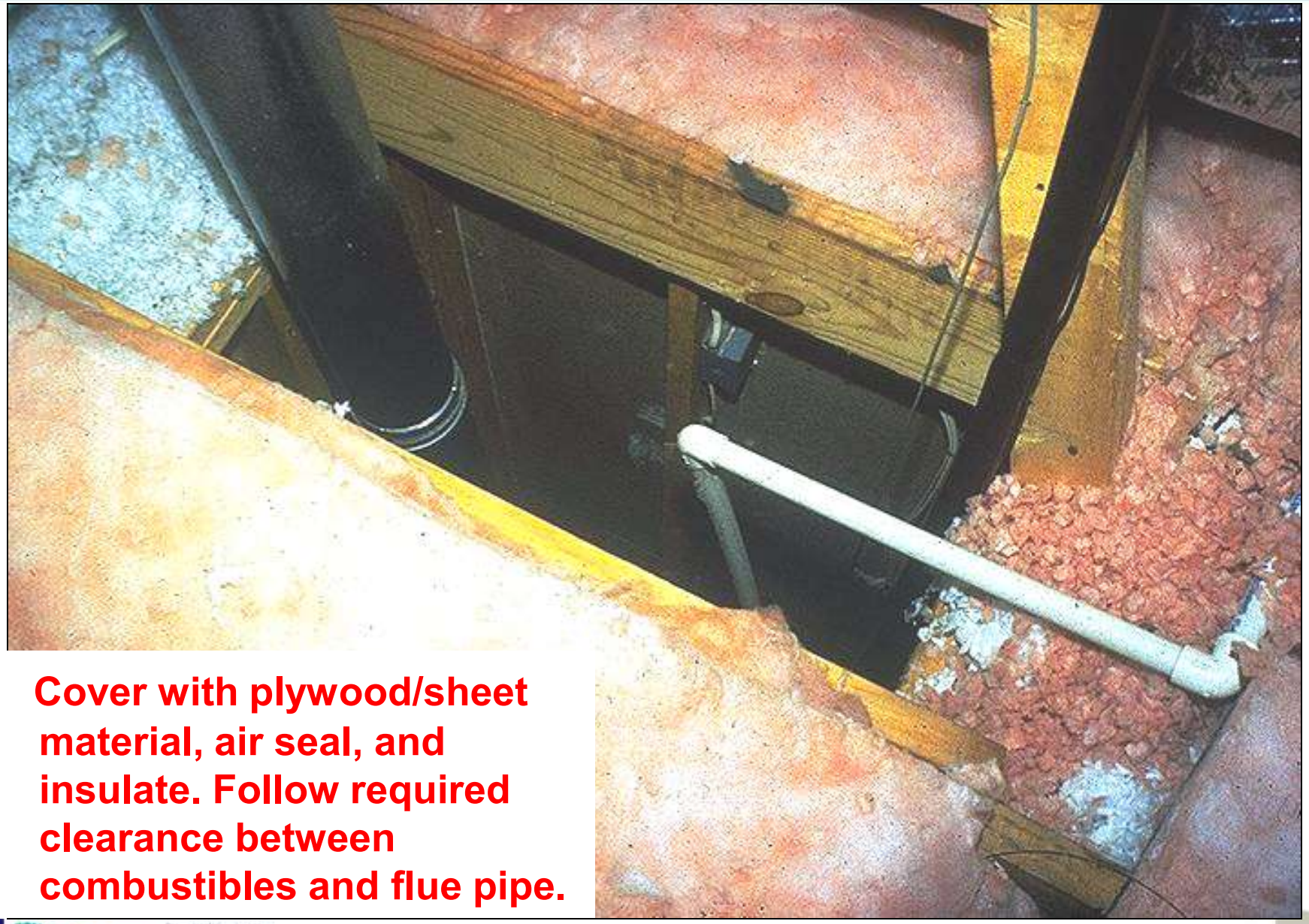


(7) Crawlspace walls (unvented, conditioned): Ground cover + permanent wall insulation. ***Note:*** *Not recommended if flood risk; risky in south La.*

(8) Shafts, penetrations: Duct & flue shafts, utility holes, knee wall openings sealed.



First Rule of Air Sealing: No BIG Holes!



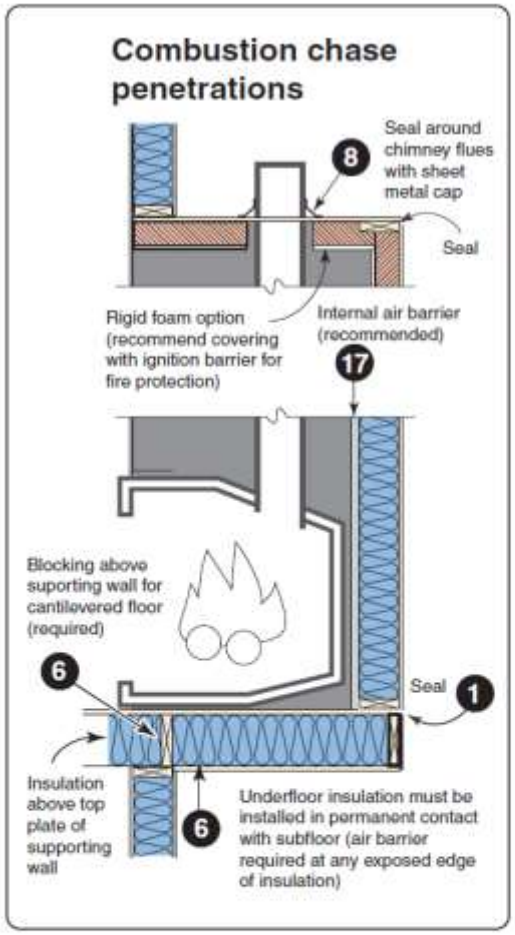
Cover with plywood/sheet material, air seal, and insulate. Follow required clearance between combustibles and flue pipe.

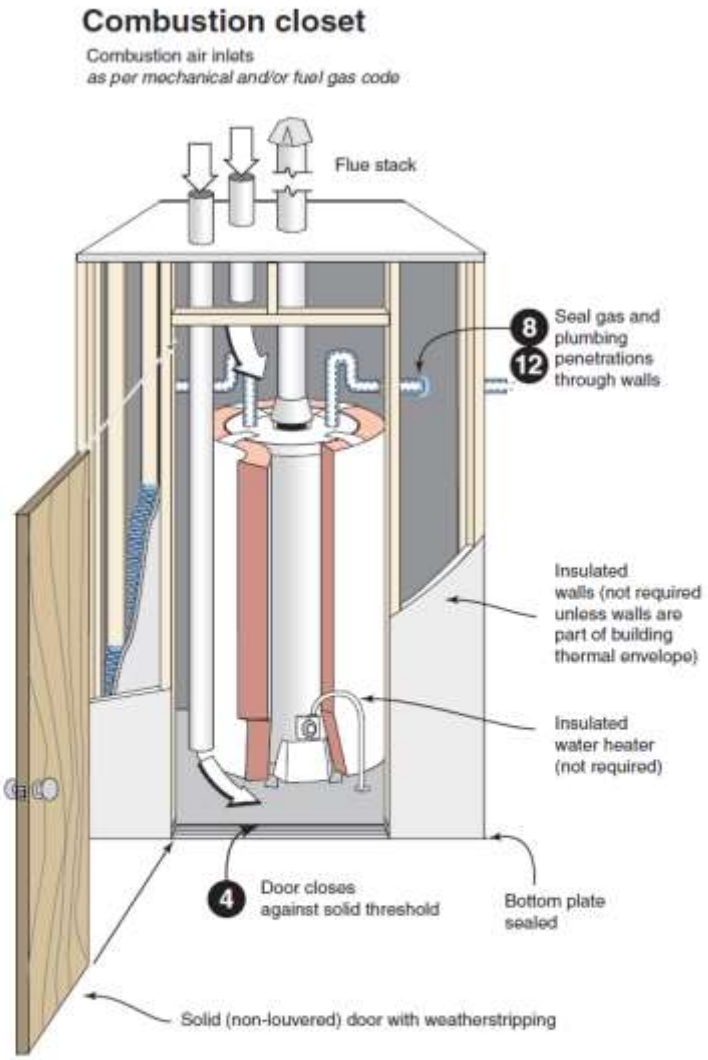
The Big Chimney Hole

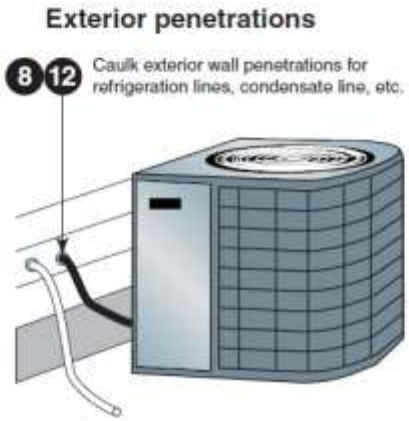
Big square hole around round chimney

Seal with metal collar, high temp. caulk. Add metal insulation dam

Best Practices



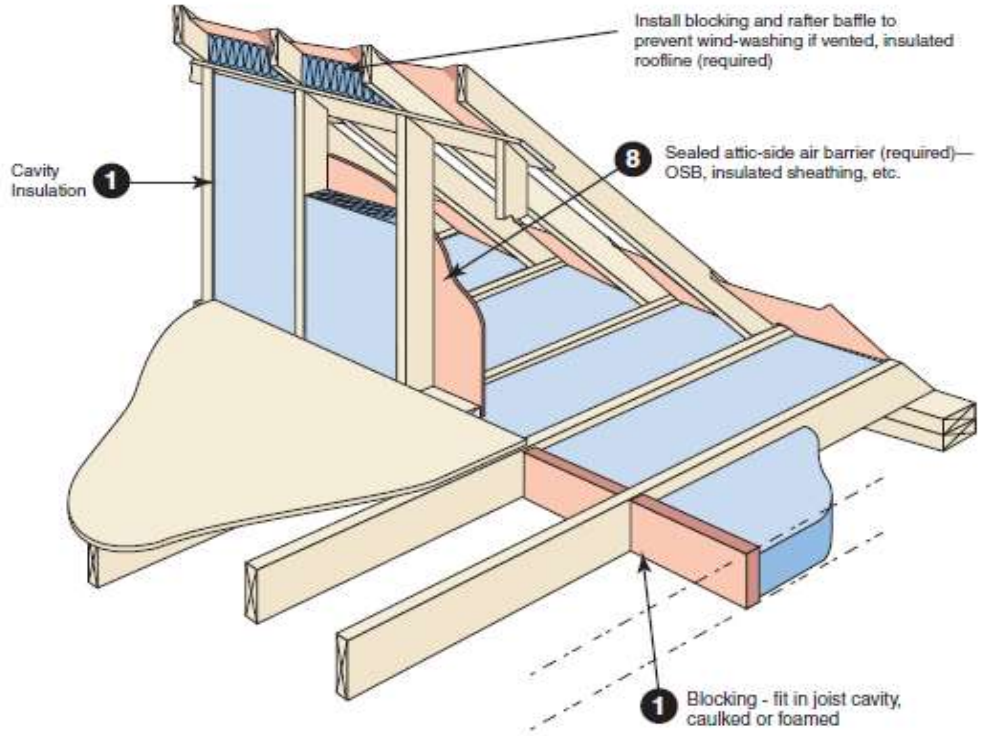




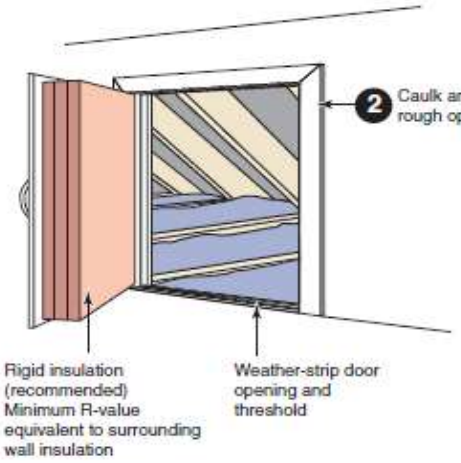
Prefabricated fireplaces must have outdoor combustion air

Air Sealing Kneewalls

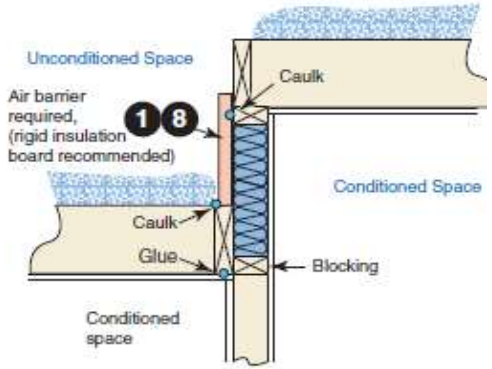
Inspector reaching under kneewall to take photo below of inter-story space open to attic air. ***List the problems!***

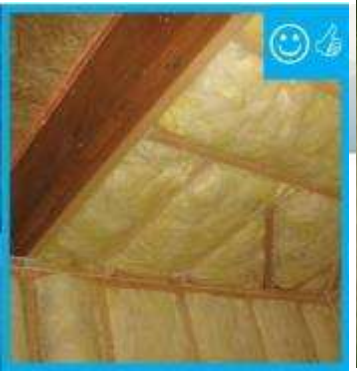


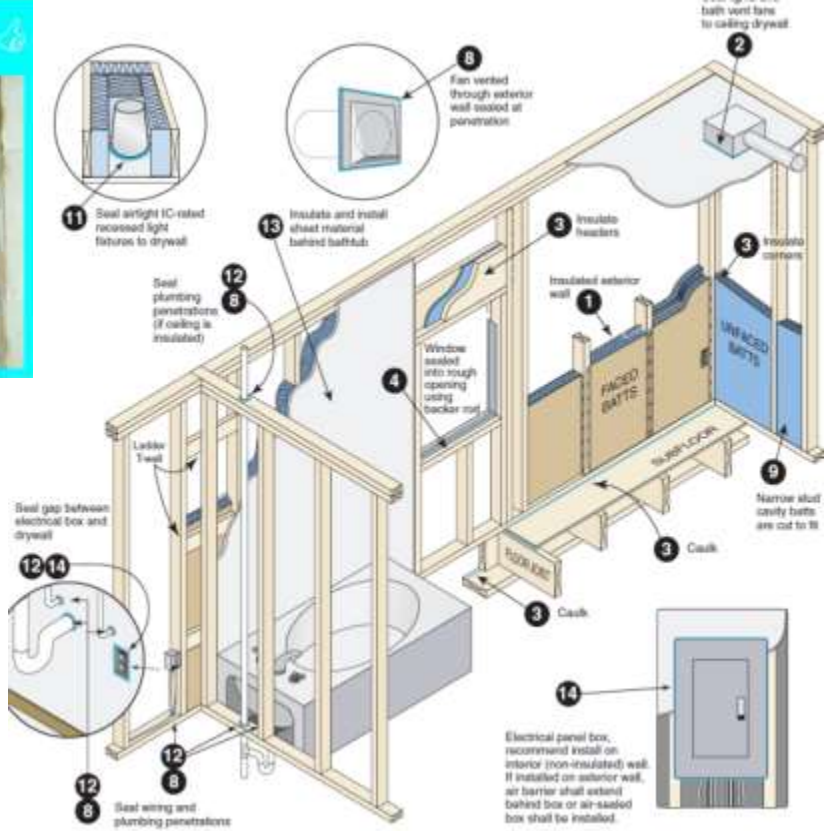
Attic knee-walls



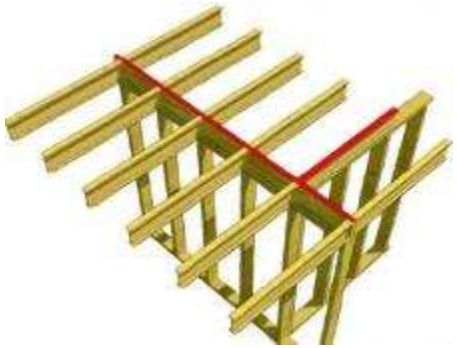
Two-level attic



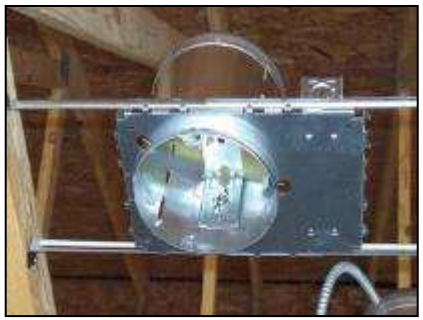




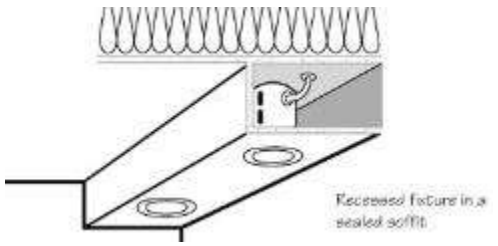
(9) Narrow cavities: filled with sprayed, blown or batts cut to fit.




(10) Garage separation: air sealing from conditioned space. *Advise continuous, rigid air barrier.*





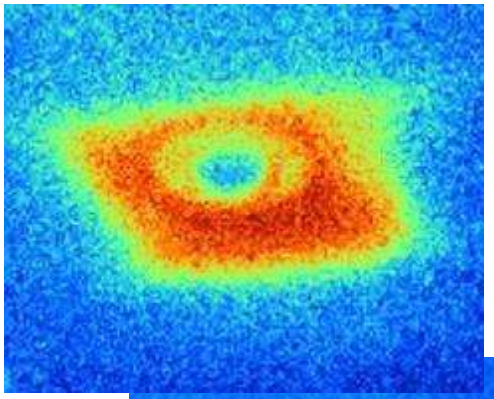


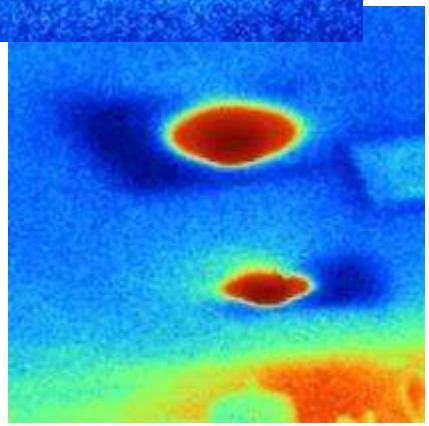
(11) Recessed lighting: ICAT rated and **sealed** to drywall. *Exception: fixtures in conditioned space.*

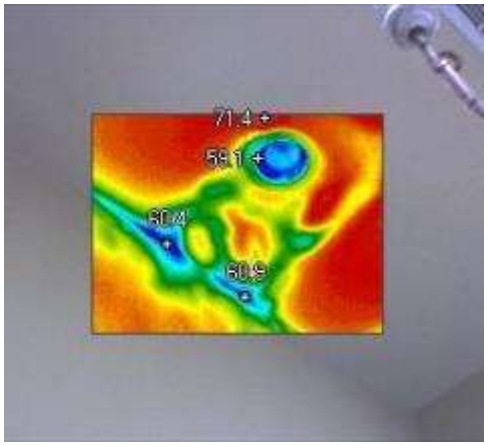
Turbocharged Leakage!

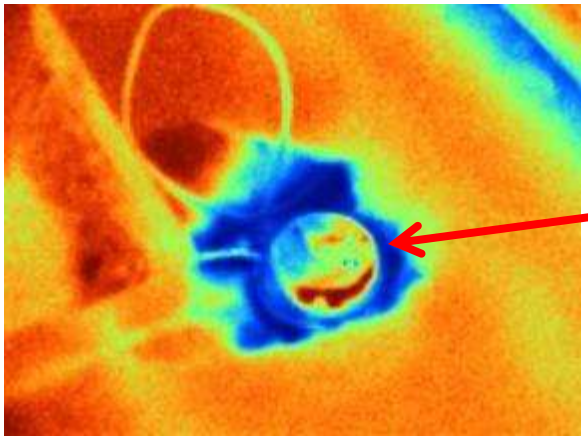
Each un-insulated recessed light
= **2 sq.ft. thermal hole to attic**

Bulb gets hot, creates draft,
pulls conditioned air out of house







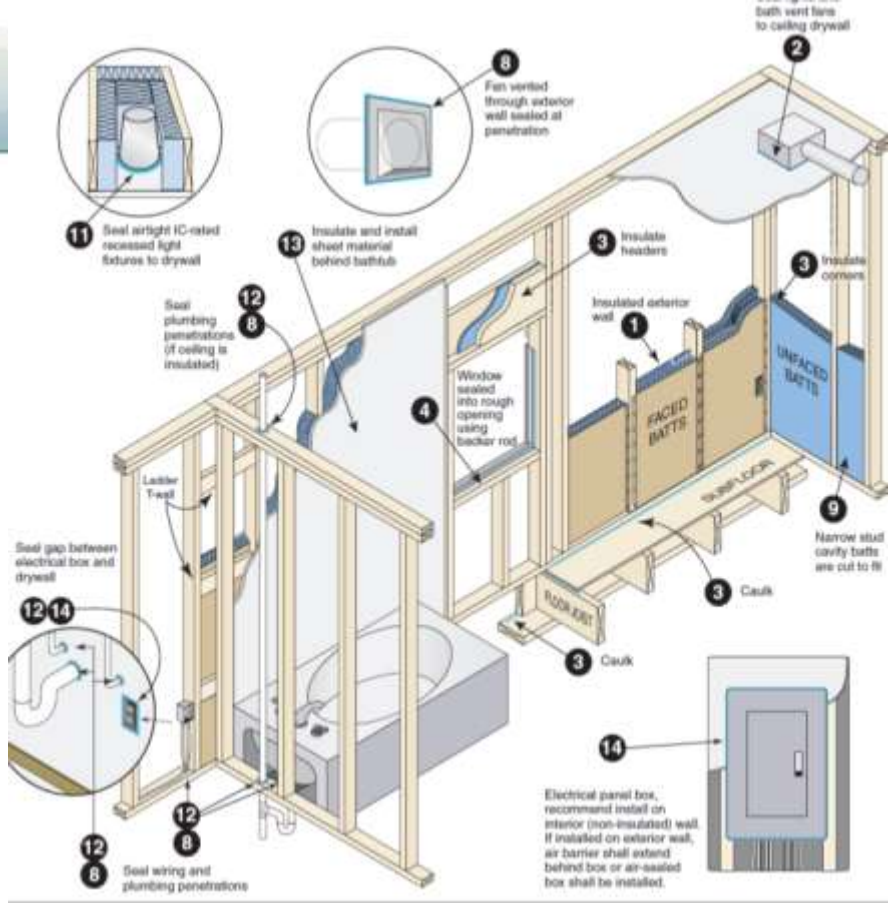


View from the attic – cold air leaking into attic from the house

Image courtesy of Energy Services Group

(12) Plumbing and wiring:

Insulation **between outside & pipes.**
Piping, wiring within insulation: sprayed, blown or batts cut to **fit around**.



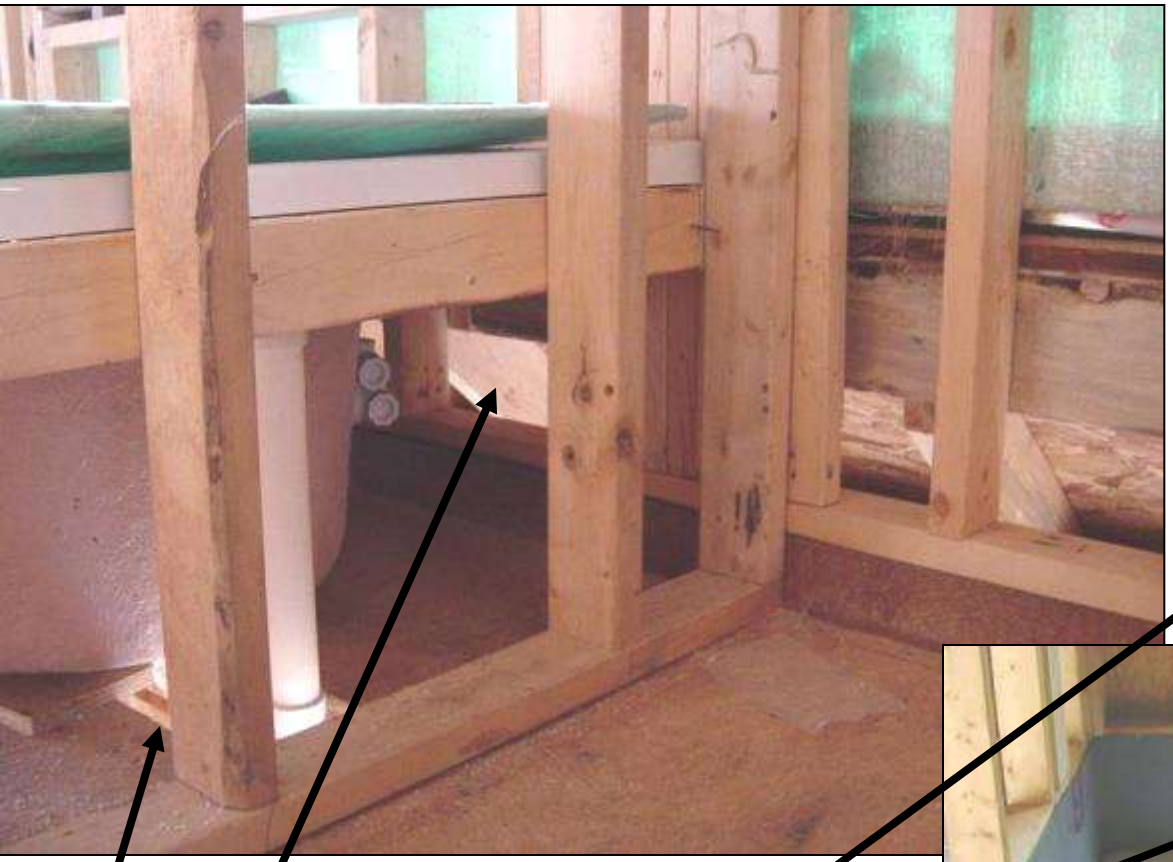
(13) Shower/tub on exterior wall:

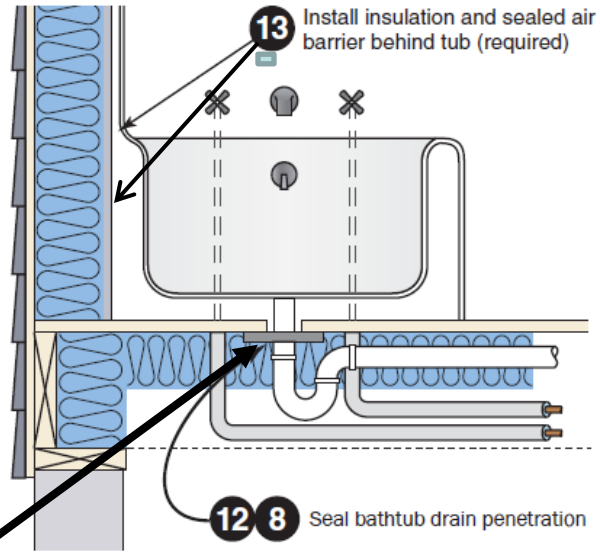
Insulation and inside air barrier installed before installing tub:

A. Install insulation (no voids).
B. Back with rigid air barrier (paperless).
C. Seal seams, gaps, holes.

Solid sheet behind tubs & showers on insulated walls

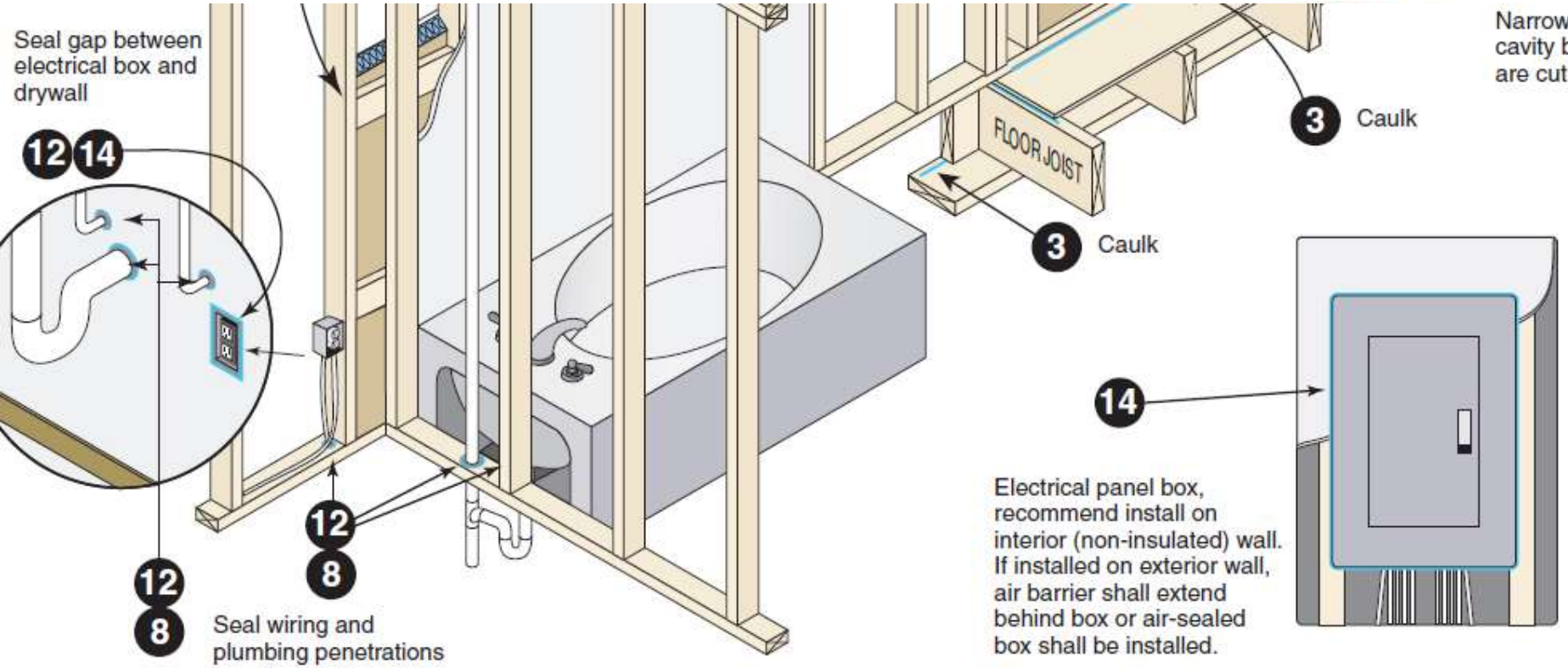
(cement board, paperless gypsum, thin structural sheathing)





Call back waiting to occur

Call back prevention



(14) Electrical/phone box: Air barrier behind boxes on exterior walls or airtight type box.

Gap in common wall

(15) Common wall:
Air barrier between dwelling units.

(16) HVAC register boots: Sealed to drywall or subfloor.

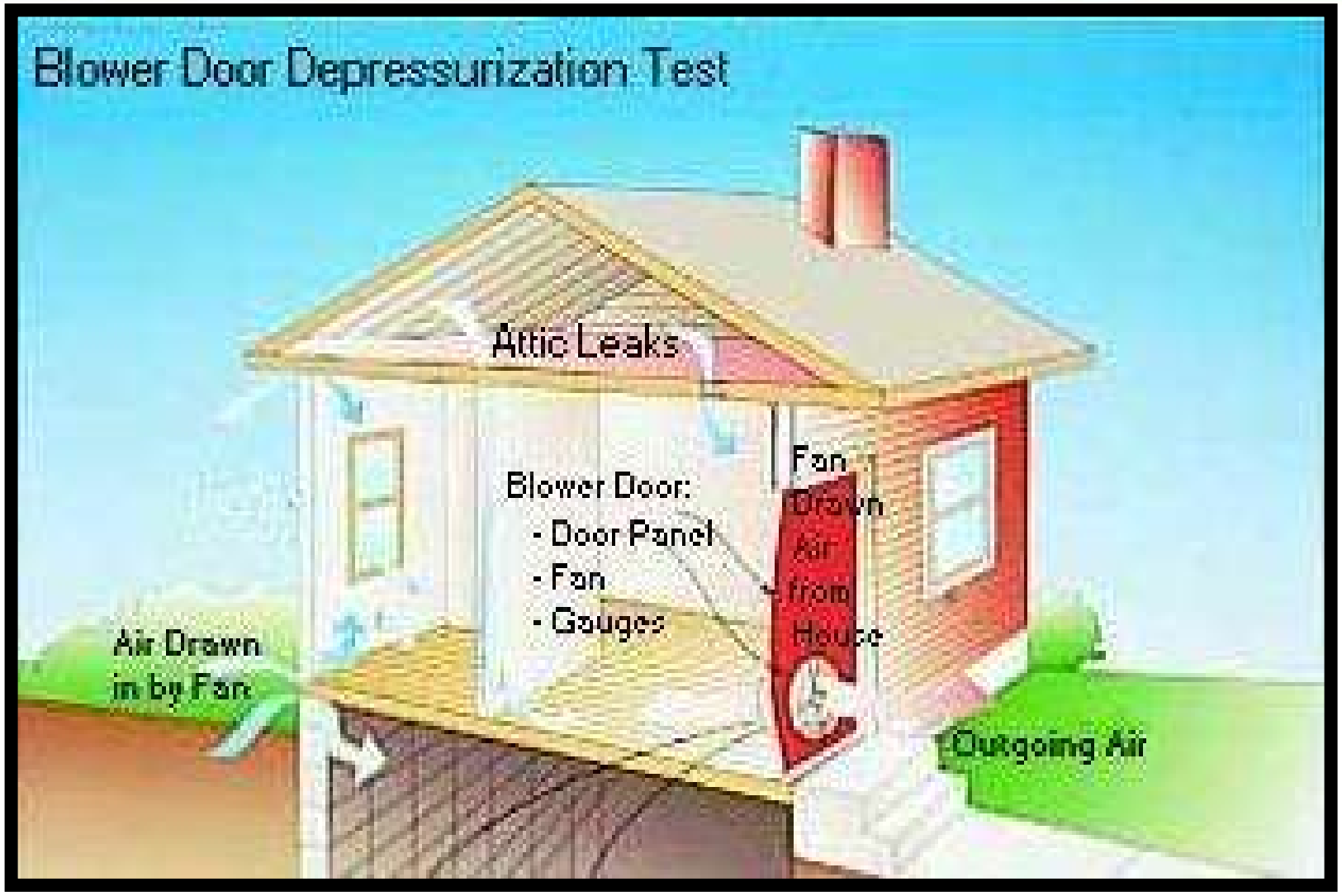
Fireplace on Exterior Wall

(17) Fireplace walls include (fireproof) air barrier.

Sequence:

1. **Insulate** exterior wall,
2. Install rigid, fireproof **air barrier** and seal
3. Install **fireplace** (with outside combustion air duct)

Blower Door Test Option



Air pulled out of house at 50 Pa is replaced by air pulled in through building envelope, so = sum of all leaks.

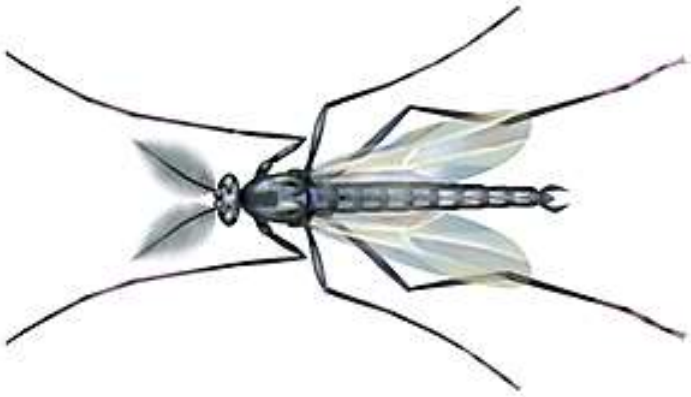
Blower Door Testing

- **Measures air infiltration rate** when house undergoes a pressure difference of 50 Pascals with reference to (WRT) the outside
- One tested home can be compared to another
- Helps identify leak paths
- Can show pressure imbalance problems & locate duct leaks (pressure pan)

What is a Pascal?

A **Pascal** is the **unit of pressure** in the International System of Units. It is named after French scientist Blaise Pascal (1623-1662) and is abbreviated **Pa**.

Blaise Pascal

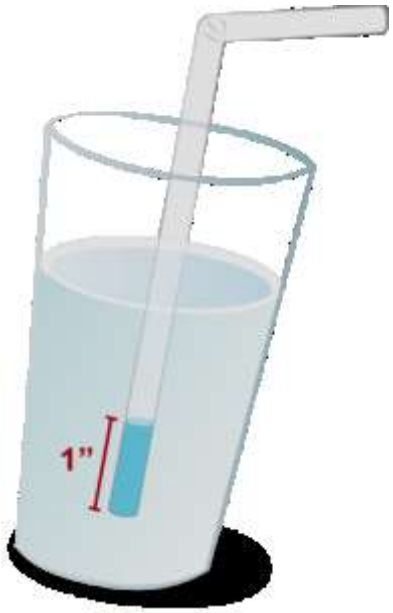


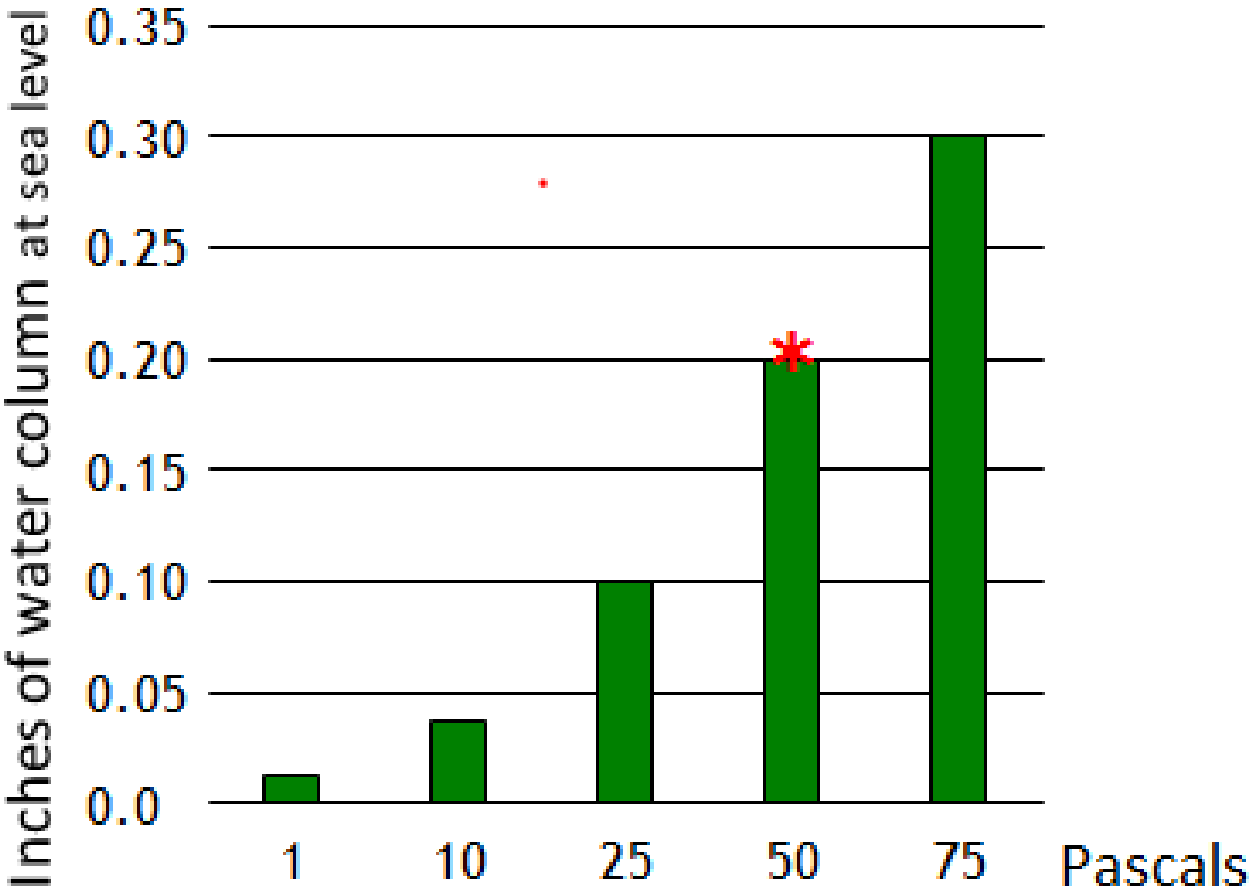
Flap of wing = 1 Pa

1 Pa = weight of 1 Post-It

Pascal & Inches of Water Column

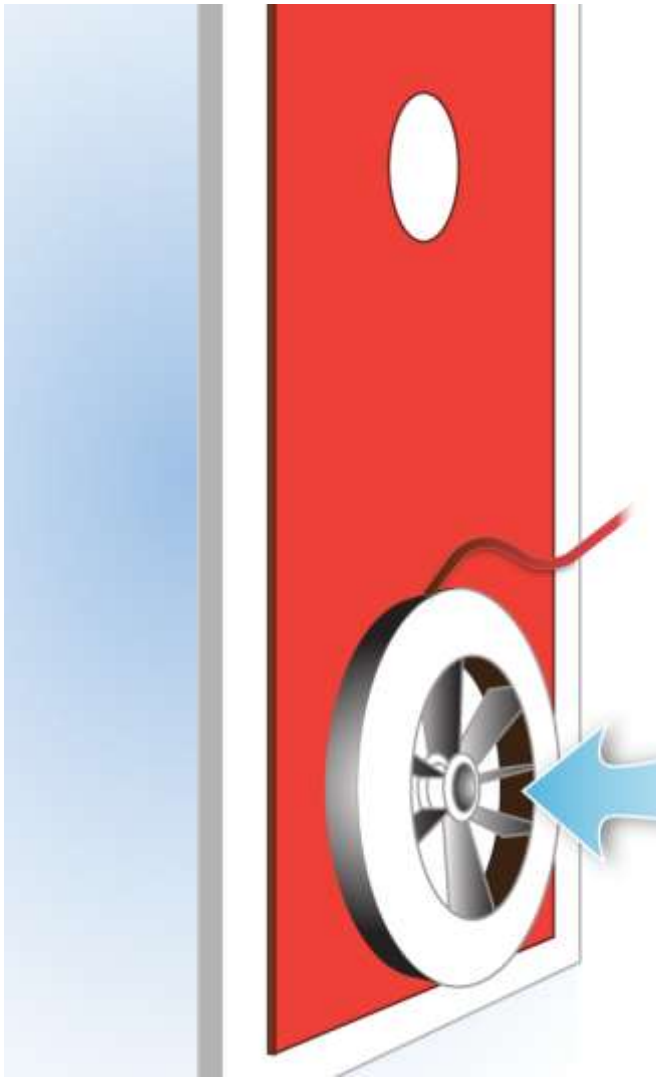
50 Pascals is similar to a 20 mph wind blowing on all 6 surfaces of a house





1 inch of water column = 248 Pascals

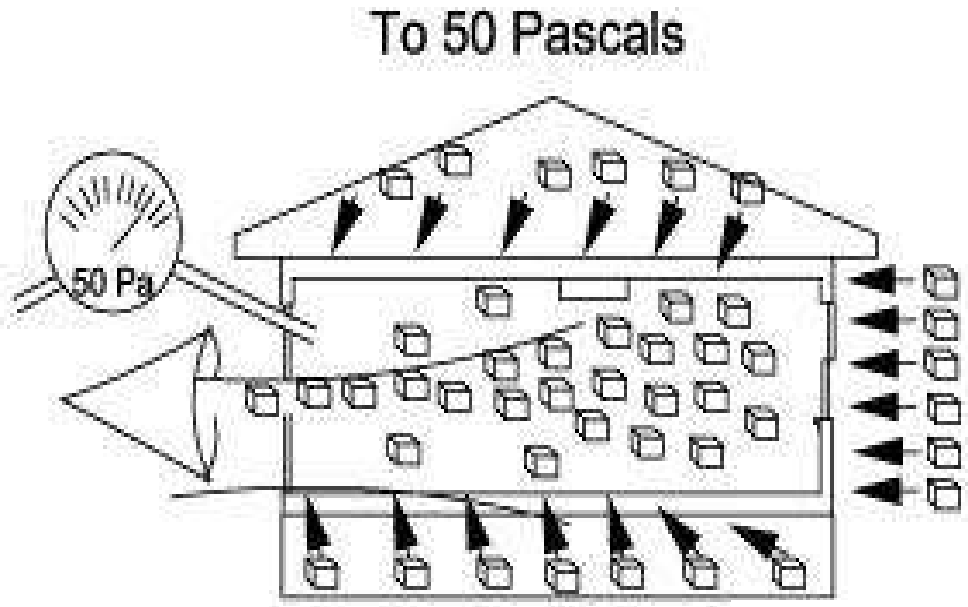
How a Blower Door Works



- Air flow across a sensor in the fan causes a pressure difference with reference to (WRT) the *inlet side of the fan*
- A manometer measures fan pressure difference compared to the fan inlet side (the house when depressurizing)
- Fan pressure difference is used to look up flow (CFM) on a chart *OR* gauge may convert fan pressure difference to flow rate (CFM)

Direction of Air Flow
(when depressurizing)

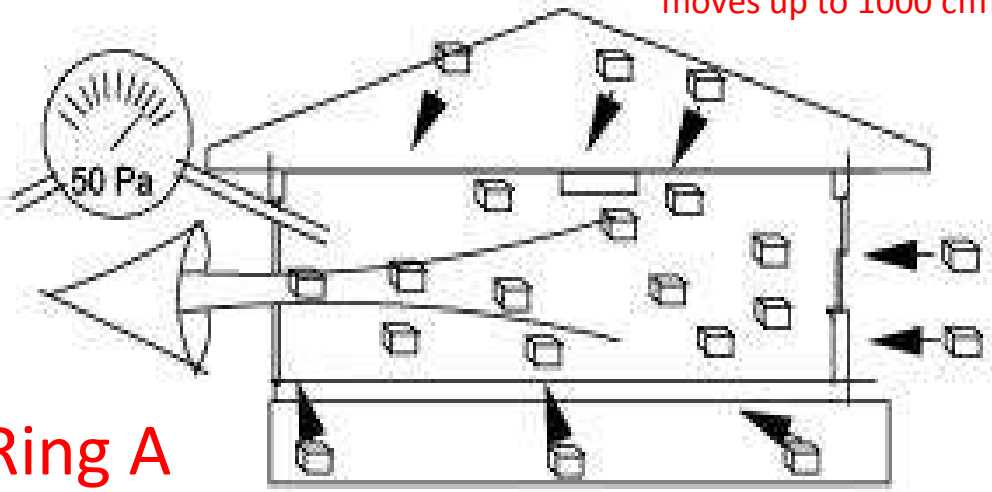
Blower Door Depressurization



Cubic Feet ("milk crates") per Minute!

Open Fan
(big blower door moves 6000+ cfm)

Ring B
(tiny blower door moves up to 1000 cfm)



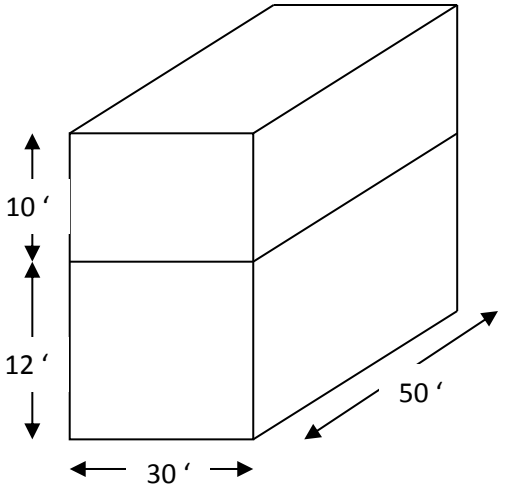
Use ring when possible for greater accuracy.

Ring A
(little blower door moves up to 2500 cfm)

Determining ACH_{50}

First, run blower door to determine CFM_{50}

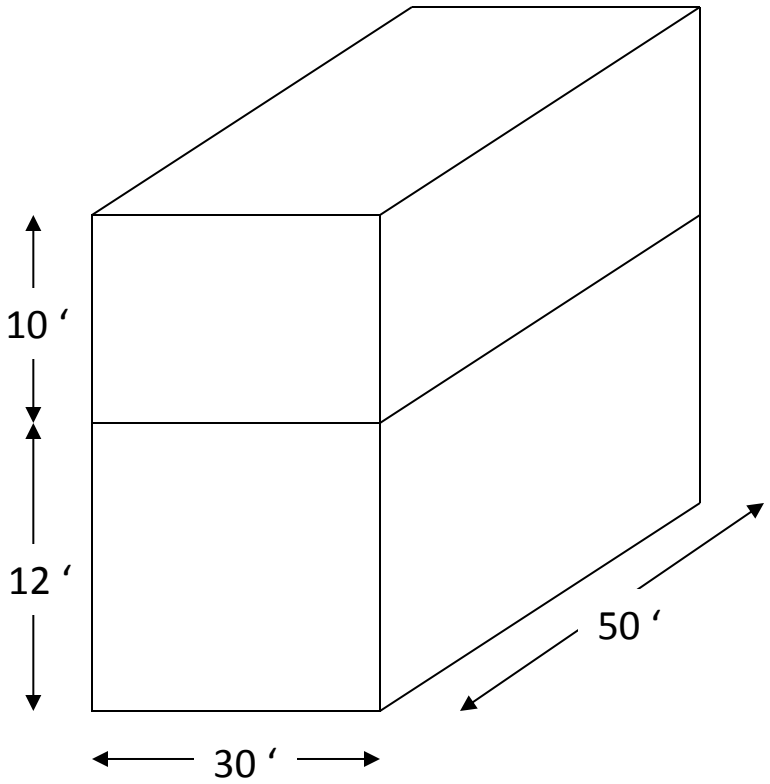
Then, Calculate ACH_{50}



Formula for ACH_{50}, requires volume of conditioned space

$$ACH_{50} = \frac{\text{Final Fan Flow } (CFM_{50}) \text{ X } 60}{\text{Volume}}$$

Blower Door - Sample House



1st Floor: 30x50x12 = 18,000 c.f.
2nd Floor: 30x50x10 = 15,000 c.f.
Total Volume: 33,000 c.f.

$$ACH_{50} = \frac{\text{Final Fan Flow } (CFM_{50}) \text{ X } 60}{\text{Volume}}$$

$$ACH_{50} = \frac{6755 \text{ x } 60}{33{,}000} = \mathbf{12.3}$$

Does it Pass or Fail?

FAIL!

Measured Blower Door result was 6,755 CFM @ 50 Pascals

2009 Energy Code requires $ACH_{50} < 7$

Blower Door DET Practice Exercises

Report the leakage rates from Examples 1, 2, & 3

	Ex. 1 1-story 1200 s.f. Vented Attic	Ex. 2 1-story 1200 s.f. Vaulted Ceiling	Ex. 3 2-story 2400 s.f. Vented Attic
• CFM_{50}	754	760	2,200
• Volume	9,600	12,000	21,000
• ACH_{50}	4.7	3.8	6.3
• **Pass Code?**	YES	YES	YES

Preparing the House

1. Walk through house
2. Close all windows
3. Close all exterior doors & attic or crawlspace
   hatches connected to conditioned space
4. Close exterior crawlspace doors
5. Set combustion appliances to “pilot” (if connected to building envelope)
6. Turn off all thermostats / air handlers
7. Open all interior doors
8. Make sure cover is on AHU
9. Close fireplace damper
10. Ensure fireplace ashes will not be pulled into room
11. Turn off everything that moves air
12. Tape over or pour water into traps
13. Close pet doors (existing homes)

See RESNET Standards Chapter 8 and Appendix A-26-27 www.resnet.us

Preparing the House

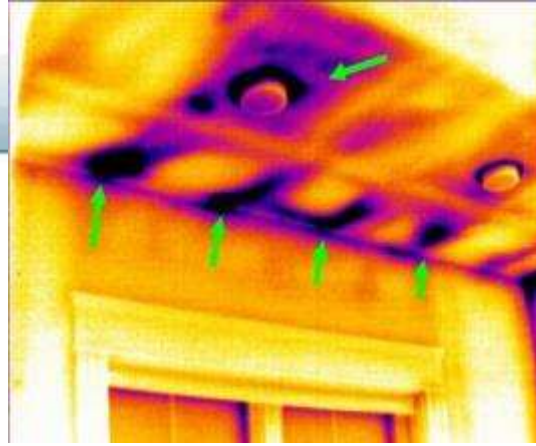
The biggest preparation issues are those that could:

- **Affect accuracy** of the test

- **Damage** the home

- Cause a **safety hazard** in the home

What if Blower Door test fails?



If a house fails the blower door test, diagnostic methods can find the problems. **A DET verifier may:**

1. **Check equipment and house setup** to make sure all windows and closures are indeed closed (kneewall doors, flue dampers, etc.).
2. **Try closing interior doors to isolate rooms or zones (one at a time) to find biggest problem area.** Feel airflow as door is closed and also note impact on CFM_{50}. For example, if closing the MBR door shows a drop of 1800 cfm_{50}, this area likely contains significant leaks.
3. **Use a smoke pencil or fog stick to find leaks.** May increase house pressure beyond 50 Pa. Consider pressurizing so positive pressure will push the smoke out at any leak paths.
4. When available, **run blower door in conjunction with an IR-camera inspection** identify leaks and other bypasses. (Most effective on hot or cold days.)
5. **Apply zone pressure testing** to identify problem areas.

A Blower Door can answer more…

BD+

- Determine where is the air barrier (*pressure boundary*) so you can focus air sealing efforts **(*blower door guided air sealing*)**
- Does the pressure boundary and insulation **(*thermal boundary*) properly lined up**?
- Are zones with poor **air quality**, such as garages or crawlspaces, connected to the indoors?
- **Which duct runs are leaky** (pressure pan)**?**

HVAC Systems

All Mandatory Requirements

Load Calculations

Heating and Cooling Efficiency

Ductwork

Duct Sealing, Testing, Installation and Insulation

FURNACE

A/C UNIT

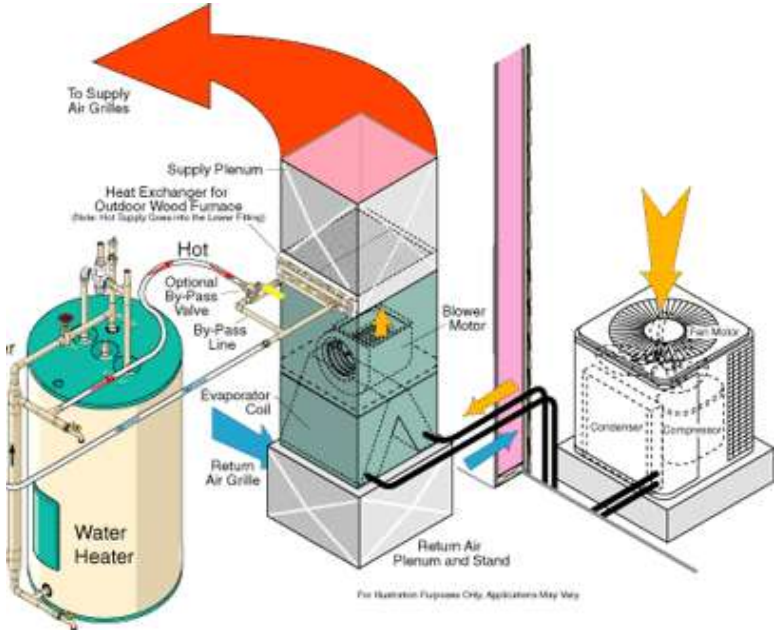
Temperature & Humidity Controls

Pipe Insulation

HVAC Controls

Mandatory Requirement:

- **Programmable thermostat required for furnace**
- **Heat Pump requires lockout capability to prevent unnecessary strip heat**



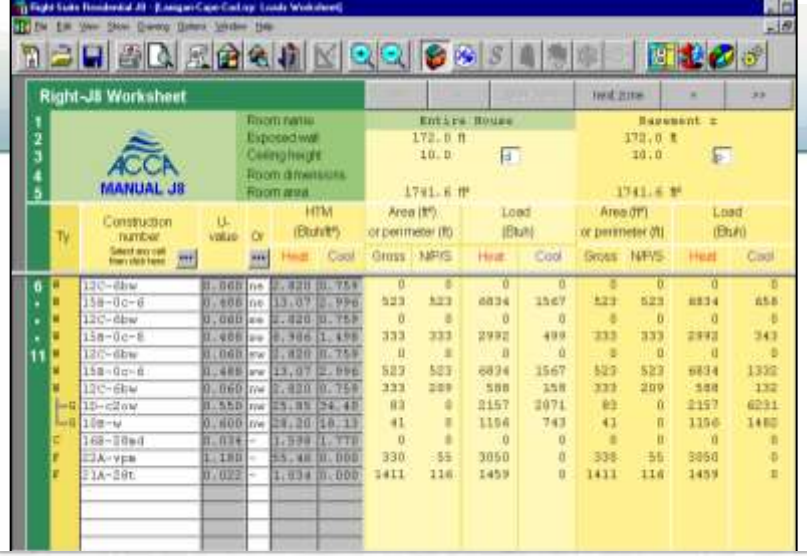
Code: HVAC Piping, Mechanical Vents

- **Pipe Insulation**
  - R-3: mechanical systems – fluids > 105 F or < 55 F
  - R-2: for plumbing circulating systems (plus controls)
  - R-4 for suction line-set as per M1411.5
- **Mechanical Vents**
  - require dampers (gravity/barometric or motorized)

Equipment Sizing

Load Calcs & Sizing

- **Per Mechanical section of IRC**
- **ACCA Manual J** or approved equivalent, i.e., ASHRAE Fundamentals
- **302.1: Interior design temp (72ºF heating, 75ºF cooling)**
- **MUST BE ACCURATE**



SECTION M1401
GENERAL

M1401.1 Installation. Heating and cooling equipment and appliances shall be installed in accordance with the manufacturer's installation instructions and the requirements of this code.

M1401.2 Access. Heating and cooling equipment shall be located with respect to building construction and other equipment to permit maintenance, servicing and replacement. Clearances shall be maintained to permit cleaning of heating and cooling surfaces; replacement of filters, blowers, motors, controls and vent connections; lubrication of moving parts; and adjustments.

M1401.3 Sizing. Heating and cooling equipment shall be sized based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.

M1401.4 Exterior installations. Equipment installed outdoors shall be listed and labeled for outdoor installation. Supports and foundations shall prevent excessive vibration, settlement or movement of the equipment. Supports and foun-

Ducts

Mandatory Requirements:

- **Insulation required for ducts outside of envelope.** In Louisiana:
  - **R-6 -- for supply ducts in vented attic**
  - **R-6 -- all other ducts in unconditioned space**
  - **No Insulation required if ducts inside building thermal envelope** (R-4 advised to prevent sweating)
- **Sealing required with mastic or UL 181 tape**
- **May NOT use building cavities as supply ducts**

IRC Reference – Duct Sealing

M1601.4.1 Joints and seams. Joints of duct systems shall be made **substantially airtight** by means of tapes, mastics, liquid sealants, gasketing or other approved closure systems. Closure systems used with rigid fibrous glass ducts shall comply with UL181A and shall be marked 181A-P for pressure-sensitive tape, 181A-M for mastic or 181A-H for heat-sensitive tape. Closure systems used with flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked 181B-FX for pressure-sensitive tape or 181B-M for mastic. **All metal to metal connections shall be mechanically fastened. All duct connections shall be sealed.** Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL181B and shall be marked 181B-C. Crimp joints for round metal ducts shall have a contact lap of at least 11/2 inches (38 mm) and shall be mechanically fastened by means of at least three sheet-metal screws or rivets equally spaced around the joint. Closure systems used to seal metal ductwork shall be installed in accordance with the manufacturer's installation instructions.

Testing Duct Leaks

Don't use duct tape on ducts!

Code Required: Duct Tightness Testing

Duct systems MUST be leak tested* **and verified by certified tester (RESNET, BPI, DET, national duct leak test equipment co.) or code official. Four options:**

- **When tested at *rough-in*:**
  - **4% Total leakage w/ no AHU installed *(RITnah)***
  - **6% Total leakage w/ AHU *(RIT)***
- **When tested at *final*** (post-construction)**:**
  - **12% Total Leakage *(PCT)***
  - **8% Leakage to Outside *(PCO)***

Exception*: *Duct tightness test is not required if the air handler and all ducts are located within conditioned space.

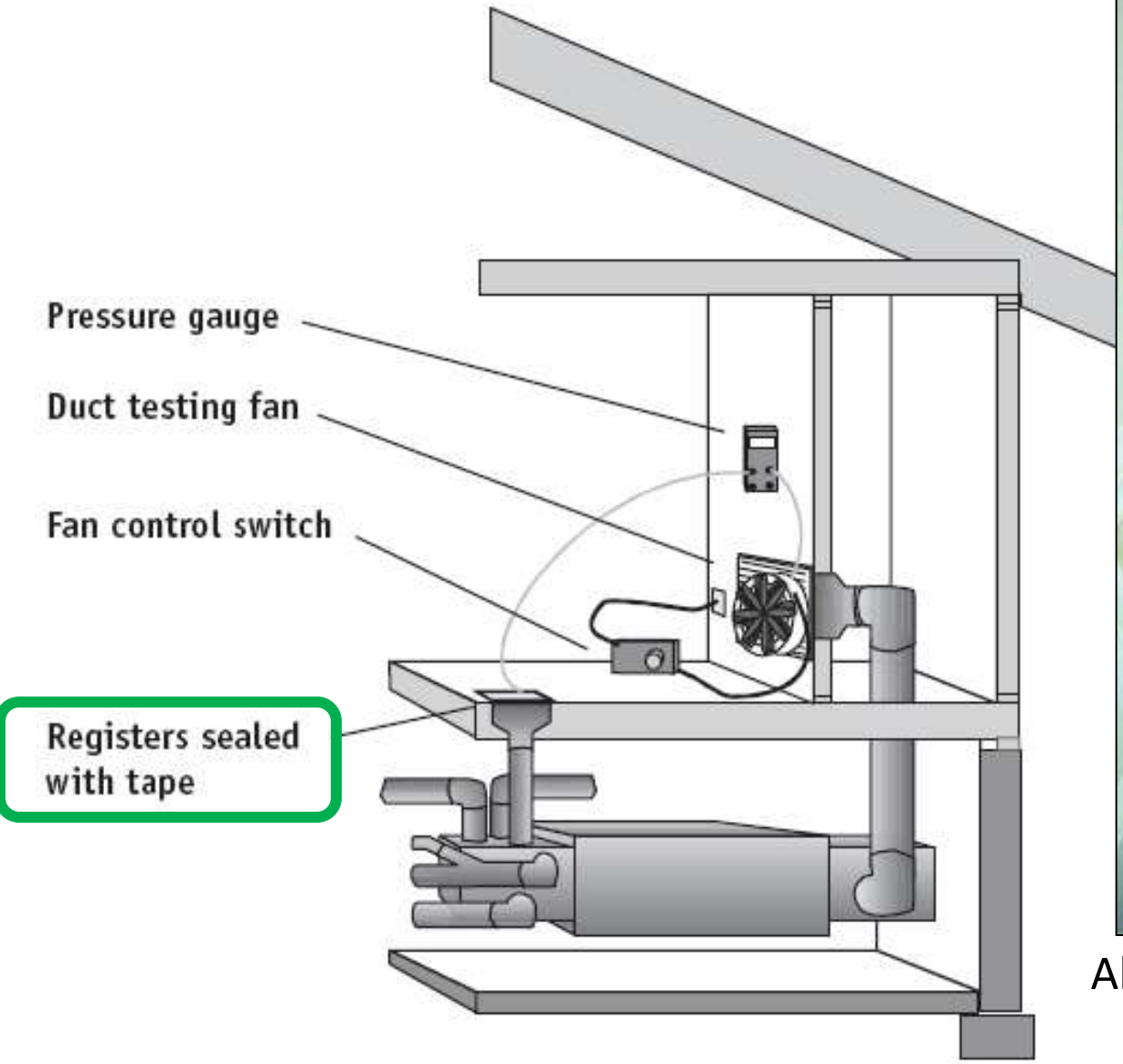
Duct Blower Test

Duct pressure test finds leaks and estimates air flow in cfm

Pressurizing the system;
connected at the largest return

Depressurizing the system;
connected at the air handling unit

Duct Testing Basics



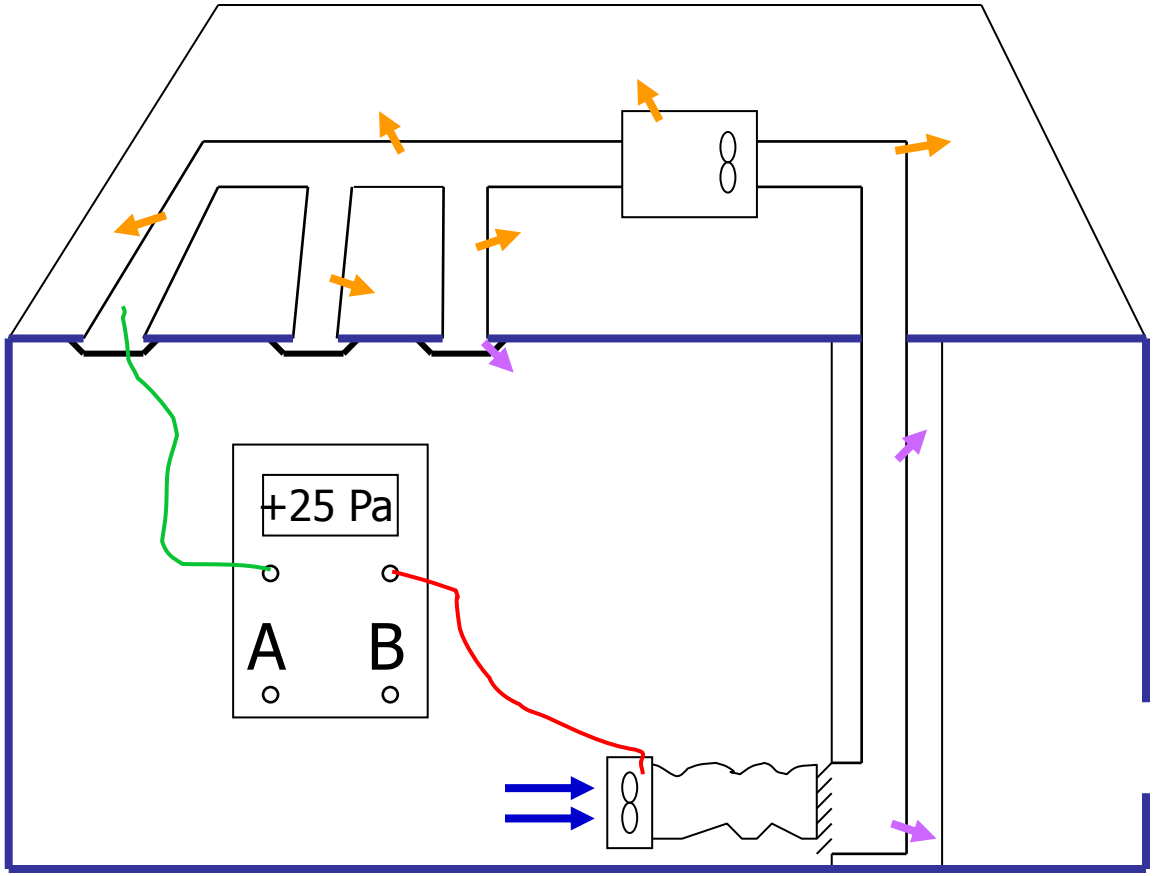
Allow the air to flow freely from the fan to the duct system

Duct Test – "Total Leakage"

Note: May be performed at rough-in (**RIT**) stage OR at final (**PCT**)

1. **Open a door** so house = outside pressure.
2. **Use duct tester to pressurize duct system to +25 Pa** WRT outside.
3. Record fan flow (channel B) in **CFM_{25}.**

(when programming gauge, set MODE as "PR/FL@25"



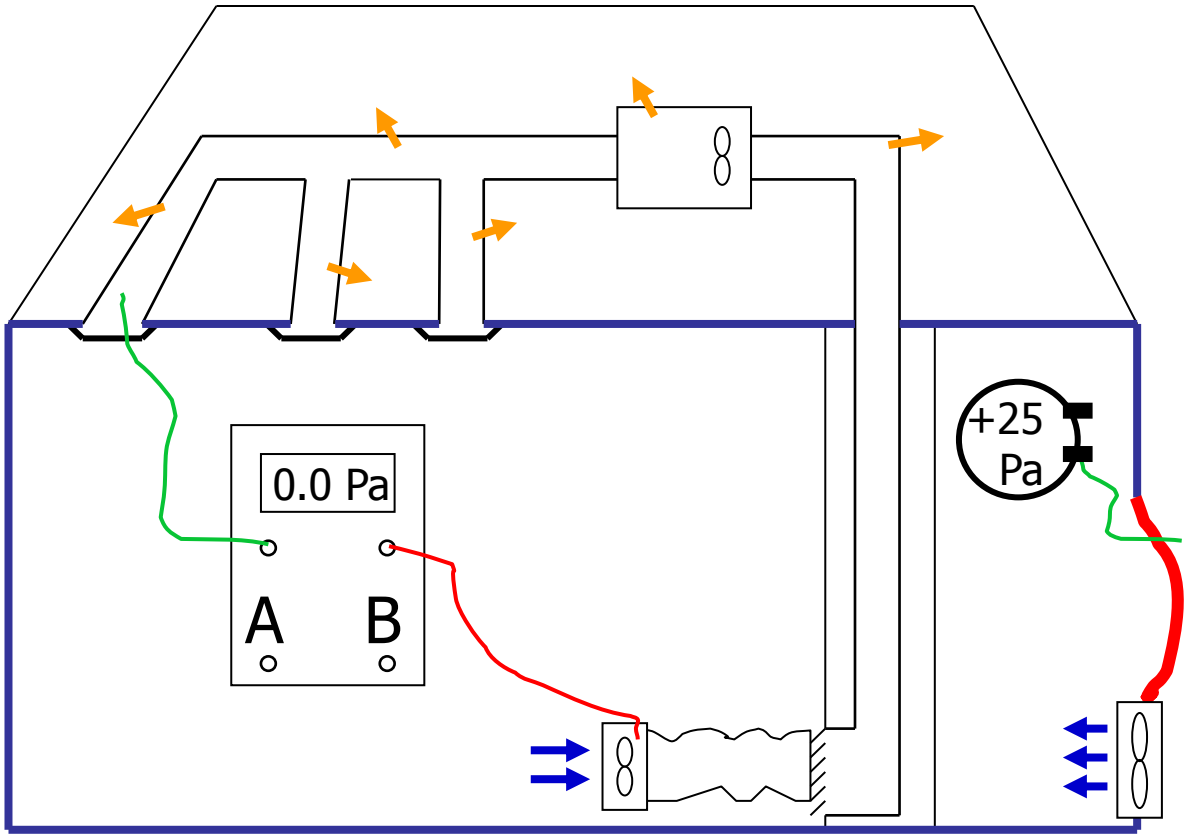
Ring 2, Fan Press = 86 Pa

Flow is 147 cfm_{25}

Duct Test – "Leakage to Outside"

Note: This test can only be performed at final (**PCO**)

1. **Use blower door** to pressurize house (and ducts) **to +25 Pa** WRT outside.
2. **Use duct tester** to pressurize duct system **to 0.0 Pa** WRT house (+25 Pa WRT outside)
3. Record fan flow (channel B) in **CFM_{25}** (when programming gauge, make sure MODE is "PR/FL" not "PR/FL@25"

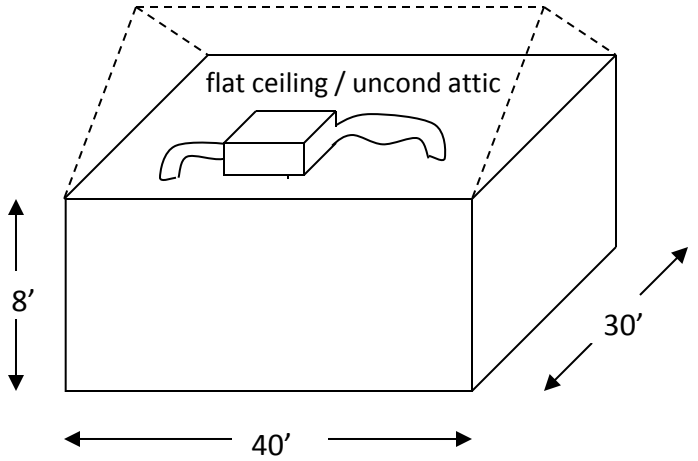


Ring 3, Fan Press=287 Pa

Flow is 107 cfm_{25}

Duct Leakage Test Example

One-story house with flat ceiling and unconditioned attic – air handler and duct system is located in attic



Duct Leakage Test Results

Duct pressure: 25 Pa WRT outside

Total Leakage (at final, PCT):

Duct blaster flow: 149 CFM_{25}

Floor area served: _____ s.f.

Percent duct leakage: _____

Pass Code? _____

Duct pressure: 0 Pa WRT house

Leakage to Outside (at final, PCO):

Duct blaster flow: 92 CFM_{25}

Floor area served: _____ s.f.

Percent duct leakage: _____

Pass Code? _____

Example Report

DET Verifier fills in passing duct tightness test results

- At final, Duct Blower used to measure "Total Leakage" (PCT) = 149 CFM_{25}
- % Duct Leakage (149/1,200 s.f. x 100) = 12.4% (FAILS)
- At final, Blower Door + Duct Blower used to measure "Duct Leakage to Outside" (PCO) = 92 CFM_{25}
- % Duct Leakage (92/1,200 s.f. x 100) = 7.7% (PASSES)
- Record only one passing result per system

Georgia Residential Energy Code Compliance Certificate*

Address: 111 Example House Drive Permit #: _____
Builder/Design Prof.: Bob D. Builder Phone: 555-555-5555

Envelope Summary:

- List the R-Value for the following components:

Flat ceiling/roof:		Sloped/vault ceiling:	
Exterior wall:		Above grade mass wall:	
Attic kneewall:		Attic kneewall sheathing:	
Basement stud wall:		Basement continuous:	
Crawlspace stud wall:		Crawlspace continuous:	
Foundation slab:		Floors over unconditioned space:	
Cantilevered Floor:		Other insulation:	

- Fenestration Components:

Window U-factor:		Window SHGC:	
Skylight U-factor:		Skylight SHGC:	
Glazed Door U-factor:		Opaque Door U-factor: (<50% glazed)	

- Building Envelope Tightness (BET):

BET test conducted by: _____ Phone: _____
Fan Flow at 50 Pascals= _____ CFM_{50} Total Conditioned Volume = _____ ft^3
ACH_{50} = CFM_{50} x 60 / Volume= _____ ACH_{50} (must be less than 7 ACH_{50})
Low Rise Multifamily Visual Inspection Option
(The visual inspection option may be conducted by a third-party instead of the BET test for R-2 buildings only.)
Visual inspection conducted by: _____ Phone: _____

Mechanical Summary:

Water Heater Energy Factor: _____ Ef Fuel type: ☐ Gas ☐ Electric ☐ Other
Number of Heating and Cooling Systems: _____
Heating System Type:
☐ Gas: _____ AFUE ☐ Air-Source Heat Pump: _____ HSPF
☐ Other: _____ Efficiency: _____
Cooling System Type (Standard DX, Heat Pump, Geothermal, etc.): _____
Cooling System Efficiency: _____ ☐ SEER ☐ EER ☐ Other
Heating/Cooling Load Calculations Performed by: _____ Phone: _____
Total Heating Load (Based on ACCA Man. J or other approved methodology): _____ Btu/h
Total Cooling Load (Based on ACCA Man. J or other approved methodology): _____ Btu/h
Cooling Sensible Load: _____ Btu/h Cooling Latent Load : _____ Btu/h
Total Air Handler CFM (based on design calculations): _____ CFM

Duct Tightness Test Conducted by: _____ Phone: _____
Tool used to conduct the duct tightness test: duct blower (**DB**), blower door subtraction method (**BDS**), or flow hood (**FH**).
Unless all ducts and air handler are located within conditioned space, must verify one of the following:

- Post-construction duct leakage to outdoors (**PCO**) is ≤ 8%,
- Post-construction total duct leakage (**PCT**) is ≤ 12%
- Rough-in total duct leakage (**RIT**) with air handler installed is ≤ 6%

% Duct Leakage Result = (CFM_{25} / Conditioned floor area served) x 100

System	Tool (DB, BDS, FH)	Test (PCO, PCT, RIT)	CFM_{25}	Area served (ft^2)	Result (%)
1					
2					
3					

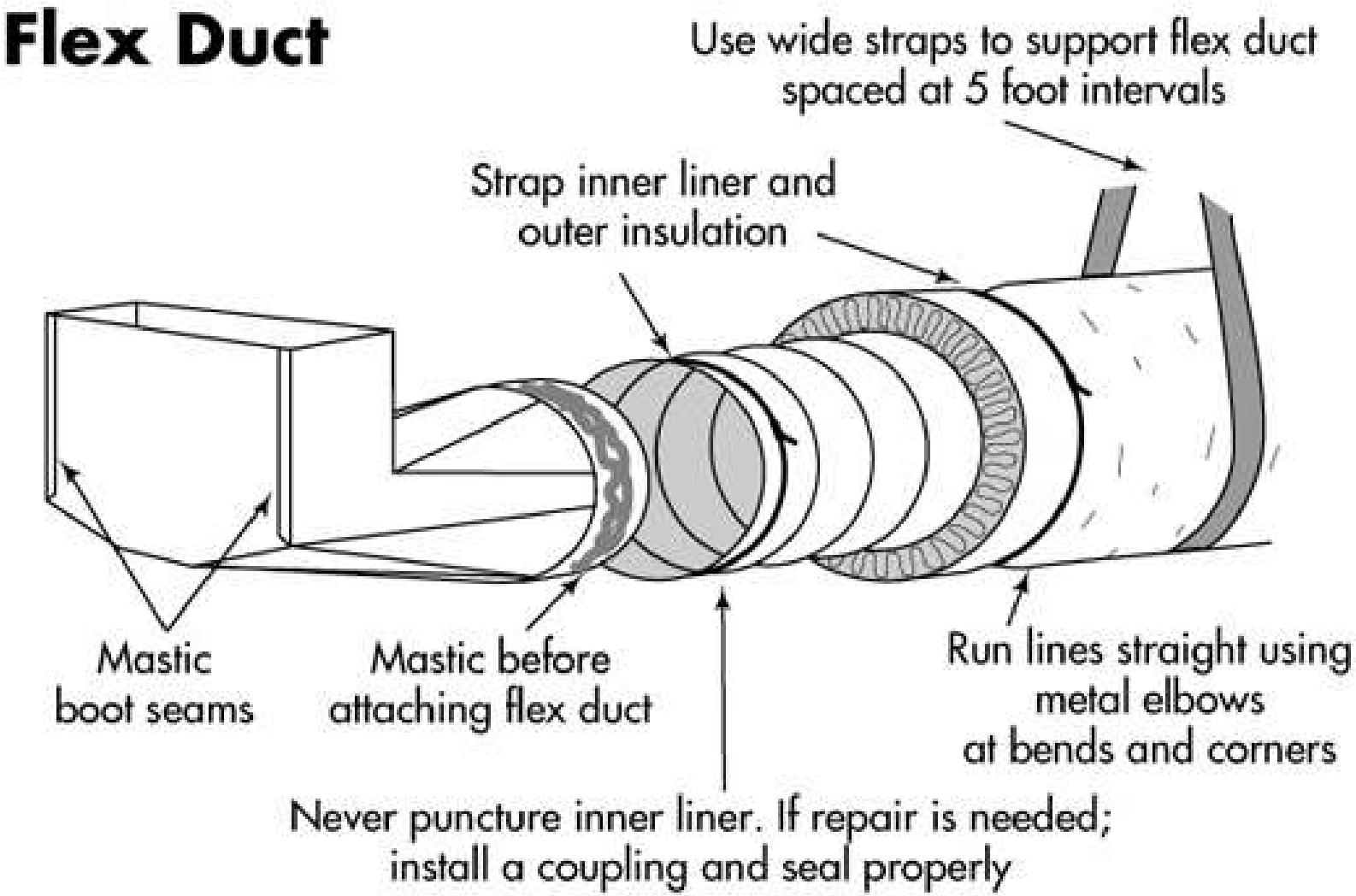
*Note: This permanent certificate shall be posted on or in the electrical distribution panel or air handler. Certificate shall be completed by the builder or registered design professional. Where there is more than one value for each component, certificate shall list the value covering the largest area

What if Duct Tightness test fails?

If the duct system fails the **Duct Tightness** test, DET verifier can:

1. **Check equipment setup** and **make sure all registers are sealed** (check walk-in closets and look for toe kick registers, etc.).
2. Make sure all **zone dampers are open on multi-zoned systems.** Make sure no balancing dampers are completely closed off.
3. Inspect the air handling unit while the ducts are being pressurized - **employ a smoke pencil or fog stick.** Look for mastic or other sealants at duct's pressure barrier. Listen for whistling and **investigate** for blockage or disconnects. Count supply and return duct runs and identify associated registers. Check to make sure boots are sealed to drywall or subfloor.
4. While pressurizing the ducts, **use a fog machine** to inject fog into the duct system and observe leakage points.
5. Determine dominant duct leakage. With no tape on registers, **measure change in house pressure when air handler is turned on** (positive = return leaks dominate, negative = supply leaks dominate).
6. Use **Blower Door and pressure pan to identify leakiest** duct runs.

Seal with mastic, connect and hang properly!



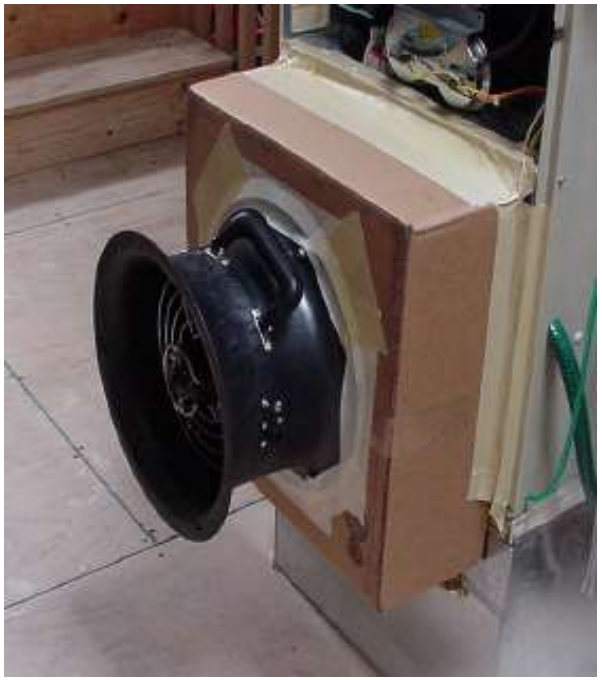
Use A Duct Blower to do more…

DB+

- In small, tight dwelling units, the duct blower can be used in a window **as a small blower door**
- Can use **as a flow hood** for supplies & returns
- **Measure actual HVAC system air flow** (via Pressure Matching)
  - Measure Static Pressure in supply plenum
  - Block return & install Duct Blower at AHU blower access panel
  - Measure air flow through Duct Blower in CFM

Pros

- Same device as needed for duct leakage testing
- High accuracy



Cons

- Some time required to attach and seal
- Can only measure ~1600 CFM (but can extrapolate to 2000 CFM)

La. Amended Mechanical Ventilation

Section M1507.4 Minimum Required Local Exhaust. Local exhaust systems shall be designed to have the capacity to exhaust the minimum air flow rate as follows.

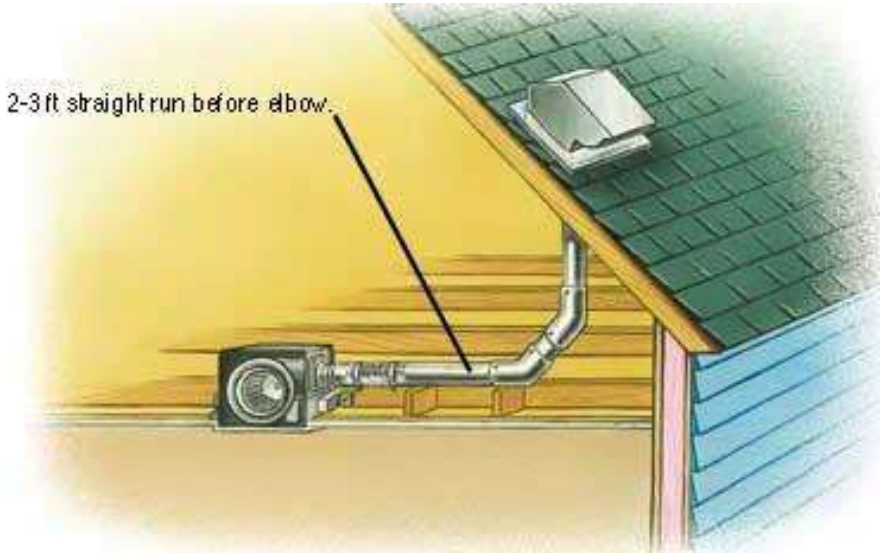
(a) Kitchen: 100 cfm intermittent or 25 cfm continuous (a balanced ventilation system is required for continuous exhaust).

(b) Bathrooms: 50 cfm intermittent or 20 cfm continuous (a balanced ventilation system is required for continuous exhaust).

Best Practices in Hot, Humid Climate:

- **Intermittent spot exhausts** (NO continuous exhaust)
- **Bathroom: timer or humidity sensor controls, quiet fans**
- **Kitchen: large hood with 100-400 cfm exhaust, quiet fans**
- **Plus whole house supply ventilation system with motorized damper and smart control**

Best Practice: *Effective* spot exhaust systems



50-80 CFM low-noise exhaust fan with auto motion sensor

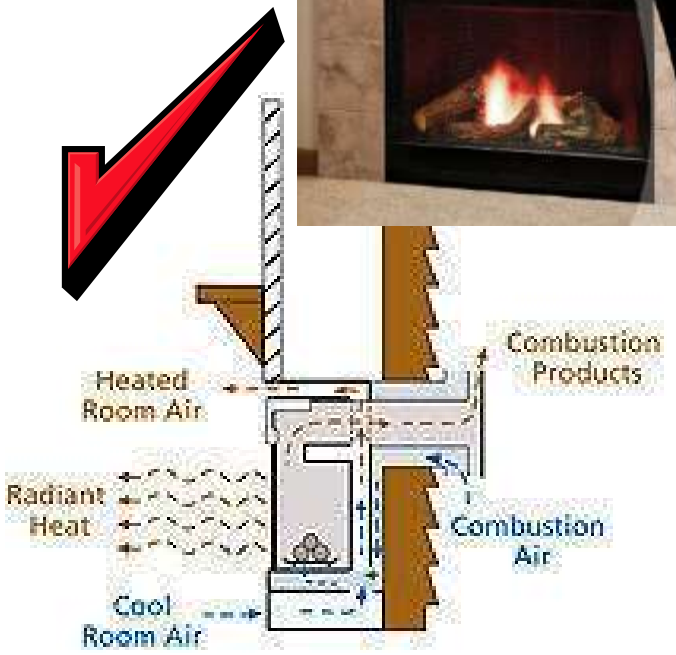
Quiet fans + proper duct installation = effective exhaust

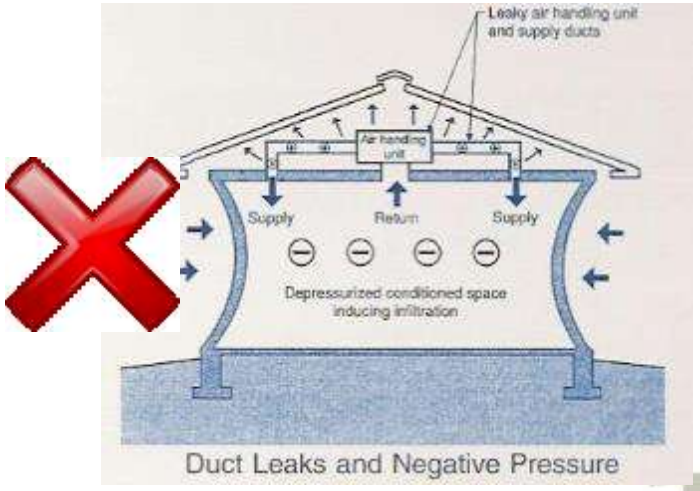
Large High Performance Hood

- < .3 sones at normal speed
- Extends over all burners
- 100-400 cfm

Best Practices to Prevent Combustion Pollution

- If within conditioned space, install ***direct vent*, sealed combustion**
  - Fireplace
  - Gas furnace & water heater
- **Quiet exhaust hood over gas range**
- **Prevent backdrafting (negative pressure)**
  - Sealed or no ducts in vented attic
  - Make-up air for dryer, range hood?
- **Air seal garage-house wall**
  - Ventilate garage or detach





What if blower door test result is less than 5 ACH_{50}?

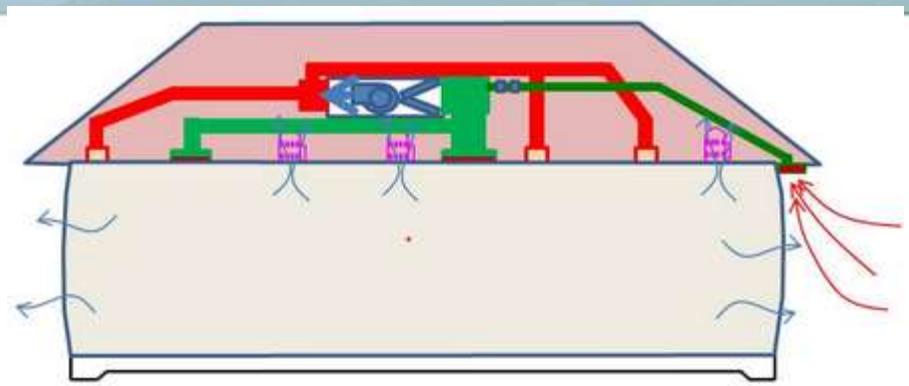
NOW: R303.4 Mechanical Ventilation. When a blower door test is performed, and the air infiltration rate of the dwelling unit is **less than 5 air changes per hour** when tested in accordance with the 2009 IRC Section N1102.4.2.1, the dwelling unit shall be provided with **whole-house mechanical ventilation** in accordance with Section M1507.3.

COMING SOON: Code Council amended to "…less than **3 ACH_{50}**…"

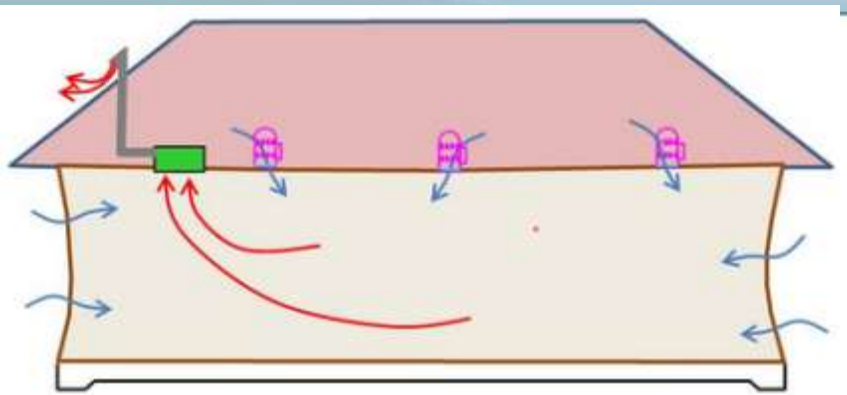
What does the La. Amended mechanical code say?

- Section M1507.3.1 System Design. The whole-house ventilation system shall consist of **a combination of supply and exhaust fans, and associated ducts and controls.** Local exhaust and supply fans are permitted to serve as such a system. Outdoor air ducts connected to the return side of an air handler shall be considered to provide supply ventilation.
- Section M1507.3.2 System Controls. The whole-house mechanical ventilation system shall be provided with **controls that enable manual override and a method of air-flow adjustment.**
- Section M1507.3.3 **Mechanical Ventilation Rate.** The whole-house mechanical ventilation system shall be ***able to*** provide outdoor air at a continuous rate of at least that determined in accordance with **Table M1507.3.3(1).**

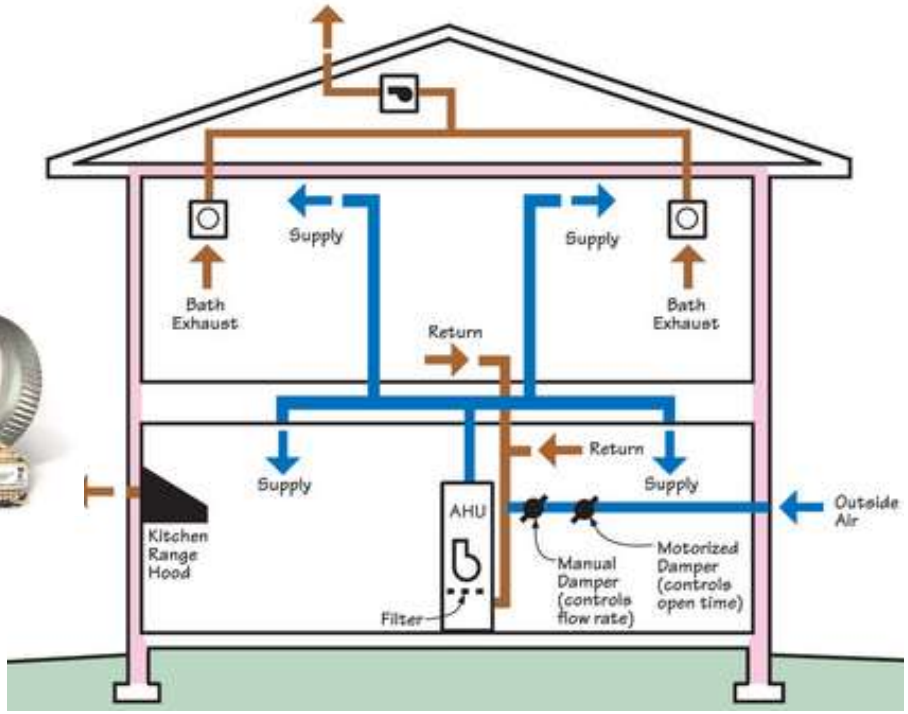
Ventilation in Hot, Humid Climate



GOOD: Positive pressure in La. house helps keep building dry.



BAD: Negative pressure in La. house sucks in humid air; can cause moisture problems, hidden mold.



How much ventilation?

The old (current), the new (2013), and the alternative

Ventilation Standards

7.5 cfm/person (# BRs + 1)

plus

1-3 cfm/100 sq. ft. of conditioned area

Example: 2000 sq. ft. 3 BR house = **50-90** cfm

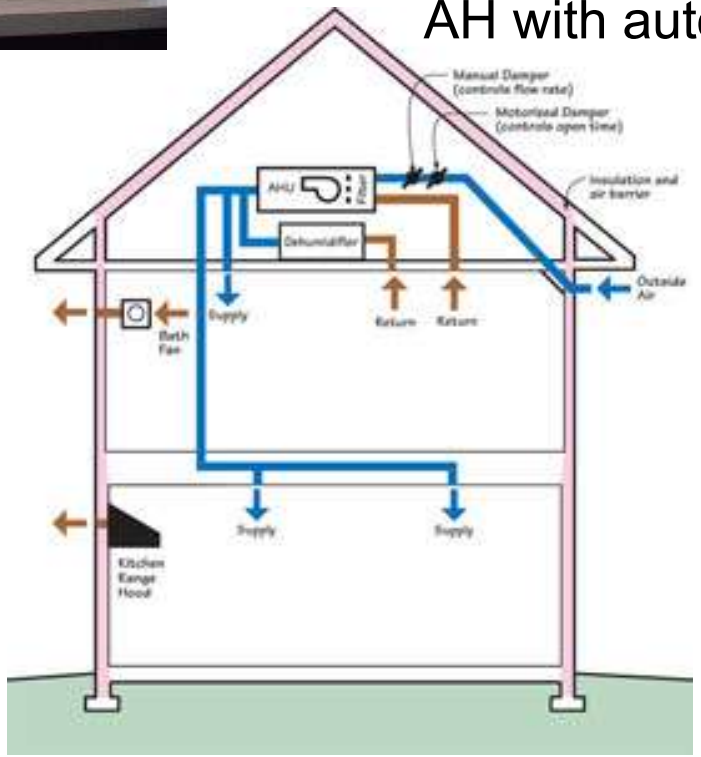
depending upon….

For healthy indoor air and to avoid mold in La…. size for code cfm but run at 50-60%.

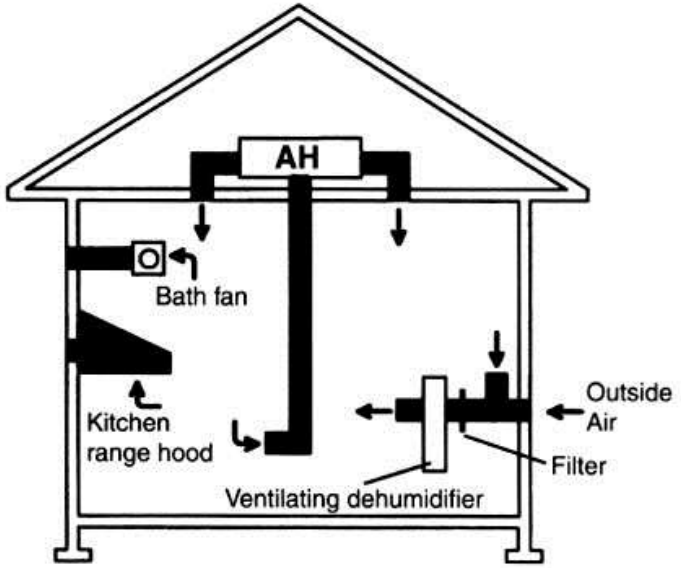
Ventilation Solutions for Hot, Humid Climate

$ **Good**: Fresh air to return of AH with auto flow controller

$$ **Better spring/fall RH**: Fresh air to return of AH with auto flow controller + dehumidifier



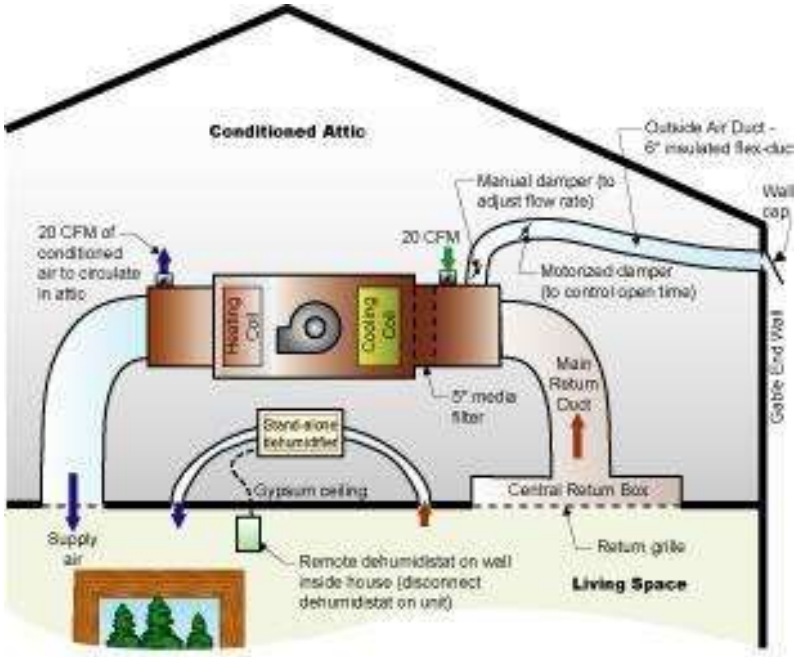
$$$ **Best RH, IAQ & Comfort:** Fresh air & indoor air to ventilating dehumidifier



Courtesy of Building Science Corporation

For High-Performance Home in Hot, Humid Climate

- ✓ **If HVAC in unvented attic:**
  - ✓ **Heat pump or sealed combustion gas ONLY**
  - ✓ **Semi-condition** attic
- ✓ ***Right* sized A/C**
  - ✓ **Manual J sizing + Manual D duct design**
- ✓ **Controlled, clean fresh air**
  - ✓ **Inlet at clean air location**
  - ✓ **Filter in convenient location**
  - ✓ **Smart flow control damper**
  - ✓ **Design to code ,BUT set to 50-60% cfm**
- ✓ **Dehumidification options, if needed:**
  - ✓ ***Good:*** **Two A/C units, divide load**
  - ✓ ***Better:*** **2-speed A/C + portable Energy Star dehumidifier w/ drain**
  - ✓ ***Better:*** **Variable capacity compressor A/C**
  - ✓ ***Best:*** **Whole house high-efficiency dehumidifier or ventilating dehumidifier**



Resources

Energy Hotline: 1-800-270-CODE

www.southface.org

www.energycodes.gov

www.dsireusa.org

www.resnet.us

basc.pnnl.gov

www.bcap-energy.org

www.bpi.org

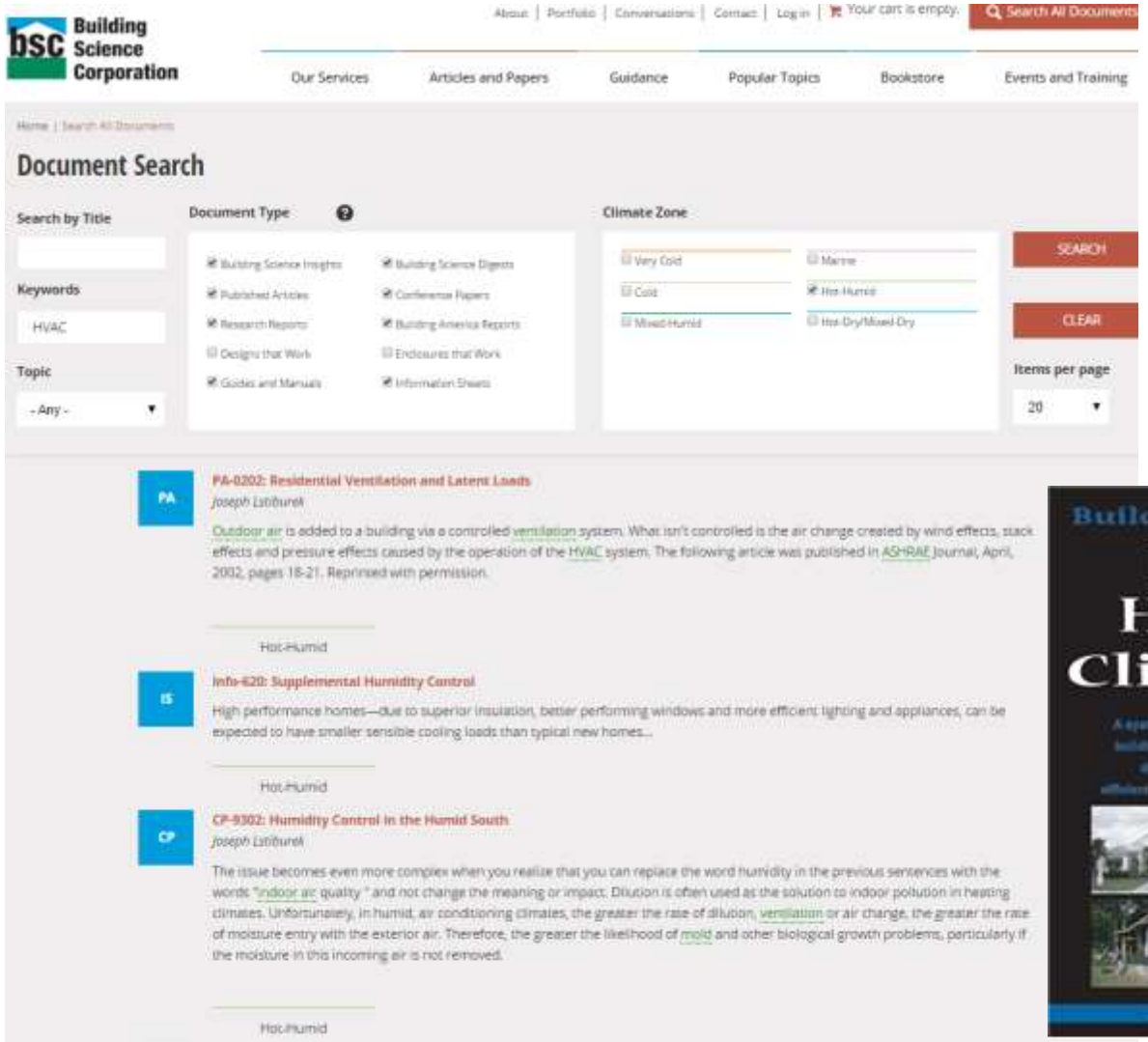
www.iccsafe.org

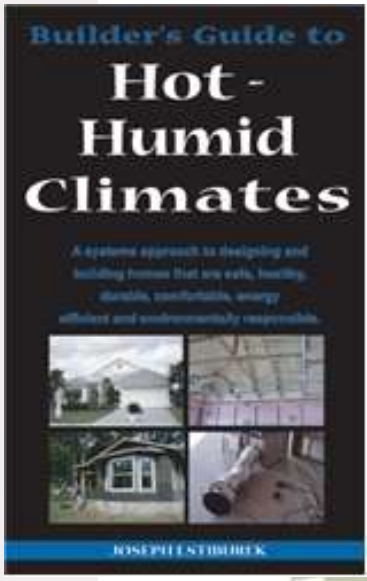
Building America Solution Center

(Energy-efficiency + Moisture, Durability, Case Studies, Research…)

basc.pnnl.gov

www.BuildingScience.com





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LSU AgCenter Research & Extension — LaHouse Home and Landscape Resource Center

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HVAC for Home Performance

Tight ducts and tight buildings, good for clients and for you.

What could go wrong?

Course Information:

As the energy-efficiency bar rises, the margin for error shrinks. The more efficient the home and HVAC equipment, the more important and challenging it is to get the HVAC right – to prevent costly call-backs, achieve the rated efficiency, and meet customers' high expectations. *Home performance* (comfort and indoor air quality with low utility bills) depends upon the relationships between HVAC and the building envelope. The interactions are even greater in our hot, humid climate.

In this 3-day workshop, you'll gain expertise in building science concepts that are key to prevent, diagnose and solve problems. You'll learn best practice methods and options; how energy-efficient homes impact Manual J, D and S or H HVAC design; and crucial air sealing techniques to achieve the 2009 IRC energy code air tightness and duct testing provisions.

This course also includes *Duct and Envelope Tightness (DET) verifier* training and certification (optional). Upon successful completion of this course and DET exams, you will be Southface Energy Institute certified as a DET verifier, qualified to perform the testing required for new homes by the 2009 residential energy codes. LaHouse Resource Center is an authorized provider of the Southface training, exam and certification.

NOTE! **DET certification provides duct leakage code compliance options that are not possible for those who are certified ONLY in duct leakage testing.** This can increase your compliance rate, saving time and money!

Through this interactive class, you will learn, observe, discuss and practice:

- Controlling building air flow, thermal (heat) flow, and moisture flow
- Measurement and Implications of differential pressures
- Troubleshooting air flow and zone pressure diagnostics
- Indoor air quality factors and options to provide outdoor air
- Make-up air for kitchen hood and fireplaces
- Insulation installation grading; labeled vs. actual whole-wall R-value
- How high efficiency equipment impacts high humidity levels
- Equipment sizing and design in tight building envelopes
- Effective HVAC ductwork, equipment and building air sealing methods
- 2009 IRC Chapter 11 building envelope and duct leakage requirements
- Code compliance options
- Protocols for blower door and duct leakage testing and reporting
- Exhaust fan flow measurement
- Testing equipment set-up, orientation, and problem solving
- How to calculate CFM50, ACH50, percent duct leakage, NACH, EqLA, building pressures
- How to evaluate and report testing results for the 2009 IRC energy code
- Tips for successfully completing the DET Verifier certification exams

LSU AgCenter Research & Extension — LaHouse Home and Landscape Resource Center

Science-based information, training, outreach and showcase of solutions for high performance homes in the Gulf Region. Learn more at www.LSUAgCenter.com/LaHouse

Duct and Envelope Testing (DET) Verifier certification class

La. has adopted the 2009 IRC energy chapter

Certified verifiers are needed statewide.

Course Information:

This two-day course is designed to introduce the skills necessary to become a Southface Energy Institute certified *Duct and Envelope Tightness (DET) Verifier* qualified to perform the diagnostic testing required for new homes by the 2009 and 2012 residential energy codes. LaHouse Resource Center is an authorized provider of the Southface training, exam and certification.

After successful completion of this course, you will be able to test the air leakage of a building envelope and duct system, and evaluate the results as measured against the 2009 International Residential Code (IRC) energy chapter requirements.

Course content includes:

- Basic building science concepts of air flow, air pressure and building performance.
- The relationship between duct and building tightness
- Requirements of the 2009 IRC energy chapter.
- Protocols for blower door and duct leakage testing and reporting.
- Calculations for ACH50 and percent duct leakage
- Tips for successfully completing the written and in-field DET Verifier certification exams

This DET Verifier training program and the class fee include:

- 1.5 days of live, interactive instruction and hands-on practice (plus half day DET exams)
- DET training handbook
- Online tutorials
- Written DET Verifier exam
- In-field DET Verifier exam
- DET Verifier Certificate (with passing score on both exams)
- Certificate of Attendance (for CEU hours)

Southface/LaHouse Certified DET Verifiers

LSU College of Agriculture

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eXtension www.eXtension.org

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friend

DET and HVAC certified verifiers

DET	HVAC	Name	Organization	City, State	Phone/Email
X	X	Boykins, Kenneth	Boykins Heating & Cooling LLC	Marksville, La	318-613-7141 boykinsheathingcooling@yahoo.com
X	X	Burbank, Darrick	Rebirth Energy Solutions	Metairie, La	504-684-4580 drrickburbank@gmail.com
X		Callahan, Matthew	Ken's Plumbing & Heating, Inc.	Schriever, La	985-872-4729 kensplumbing@mail.com
X		Chalsson, Sydney	Chalsson Building Inspection Services	Baton Rouge, La	225-769-6696 sjchalsson@cox.net
X	X	Fontenot, Guy	Total Comfort Heating & Air	Baton Rouge, La	225-928-2251 totalcom@eatel.net
X		Hearne, Bill	Energy +	West Monroe, La	318-366-8824 Bhearne09@comcast.net
X	X	Horton, Xavier	Rebirth Energy Solutions	New Orleans, La	504-684-4580 katie@rebirthenergysolutions.com
X	X	Iserail, Greg	Entergis	Baton Rouge, La	225-445-2362 giserai@hotmail.com
X	X	King, Edwin Jr.	King Building Inspection LLC	Shreveport, La	318-560-9730 efking jr@gmail.com
X		Johnson, Rocky	Zero Draft	Baker, La	225-571-4892 Rocky150@cox.net
X	X	LaGrange, Paul	LSU AgCenter LaHouse & LaGrange Consulting	Madisonville, La	985-845-2148 paul@lagrangeconsulting.com
X		Macomber, Shawn	Healthy Home Solutions, LLC	Slidell, La	985-710-3789 healthyhomesolutionsllc@gmail.com
X		Madrid, Enrique	National A1 Services	Gretna, La	504-338-2769 fenriquemadrid@yahoo.com
X		McGee, Kyle	Ken's Plumbing & Heating, Inc.	Schriever, La	985-872-4729 kensplumbing@mail.com
X		McKendall, Greg	McKendall A/C	New Orleans	504-885-8033 mckendall_ac@email.com
X		McShan, Charles	Vernon Parish Police Jury	Leesville, La	337-2080-0195 Bjmchshan3@msn.com
X		McShan, William	Vernon Parish Police Jury	Leesville, La	337-2080-0195 Bjmcshan3@msn.com
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X	X	Ray, Jason	RTC of Louisiana	Central, La	225-262-7942 Jason@rtcpro.com
X		Robinson, Bill	LSU AgCenter LaHouse & Train 2 Build	Jefferson, La	805-797-4127 bill@train2build.com
X		Setliff, James	James Setliff Electric	Pineville, La	318-623-4754 nicolewoodrum@yahoo.com
X		Tate, Carl	Tate Services, Inc.	New Orleans, La	504-622-1103 tateservicesinc@ymail.com
	X	Thomas, Randy	Cameron Parish Police Jury	Cameron, La	337-775-5718 rthomas@camtel.net
X		Turner, Al	Turner & Turner Contracting, LLC	Woodworth, La	318-290-3231 turnerturnercontracting@gmail.com
X		Washington, Ronald	DR A-C and Home Maintenance LLC	Baton Rouge, La	225-355-1123 drairondit@att.net
X		Wilbur, Brandon	Dwayne's Southern Air	Ragley, La	337-401-1051 brandon_wilbur@yahoo.com

sub-topics

related articles
- HVAC for Home Performance workshop
- Duct and Envelope Testing (DET) Verifier certification class
- Lead Certified Renovator Training (RRP)
- Mold Control and Remediation Training

more...

point of contact
- Reichel, Claudette H.

institutions
- LSU AgCenter

www.LSUAgCenter.com/LaHouse

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