Types of Ductwork

- **Round Metal**: Minimal air pressure loss retards growth of fungus and mildew; joints leak unless well sealed; must be insulated (in unconditioned space only); installation is more expensive
- **Flex Duct**: Few joints to leak; inexpensive to install; poor design & installation can crimp duct and reduce air flow; easier to damage

Proper Flex Duct Installation

- Short straight runs from rigid trunk preferred
- Upsize diameter from rigid by 1″
- Support with 1″ or wider straps spaced no more than 5′
- Sag no more than ½″ per foot
- Cut duct to proper length
- Do not pinch duct to change direction or at connections

Types of Ductwork

- **Fiberglass Ductboard**: Must be sealed carefully to be airtight; good noise control; exposed fiberglass; less durable; can be field fabricated
- **Building Cavities**: panned ducts; shelf systems that support for air handler; often violated (not permitted in IECC2015+)

Site-Built Cavity Ducts

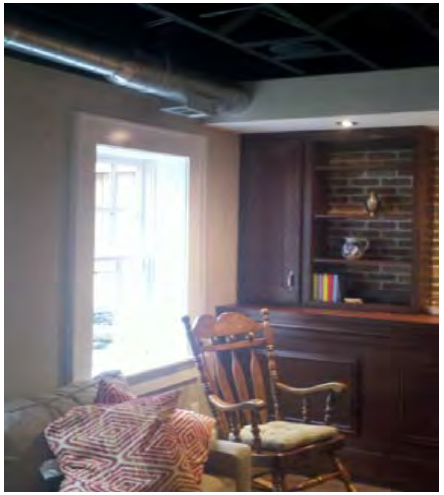
- Do not use as supply or return duct (example, toe-kick under cabinets should be fully ducted)

Violated ductwork

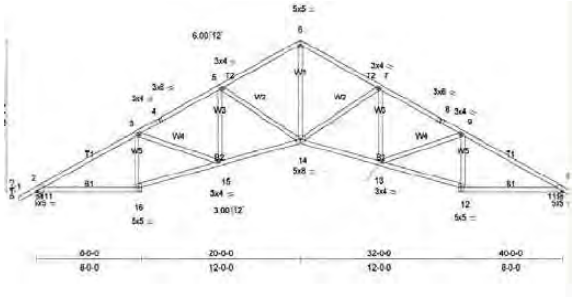
124

IAQ Issues?

Duct Design



- Try to locate the ductwork inside conditioned space



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Duct Design

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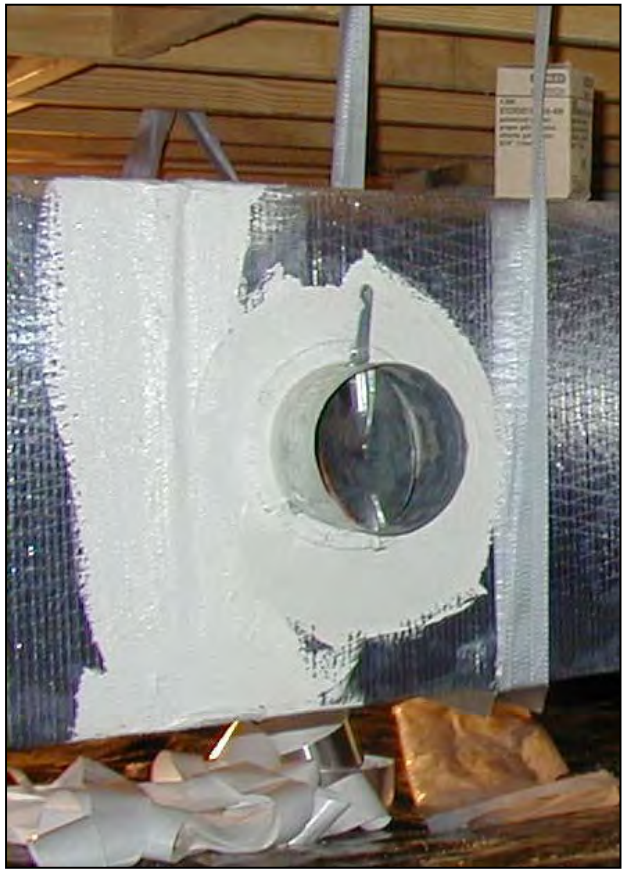
Proper Duct Design Details

- Dampers allow easy alteration of flow to each room
- Hard metal elbows should be used for tight turns
- Flex ducts turns must be gradual (radius of turn must be > than the duct diameter)

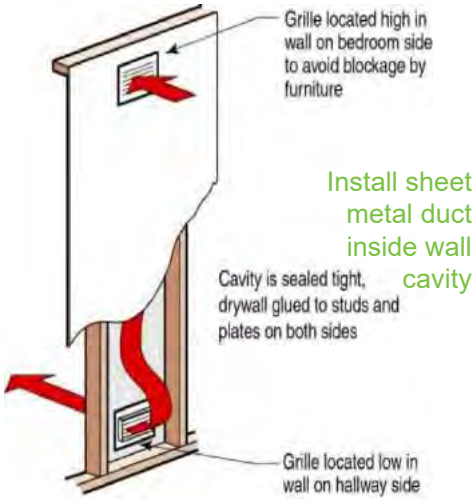


Duct Design Details

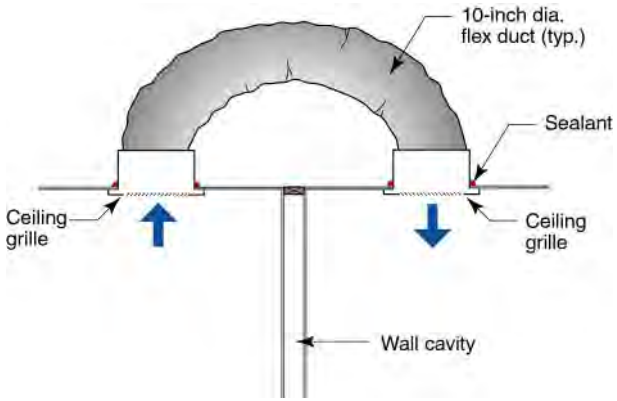
- Ducts should not originate from the plenum cap or within 6” of plenum cap

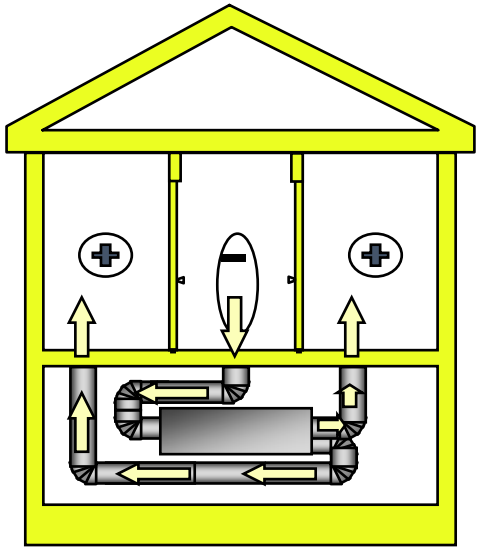
- Ducts should not originate from the end of or within 6” of the end of a trunkline

Duct Design-
Proper Return Path



Install sheet metal duct inside wall cavity





Ducts in Buildings

- Don’t use building components (stud cavities or joist cavities) as ducts
- If air must run through these spaces, use ducts designed to fit inside those spaces

Duct Sizing

- Manual D
- Duct Calculator

Supply Branches for Entire House

Heating friction rate 0.070 in/100ft
Cooling friction rate 0.070 in/100ft

Duct Tree

Duct name	ST	RB	Heat (Btuh)	Cool (Btuh)	Ds. flow (cfm)		STEL (ft)	Pr. drop (in H2O)	Veloc (fpm)	Diam (in)		Rect. duct (in)		Matl
Bedroom 3	st1	rb1	2047	1244	h	68	246	0.17	346	p	6	0	0	VlFx
Bedroom 2	st1	rb1	1757	1248	c	68	246	0.17	344	p	6	0	0	VlFx
Laundry	st1	rb1	796	415	h	26	246	0.17	303	p	4	0	0	VlFx
Kitchen	st2	rb1	389	1644	c	89	246	0.17	333	p	7	0	0	VlFx
Dining	st2	rb1	1888	1135	h	63	246	0.17	319	p	6	0	0	VlFx
Foyer	st2	rb1	1263	718	h	42	246	0.17	308	p	5	0	0	VlFx
Master Bathroom	st3	rb1	1993	1058	h	66	246	0.17	337	p	6	0	0	VlFx
Master Bedroom	st3	rb1	3565	2272	c	123	246	0.17	353	p	8	0	0	VlFx
Living	st2	rb1	2915	1779	h	97	246	0.17	362	p	7	0	0	VlFx
Breakfast	st2	rb1	1220	668	h	41	246	0.17	297	p	5	0	0	VlFx

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Poor Duct Design…

Sealing Ductwork

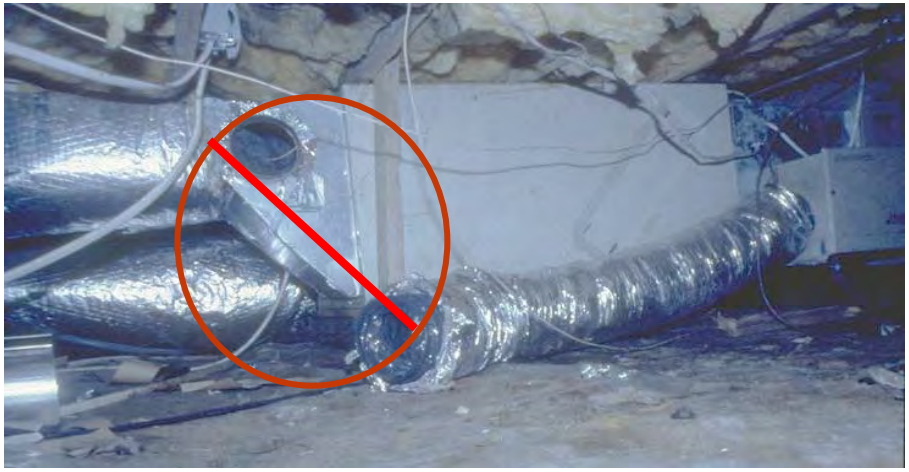
- Mastic must be installed on seams & joints of ductwork, not the insulation!

Sealing Ductwork is Code

- Rigid fiberglass ducts must be sealed with UL181A-P tape, UL181A-M tape, UL181A-H tape, or water based mastic
- Flex duct must be sealed with UL181B-FX tape, UL181B-M tape or water based mastic

International Residential Code, M1601.3.1

"Tapes and mastics used with rigid fibrous glass ducts shall be listed and labeled in accordance with UL 181-A. Tapes and mastics used with flexible air ducts shall be listed and labeled in accordance with UL 181-B. "Duct tape" is not permitted as a sealant on any ducts."



Sealing Ductwork

Sealing end of rigid supply run with water based mastic

Sealing Ductwork

1. Put mastic on collar to plenum connection
2. Put mastic on sheet metal connection
3. Slide liner over connection and install compression strap (zip tie)
4. Mastic over liner & zip tie (about 1″ on either side of liner edge
5. Pull insulation over connection and zip tie

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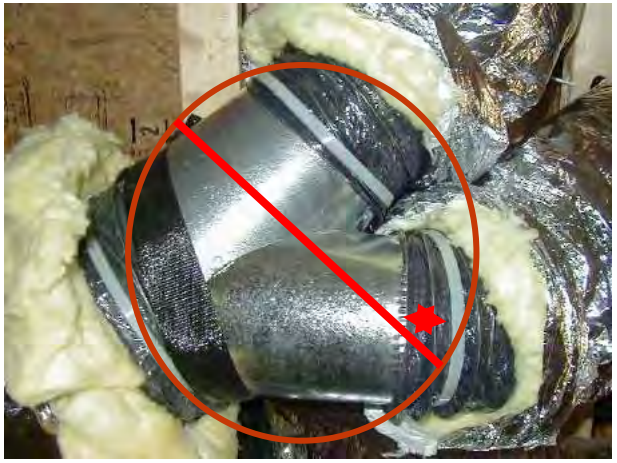
Sealing Ductwork

All duct connections must be sealed with mastic, including connections to:

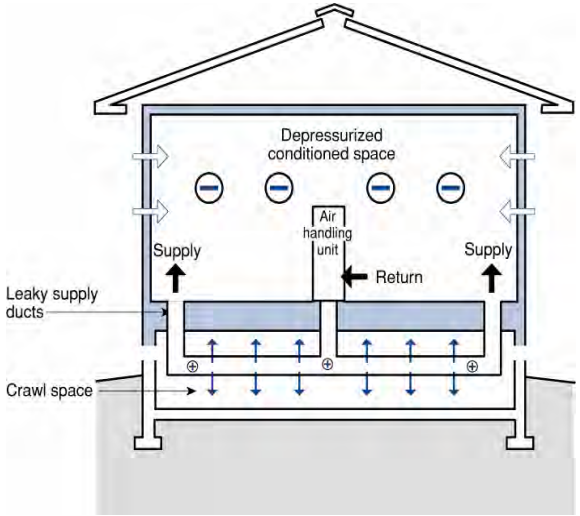
- Plenums
- Y-joints
- Boots



Sealing at the Unit Is Critical!

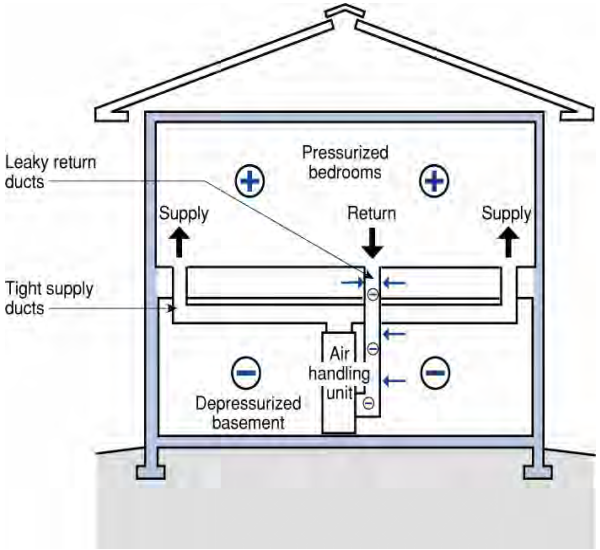
A 13 SEER A/C in a (30%) leaky duct system acts as an 8.5 SEER!
Neither the builder or homeowner get what they pay for!

Duct Leakage Affects House Pressure



Leaky Supply Duct

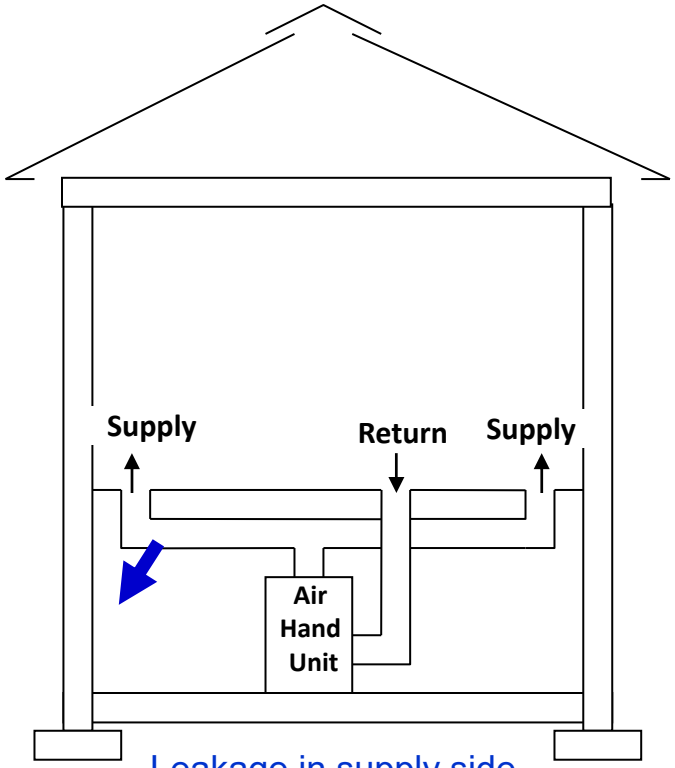
(makes house pressure go negative)



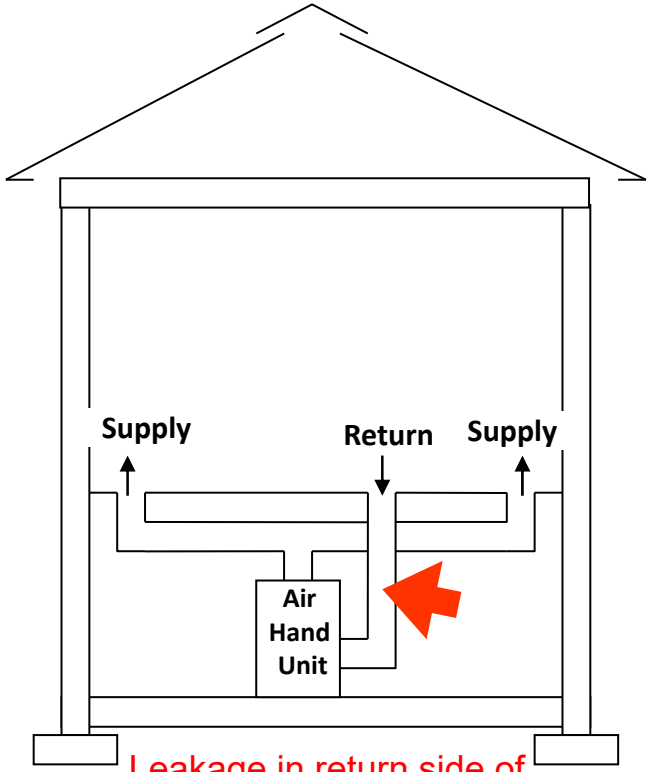
Leaky Return Duct

(makes house pressure go positive)

Duct Leakage—Driving force for Infiltration



Leakage in supply side of duct system

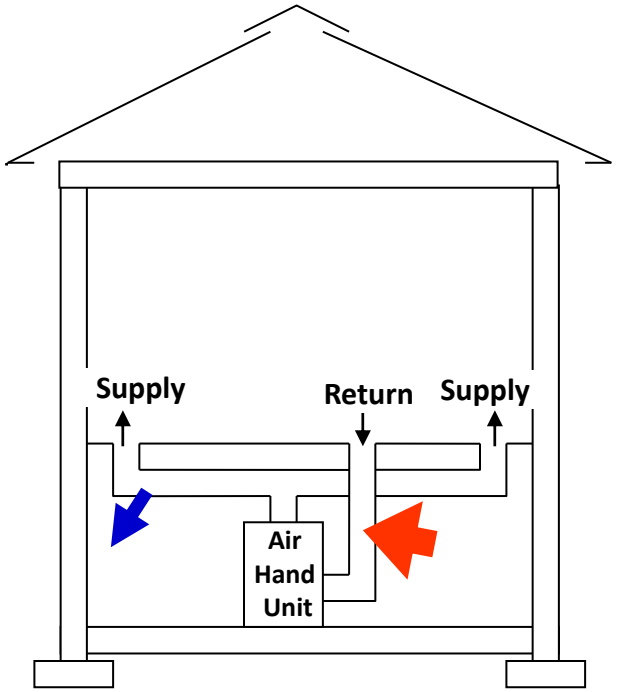


Leakage in return side of duct system

Dominant Duct Leakage – Affects House Pressure

Impact on House pressure due to small supply and larger return duct leakage

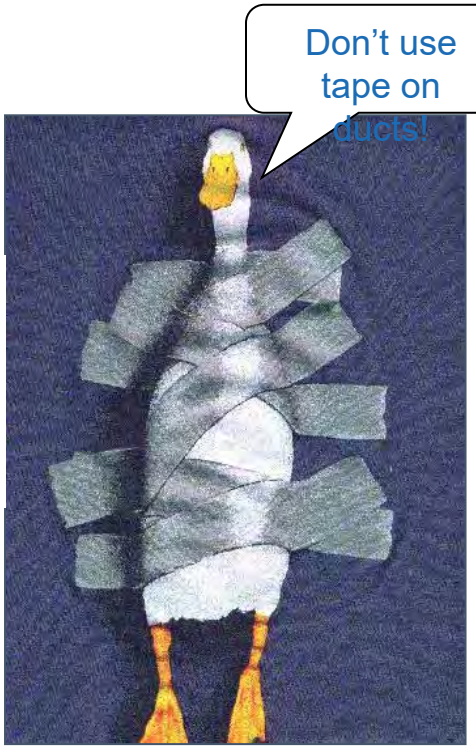
What is the net effect on house pressure due to 100 cfm of supply and 300 cfm of return duct leakage?



Some leaks in supply &
More leaks in return

Testing Duct Leaks

Although it is permitted in the code, Southface does not accept / endorse using UL181 tape to seal ducts!



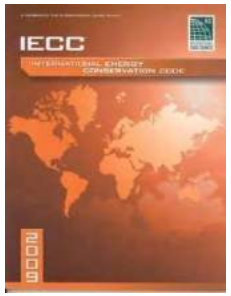
IRC Reference—Duct Sealing

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.

Southface strongly recommends **mastic or mastic tape,** which works better in the real world than foil tape (mastic should be at least 2 mm thick)

403.2.2 Duct Tightness Testing*

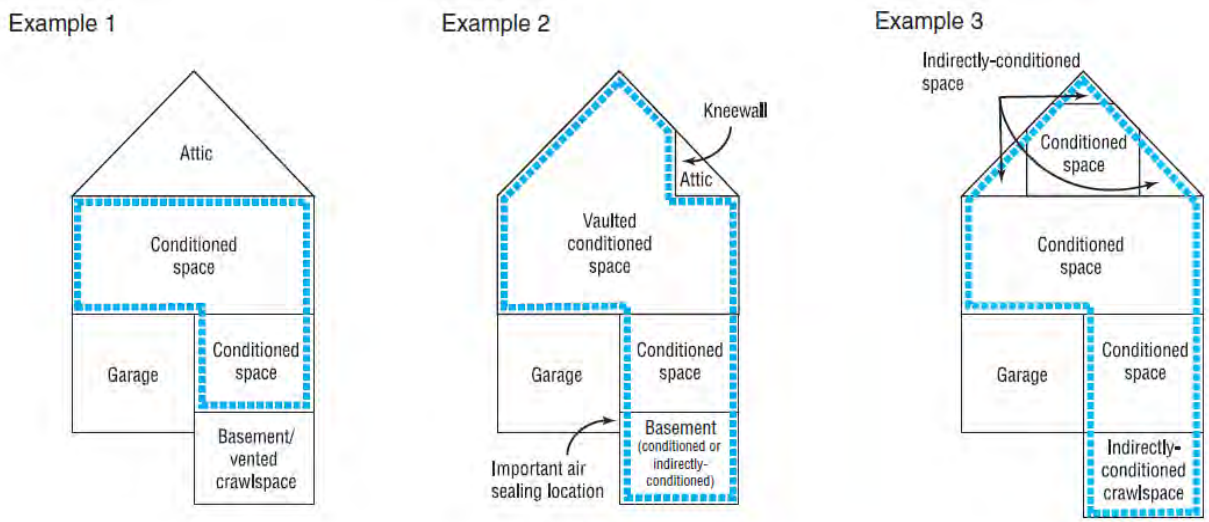
- Duct systems must be leak tested
  - When tested at rough-in
    - 4% Total leakage no AHU installed
    - 6% Total leakage w/ AHU
  - When tested at final
    - 12% Total Leakage
    - 8% Leakage to Outside



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

Total Duct Leakage ≤ 4%

Building Thermal Envelope Impacts Duct Testing



- Although these three homes look identical from the outside, each has defined the building thermal envelope differently
- This affects the requirement for duct testing

Filters

Practical Pleat

www.filtrationmfg.com

www.anykindoffilter.com

"AKF003" is discount code

- Change every leap year?
- El Cheapo vs. HEPA filters
- Want thicker, pleated filters
- Don't accept installations that prohibit easy filter access
- Seal covers with foil tape
- MERV rating

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IECC Section 403.3—Ducts

Mandatory Requirements:

- **Insulation** required for ducts outside of envelope
  - R-8 Insulation for supply ducts in attic
  - R-6 Insulation – all other ducts in unconditioned space
  - No Insulation required if ducts inside building thermal envelope (but should insulate to prevent condensation)
- Sealing required with mastic or UL 181 tape
- May not use building cavities as supply ducts

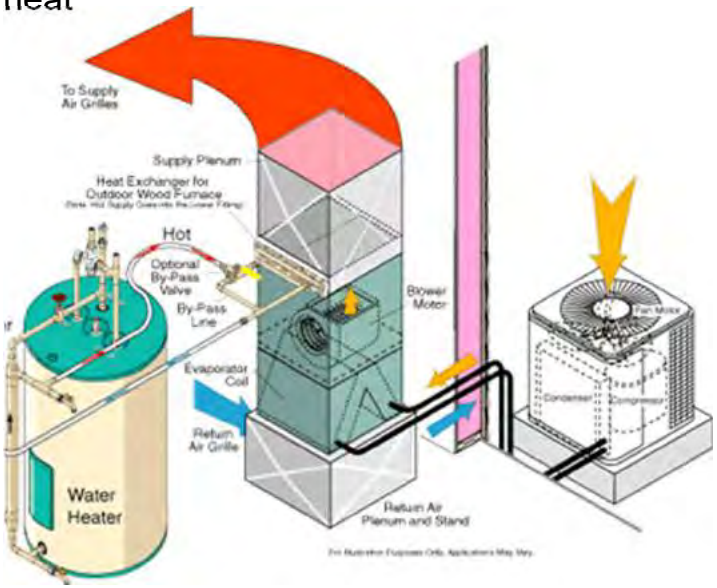
HVAC and Humidity

- Don't expect HVAC to fix bad envelope moisture issues
- Remember Psychrometrics
  - "It ain't the heat, it's the humidity"
- HVAC controls can help
  - Variable speed blower
  - Variable capacity equipment (staged compressors, staged burners)
  - Dedicated dehumidifier

Section 403.1—HVAC Controls

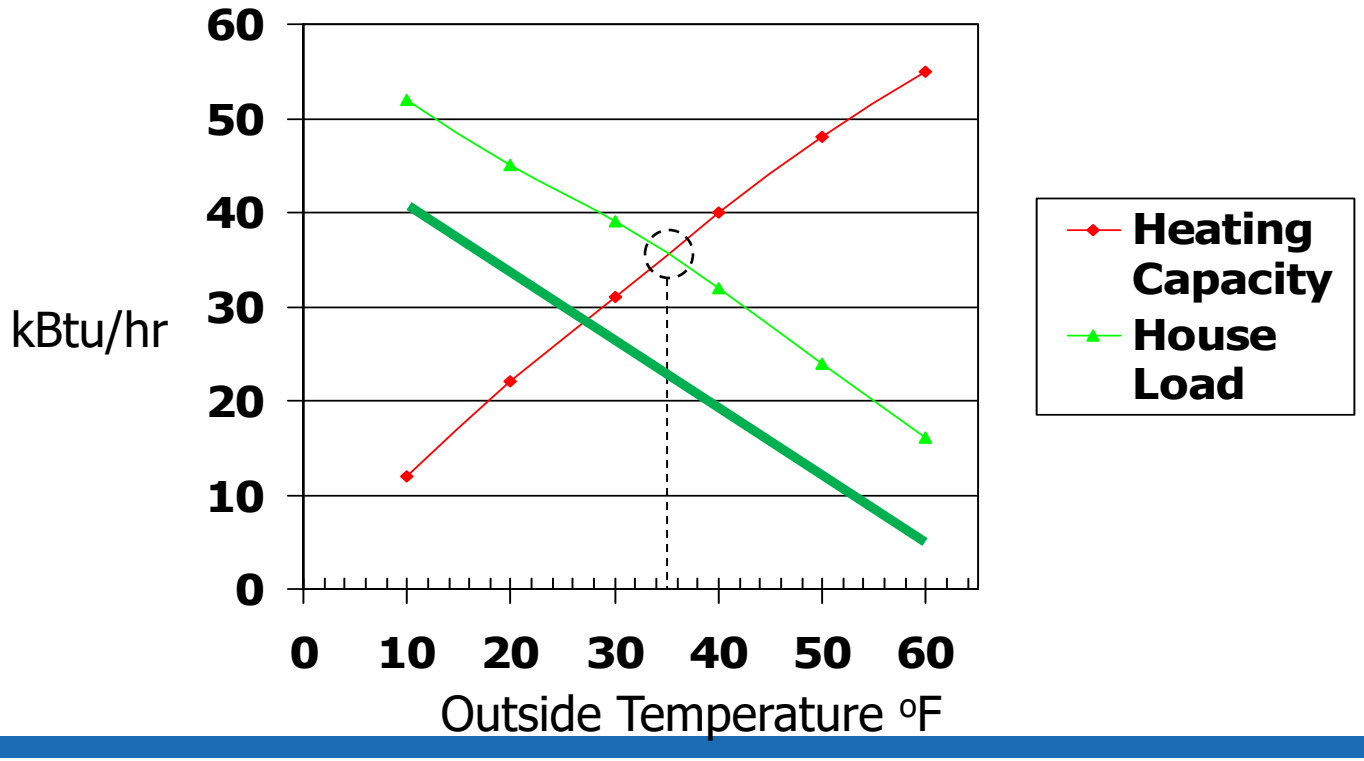
Mandatory Requirement:

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



Heat Pump Balance Point

The winter outdoor temperature at which the heat pump can deliver exactly the same amount of Btu's that the house is losing



Major Changes for IECC 2018

<u>2018 IECC</u>

- Windows
  - U-0.32
- Lighting
  - 90% efficient bulbs
- ERI modifications
  - Adjusted target ERI:
    - 62 CZ-4
    - 61 CZ-5
  - Harder “backstop” for renewables

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Wrap up and Q&A

Thank you!

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