2009 Washington State Energy Code Residential Sections

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WASHINGTON STATE UNIVERSITY
EXTENSION ENERGY PROGRAM

Produced with funding from:

U.S. DEPARTMENT OF ENERGY

neea

Washington State University Energy Program Website

- Washington State Energy Code text
- *Builders Field Guide*
- Prescriptive and Component Performance Worksheets
- Heating System Sizing worksheets
- Duct Testing Affidavit
- Duct Testing Standard
- Air Leakage Testing

www.energy.wsu.edu

Energy Code Support

Residential

- Washington State University Energy Program
- 360-956-2042
- energycode@energy.wsu.edu
- www.energy.wsu.edu/code
- Gary Nordeen, Luke Howard, Emily Salzberg, Tanya Beavers

Non-residential

- Northwest Energy Efficiency Council
- Lisa Rosenow
- 206-624-0283
- Lisa@putnamprice.com
- www.neec.net

WSEC

Make sure you're using the correct version!

2009 Washington State Energy Code
Chapter 51-11 WAC

January 1st, 2011

Free code text download at:
www.energy.wsu.edu/code/

WSEC Layout (101.3)

- Chapters 1-10 are for *single family* residential bldgs
- Chapters 11-15 are for *commercial and multi-family bldgs.*
- Shared Chapters
  - Chapter 2 – Definitions
  - Chapter 7 - Standards
  - Chapter 10 – Default U-Factors

Definition: Single Family Residential

- See IRC; R101.2, Scope for further details

Alterations: Building Envelope (101.3.2.5)

- Insulation levels in remodeled buildings do not have to meet current requirements but framing cavities must be filled to their full depth when exposed.
  - 2 X 4 walls must be insulated to R-15
  - 2 X 6 walls must be insulated to R- 21
  - Roof/Ceiling Assemblies need required space for ventilation

Furnace Replacement (101.3.2.6)

- Duct *~~sealing and~~ testing is required when a space conditioning system is altered including
  - Air handler replacement
  - Outdoor condensing unit (AC or HP)
  - Cooling or heating coils
  - Furnace heat exchanger

*Current emergency rule in effect until the end of August requires testing but no sealing

Duct Testing (existing houses)

- Compliance options for field verification
  - ~~Max. leakage rates:~~
    - ~~*8% CFA for Total duct leakage*~~
    - ~~*6% CFA for Leakage to exterior*~~

    ~~or~~
  - ~~Post installation duct leakage reduced by 50%~~

    ~~or~~
  - ~~Verification by 3rd party inspector that all accessible leaks have been sealed~~
  - Emergency rule requires test result to be documented on the affidavit and submitted to the building department and home owner

Duct testing standards are posted at:

www.energy.wsu.edu/code

See website

Exceptions:

- Ducts with less than 40 lineal feet in unconditioned spaces
- Ducts that have been previously tested
- Ducts containing asbestos

Duct Testing Affidavit (Existing Const.)

Energy Code Support

WASHINGTON STATE UNIVERSITY EXTENSION ENERGY PROGRAM

Duct Leakage Affidavit (Existing Construction)

Permit #: _____

House address or lot number: _____

City: _____ Zip: _____

Cond. Floor Area (ft^2): _____ Source (circle one): Plans Estimated Measured

☐ Duct tightness testing is not required for this residence per exceptions listed at the end of this document

Air Handler in conditioned space? ☐ yes ☐ no Air Handler present during test? ☐ yes ☐ no

Maximum duct leakage (check method used):

☐ **Method 1**

Total duct leakage, air handler installed: (floor area x .08) = _____CFM@25 Pa

☐ **Method 2**

Leakage to outdoors: (floor area x .06) = _____CFM@25 Pa

Test Result: _____CFM@25Pa

Ring (circle one): Open 1 2 3

Duct Blaster Location: _____ Pressure Tap Location: _____

☐ **Method 3**

The measured duct leakage shall be reduced by more than 50% relative to the measured leakage prior to the installation or replacement of the space conditioning equipment. A visual inspection including a smoke test shall demonstrate that all accessible leaks have been sealed.

Pre-installation test result: _____CFM@25Pa

Post installation test result: _____CFM@25Pa

Post installation leakage rate must be less than 50% of pre-installation rate

Company Name: _____ Duct Testing Technician: _____

Date: _____ Phone Number: _____

☐ **Method 4**

If it is not possible to meet the duct requirements of 1, 2 or 3, all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified third party.

I certify that these duct leakage rates are accurate and determined using standard duct testing protocol and all accessible leaks have been sealed.

Company Name:_____ Certified Third Party:_____ Date:_____

Washington State Energy Code reference:

101.3.2.6 **Mechanical Systems:** Those parts of systems which are altered or replaced shall comply with Section 503 of this Code when a space-conditioning system is altered by the installation or replacement of space-conditioning equipment (including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, cooling or heating coil, or the furnace heat exchanger), the duct system that is connected to the new or replacement space-conditioning equipment shall be sealed, as confirmed through field verification and diagnostic testing in accordance with procedures for duct sealing of existing duct systems as specified in the RS-33, to one of the following requirements.

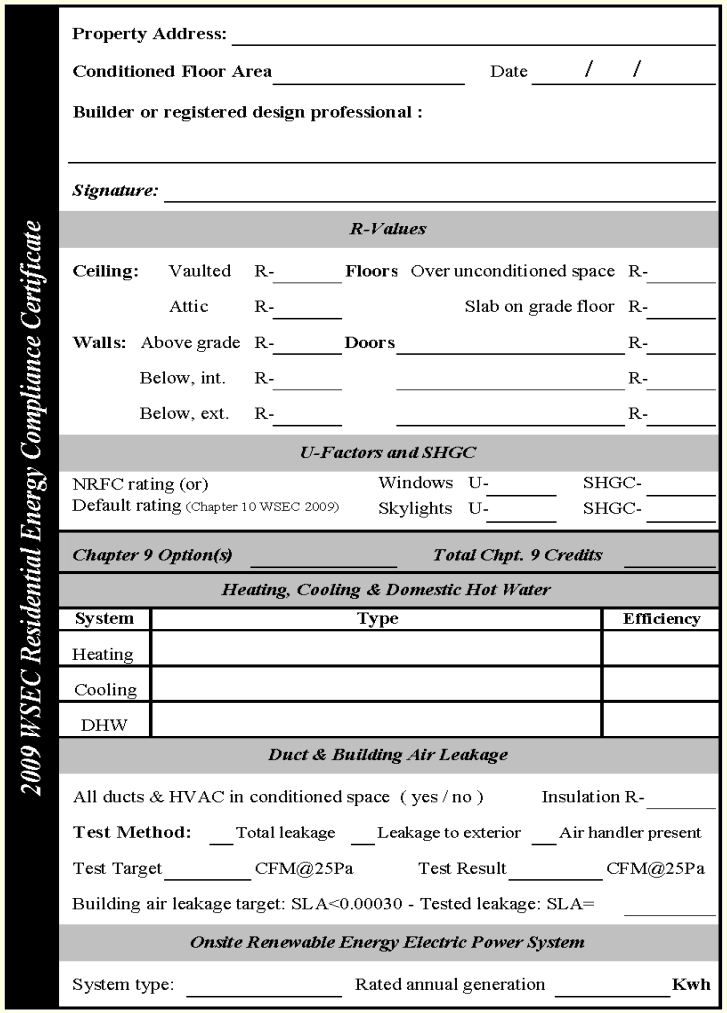
Exceptions: 1. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in RS-33.
2. Ducts with less than 40 linear feet in unconditioned spaces.
3. Existing duct systems constructed, insulated or sealed with asbestos.

Certificate (105.4)

- Posted within 3’ of electrical panel
  - Insulation
  - Windows
  - HVAC efficiency
  - Duct leakage
  - Air leakage

Certificate posted at:

www.energy.wsu.edu/code



2009 WSEC Residential Energy Compliance Certificate

Property Address: _____

Conditioned Floor Area _____ Date ___/___/___

Builder or registered design professional :

_____

Signature: _____

R-Values

Ceiling: Vaulted R-_____ **Floors** Over unconditioned space R-_____

Attic R-_____ Slab on grade floor R-_____

Walls: Above grade R-_____ **Doors** _____ R-_____

Below, int. R-_____ _____ R-_____

Below, ext. R-_____ _____ R-_____

U-Factors and SHGC

NRFC rating (or) Windows U-_____ SHGC-_____

Default rating (Chapter 10 WSEC 2009) Skylights U-_____ SHGC-_____

Chapter 9 Option(s) _____ ***Total Chpt. 9 Credits*** _____

Heating, Cooling & Domestic Hot Water

System	Type	Efficiency
Heating		
Cooling		
DHW		

Duct & Building Air Leakage

All ducts & HVAC in conditioned space (yes / no) Insulation R-_____

Test Method: __Total leakage __Leakage to exterior __Air handler present

Test Target _____ CFM@25Pa Test Result _____ CFM@25Pa

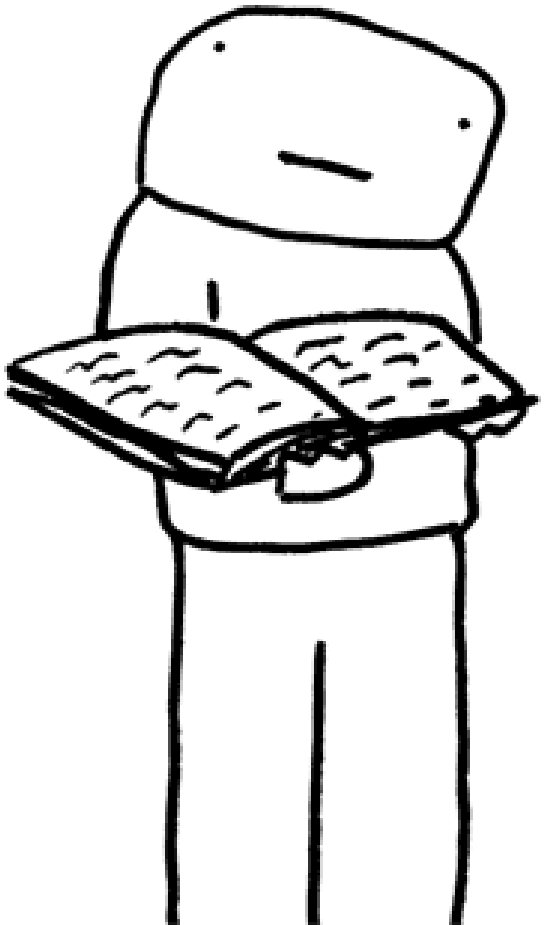
Building air leakage target: SLA<0.00030 - Tested leakage: SLA= _____

Onsite Renewable Energy Electric Power System

System type: _____ Rated annual generation _____ **Kwh**

See website

Chapter 2 – Definitions
44 new definitions added



dic · tio · nary . n.

1: a book everyone should own

2: you might want to buy two just in case

3: maybe yours is old and you need a new dictionary

Definition: NOMINAL R-VALUE:

The thermal resistance of insulation alone as determined in accordance with the U.S. Federal Trade Commission R-value rule.

www.ftc.gov/bcp/rulemaking/rvalue/index.shtml

Chapter #3 Design Conditions

- Table 3-1 added to this chapter
- Lists 100+ locations in Washington
- Lists Outdoor design temperatures for heating and cooling

TABLE 3-1
OUTDOOR DESIGN TEMPERATURES

Location	Outdoor Design Temp. (in °F) (heating)	Outdoor Design Temp. (in °F) (cooling)
Aberdeen 20 NNE	25.0	83
Anacortes	24.0	72
Anatone	-4.0	89
Auburn	25.0	84
Battleground	19.0	91
Bellevue	24.0	83
Bellingham 2 N	19.0	78
Blaine	17.0	73
Bremerton	29.0	83
Burlington	19.0	77
Chehalis	21.0	87

Three Energy Code Compliance Options

- Prescriptive
- Component Performance
- Systems Analysis

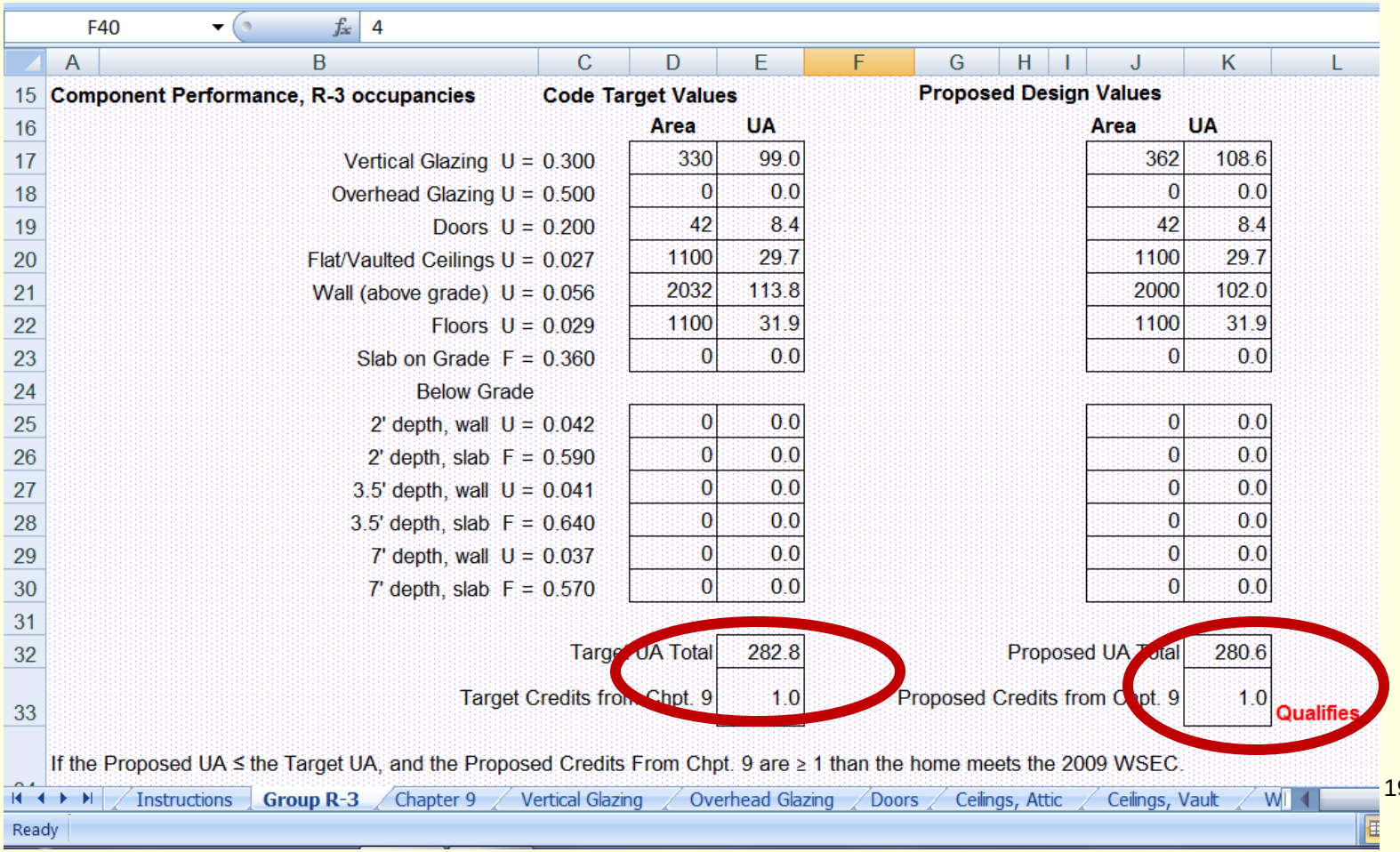
Prescriptive: **Chapter 6**

Option II.

- 25% glazing
- .32 U-factor windows
- R-21 INT walls
- R-38 ADV ceiling
- R-30 floor

Component Performance: **Chapter 5**

Building Envelope UA Trade-Off



F40 | 4

Component Performance, R-3 occupancies	Code Target Values		Proposed Design Values	
	Area	UA	Area	UA
Vertical Glazing U = 0.300	330	99.0	362	108.6
Overhead Glazing U = 0.500	0	0.0	0	0.0
Doors U = 0.200	42	8.4	42	8.4
Flat/Vaulted Ceilings U = 0.027	1100	29.7	1100	29.7
Wall (above grade) U = 0.056	2032	113.8	2000	102.0
Floors U = 0.029	1100	31.9	1100	31.9
Slab on Grade F = 0.360	0	0.0	0	0.0
Below Grade				
2' depth, wall U = 0.042	0	0.0	0	0.0
2' depth, slab F = 0.590	0	0.0	0	0.0
3.5' depth, wall U = 0.041	0	0.0	0	0.0
3.5' depth, slab F = 0.640	0	0.0	0	0.0
7' depth, wall U = 0.037	0	0.0	0	0.0
7' depth, slab F = 0.570	0	0.0	0	0.0
Target UA Total		282.8	Proposed UA Total	280.6
Target Credits from Chpt. 9		1.0	Proposed Credits from Chpt. 9	1.0

Qualifies

If the Proposed UA ≤ the Target UA, and the Proposed Credits From Chpt. 9 are ≥ 1 than the home meets the 2009 WSEC.

Instructions | Group R-3 | Chapter 9 | Vertical Glazing | Overhead Glazing | Doors | Ceilings, Attic | Ceilings, Vault | W

Ready

Systems Analysis – Chapter 4

- Same procedure as always
  - Model Target (Base Code) house
  - Model Proposed house
  - Proposed house must be at least 8% more efficient than the Target house.

Systems Analysis – Chapter 4

BATCH REPORT

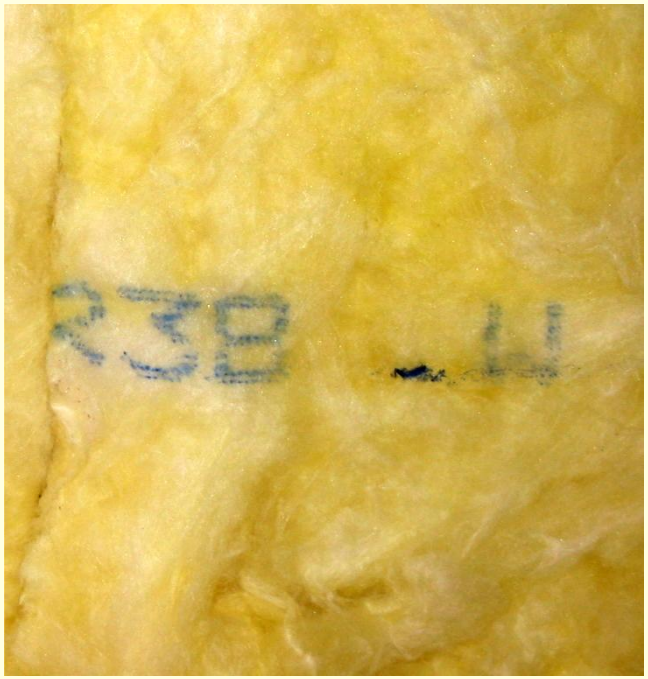
			Water	Tax	Energy	HERS
Annual Load (MMBtu/yr)	**Heating**	**Cooling**	**Heating**	**Credit**	**Star**	**Index**
H:\...\WSEC 2009 + 1C.blg	28.2	8.3	17.4	No	No	87
H:\...\WSEC 2009 BASE.blg	28.2	8.3	17.4	No	No	87

Annual Energy Cost ($/yr)	**Heating**	**Cooling**	**DHW**	**L & A**	**PV**	**Charge**	**Total**
H:\...\WSEC 2009 + 1C.blg	261	50	277	594	-0	171	1353
H:\...\WSEC 2009 BASE.blg	500	52	277	594	-0	171	1593

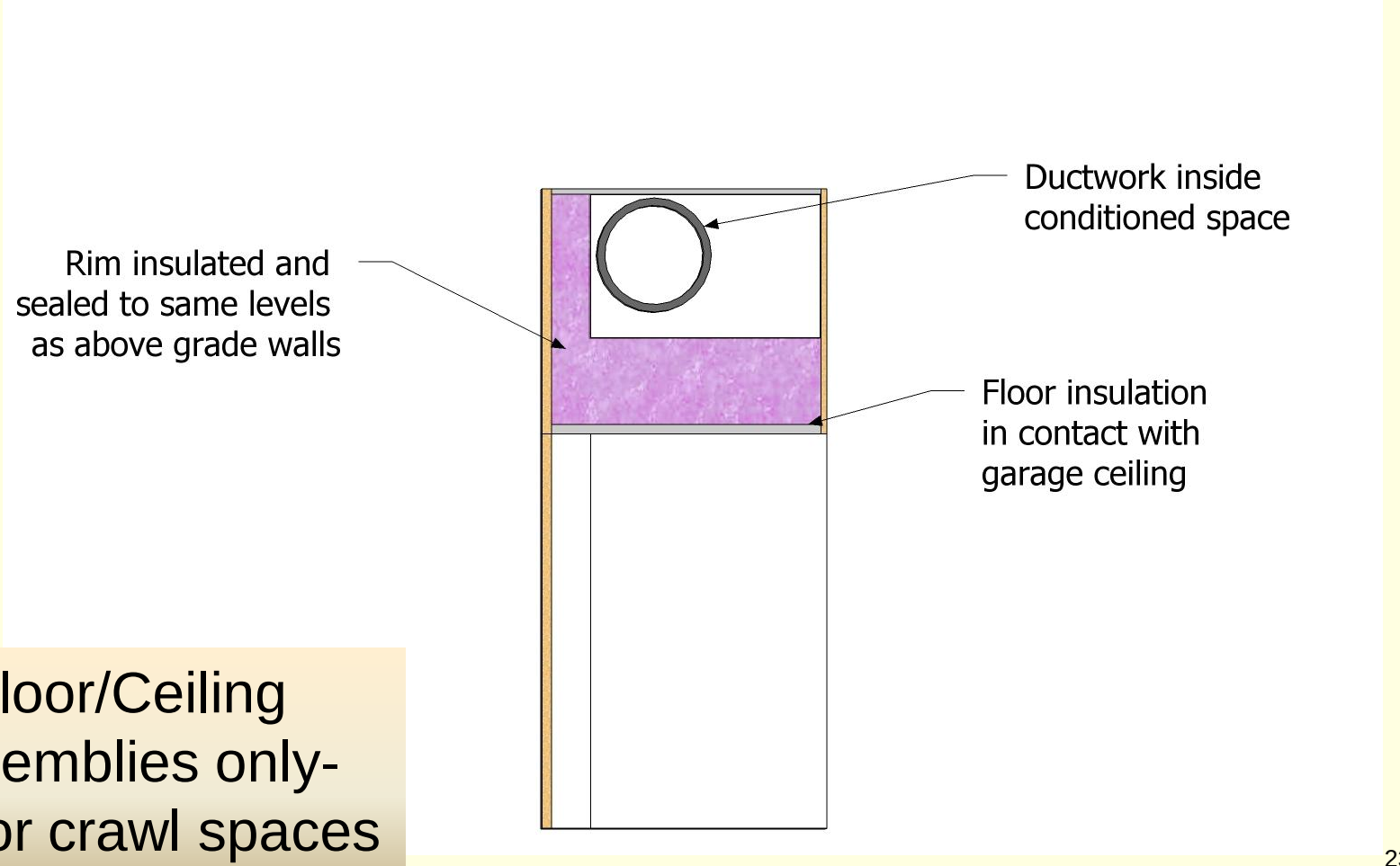
Annual Consumption (MMBtu/yr)	**Heating**	**Cooling**	**DHW**	**L & A**	**PV**	**Total**
H:\...\WSEC 2009 + 1C.blg	11.2	2.1	22.8	25.5	-0.0	61.7
H:\...\WSEC 2009 BASE.blg	38.4	2.2	22.8	25.5	-0.0	89.0

Insulation (502.1.4.1)

- Substantial contact with the surface being insulated is required
  - *There is an exception for floor/ceiling assemblies*
- Installed to maintain uniform R-values
- Installed so R-value mark can be seen by the inspector

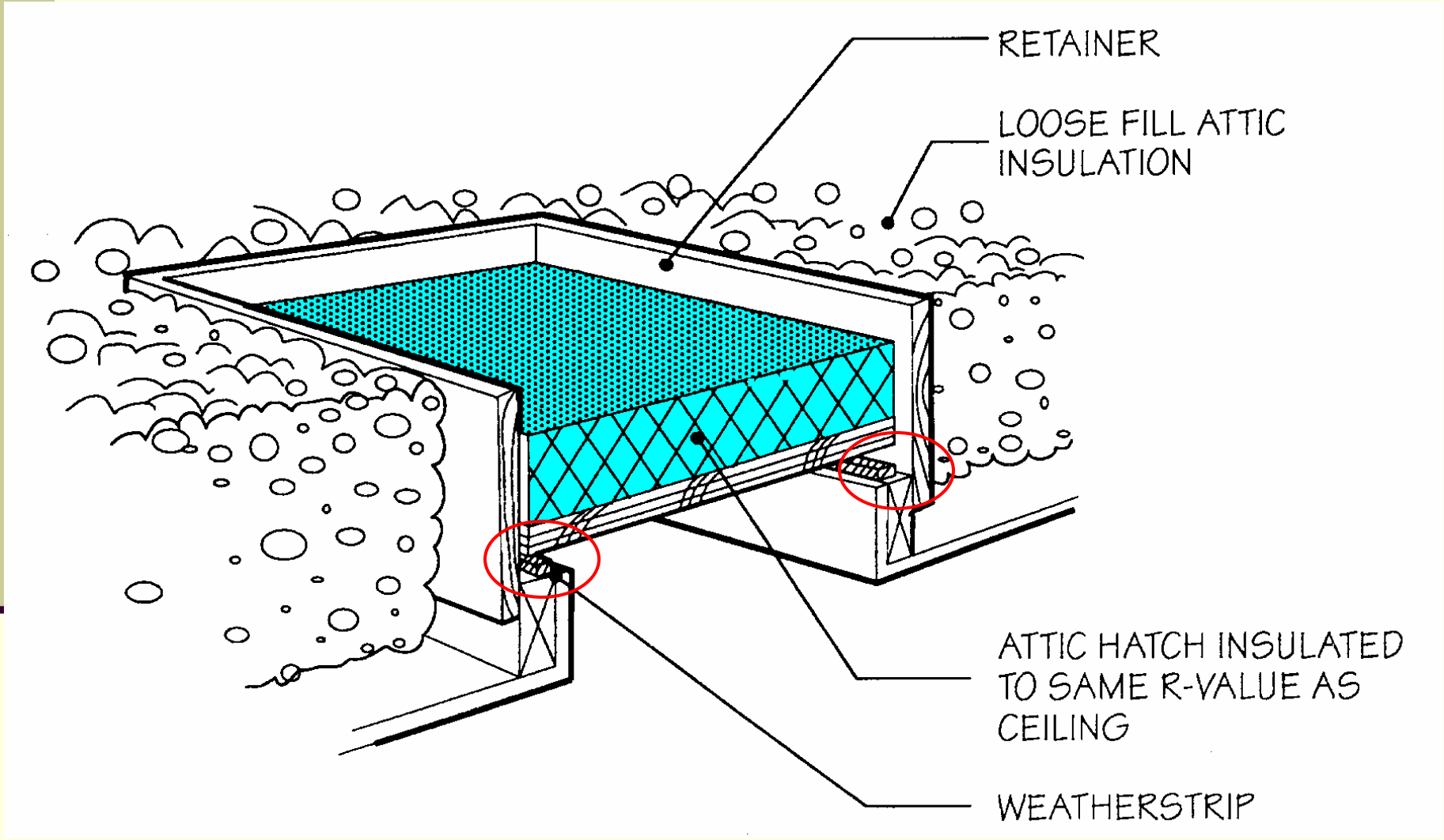


Substantial contact not required in this application (502.1.4.7 Exception)

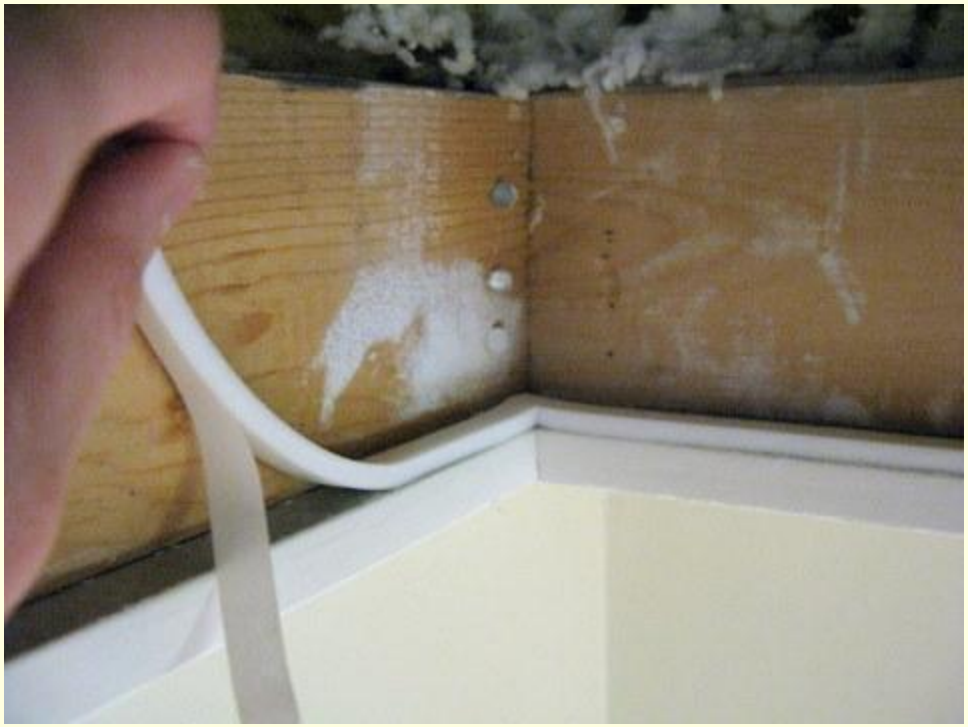


Floor/Ceiling assemblies only- not for crawl spaces

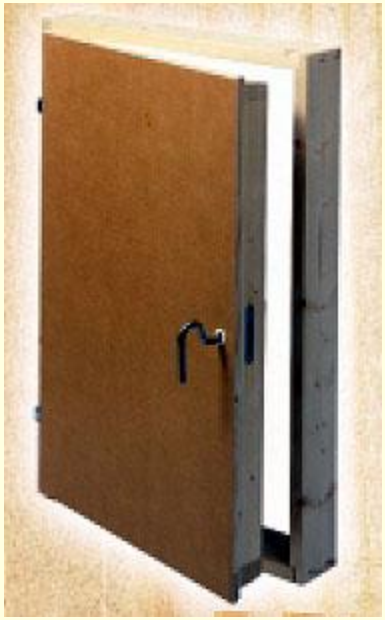
Attic Access (502.1.4.4)



Weather stripping reduces air leakage



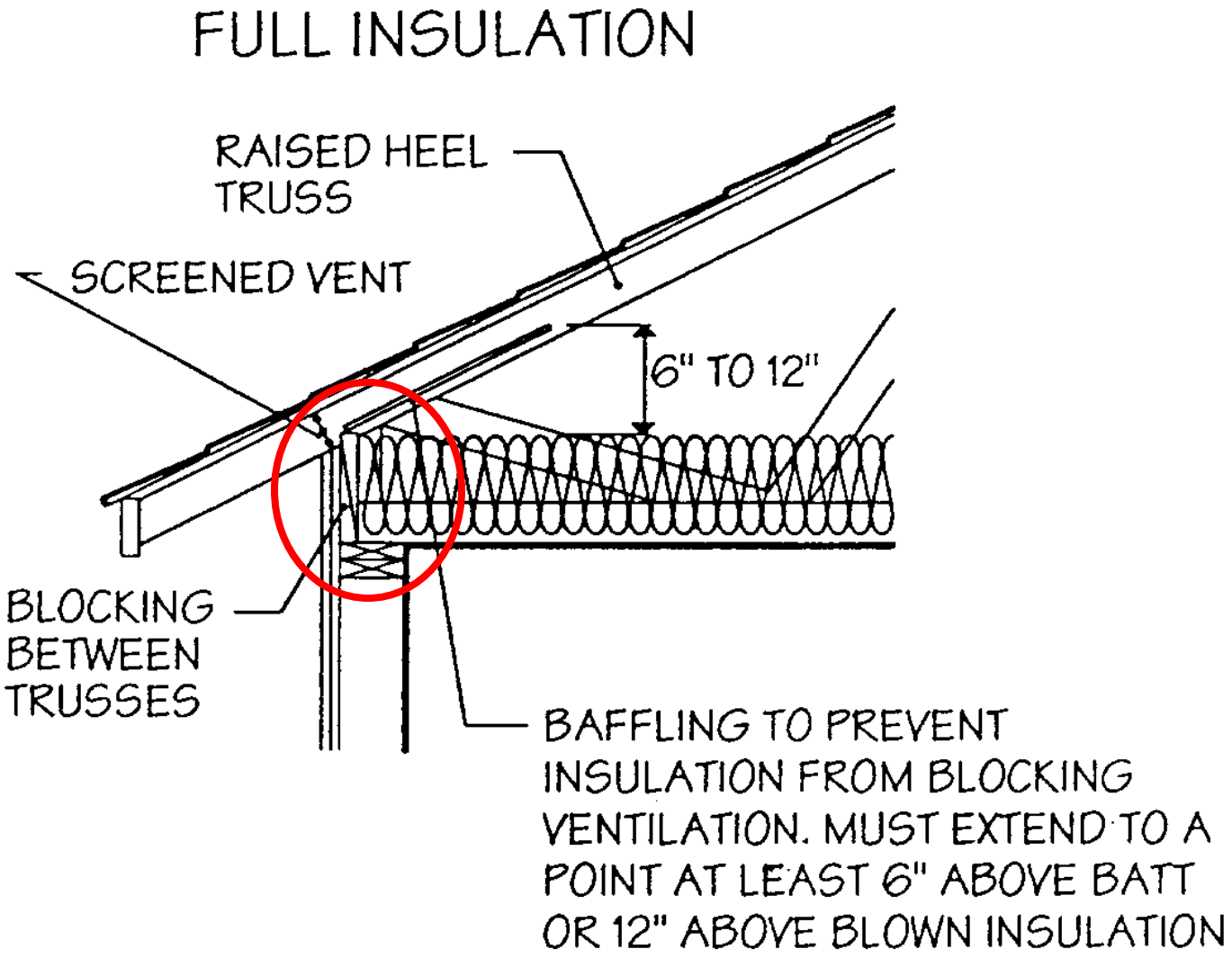
Pull-down ladder access/knee wall access



Ceilings: Two Types

- Attics (R-38 ADV framed or R-49)
  - Including Standard and Scissor Trusses
- Single Rafter Joist (R-38)

Advanced Framed Roof



Maintain a minimum 1” airspace

Blown-in Ceiling Insulation

Fiberglass

Cellulose

Insulation Markers (502.1.4.1)

- Required for blown-in insulation
- Placed every 300 Ft^2
- Faced toward attic access


R-50
16¾"
R-44
14¾"


R-30
10¼"
R-26
9"
R-22
7¼"
R-19
6¼"
R-13
4¾"

Cellulose Depth & Bag Count

Application Coverage Chart			Product #INS551LD				
R-Value @ 75° F Mean Temperature	Minimum Thickness (inches)		Maximum Net Coverage (no adjustment for framing)			Gross Coverage (based on 2" x 6" framing on 16" centers)	
To Obtain a Thermal Resistance of:	Installed Insulation Should Not Be Less Than:	Thickness After Settling	Maximum Sq. Ft. Per Bag	Minimum Bags Per 1,000 Sq. Ft.	Minimum Weight (lbs) Per Sq. Ft.	Maximum Sq. Ft. Per Bag	Minimum Bags Per 1,000 Sq. Ft.
R-13	4.1	3.7	55.4	18.0	0.407	61.1	16.4
R-19	5.9	5.4	36.2	27.6	0.623	40.0	25.0
R-22	6.9	6.2	30.7	32.6	0.734	33.5	29.8
R-24	7.5	6.7	27.9	35.9	0.809	30.2	33.1
R-25	7.8	7.0	26.6	37.6	0.847	28.7	34.8
R-30	9.3	8.4	21.7	46.1	1.039	23.1	43.2
R-38	11.7	10.5	16.6	60.1	1.355	17.5	57.1
R-42	12.9	11.6	14.9	67.2	1.516	15.6	64.2
R-49	15.0	13.5	12.5	79.9	1.802	13.0	76.8
R-60	18.3	16.5	10.0	100.3	2.261	10.3	97.1

SIDEWALLS					
R-value	Wall Thickness	Thickness (inches)	Maximum Square Feet per Bag Coverage 16" oc	24" oc	Weight per Square Foot
R-13	(2 x 4)	3.5	32.8	31.7	0.758
R-20	(2 x 6)	5.5	20.9	20.2	1.192

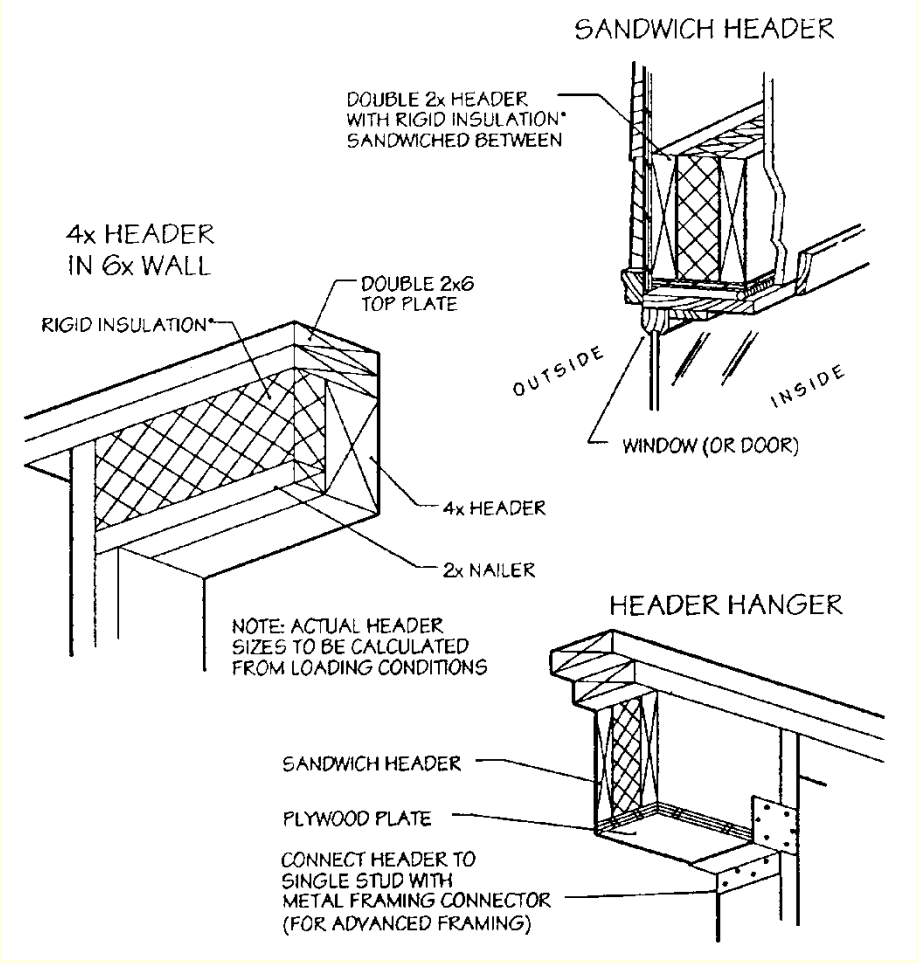
R-value/inch: 3.7 Attic Density Range: 1.32-1.65 lbs/cu. ft.
Bag Weight : 22.55 lbs. Wall Density: 2.6 lbs/cu.ft.

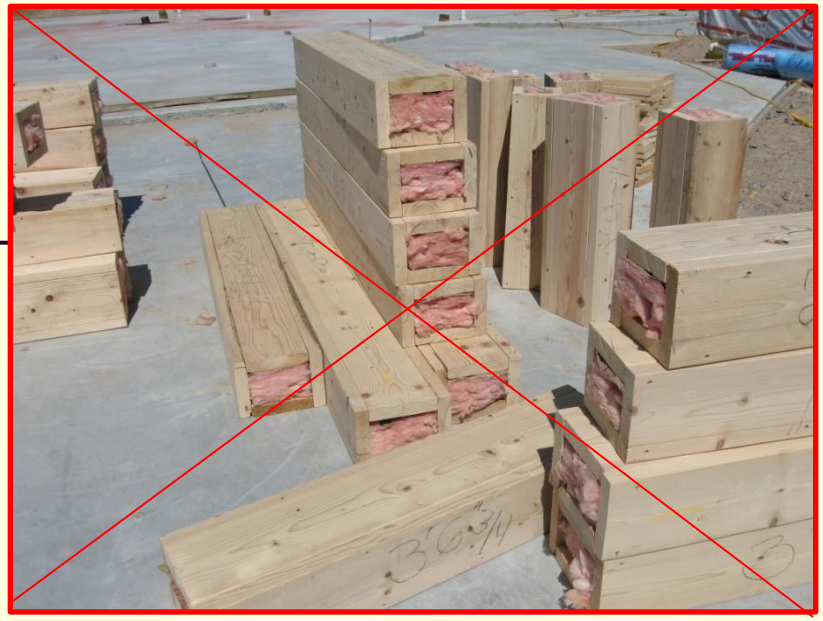
Walls (502.1.4.6)

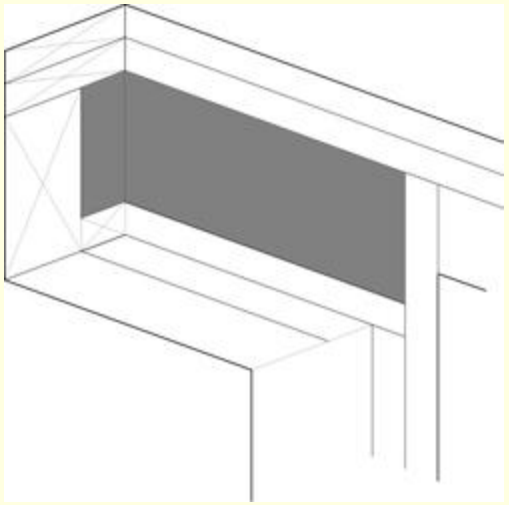
- Climate Zone 1
  - R-21 for all paths
  - All paths are intermediate framing (requires R-10 insulated headers)
- Climate Zone 2
  - R-21 for 12% glazing or less
  - R-19+R-5 for other paths

R-21 INT Includes Insulated Headers

All Climate Zone 1 Prescriptive Paths require Intermediate Framing







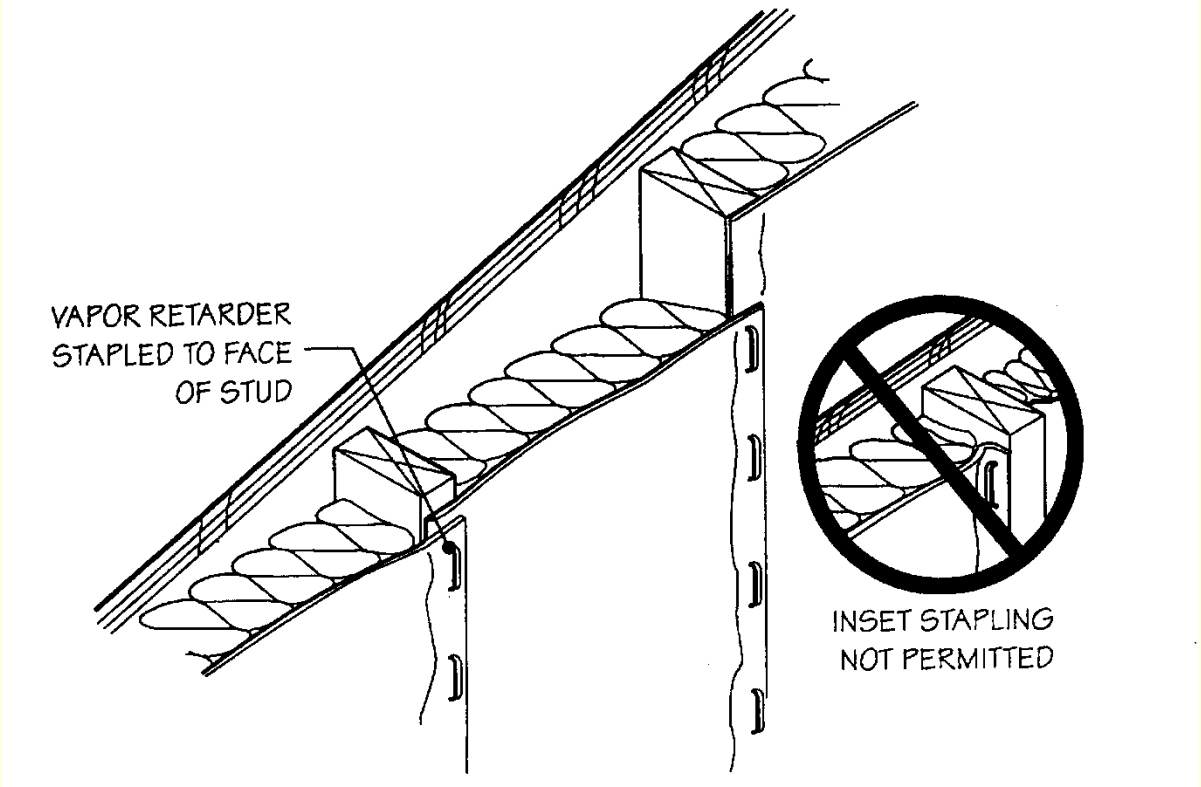
Above Grade Walls

Mold may grow here


WOLF STEEL
If six studs are good…


Nine must be
better.

Stapling Insulation (502.1.6.6)




KNAUF
"This is my insulation."
GREENGUARD
R21 W 4
APPLY THIS SIDE TOWARD HEATED AREA


KNAUF


hns Manville
WARNING! This facing will burn. Do not leave exposed; it must be covered with gypsum board or other code-approved materials and installed in compliance with all building codes. To prevent a fire, keep open flames and other sources of heat away from the facing.


Johns Manville


Not so good


BIBs System


Blow-In-Blanket® Blow-In-Blanket® Blow-In-Blanket® Blow-In-Blanket® Blow-In-Blanket® Blow-In-Blanket® Blow-
-Blanket® Blow-In-Blanket® Blow-In-Blanket® Blow-In-Blanket® Blow-In-Blanket® Blow-In-Blanket® Blow-In-Bl

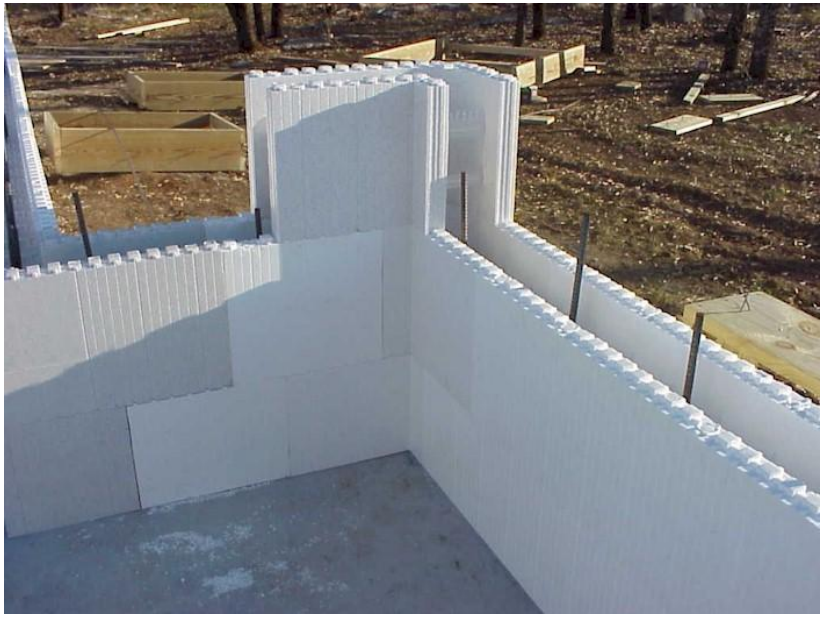
Spray Foam

SIPS Panels


Tyvek
HomeWrap

Insulated Concrete Forms

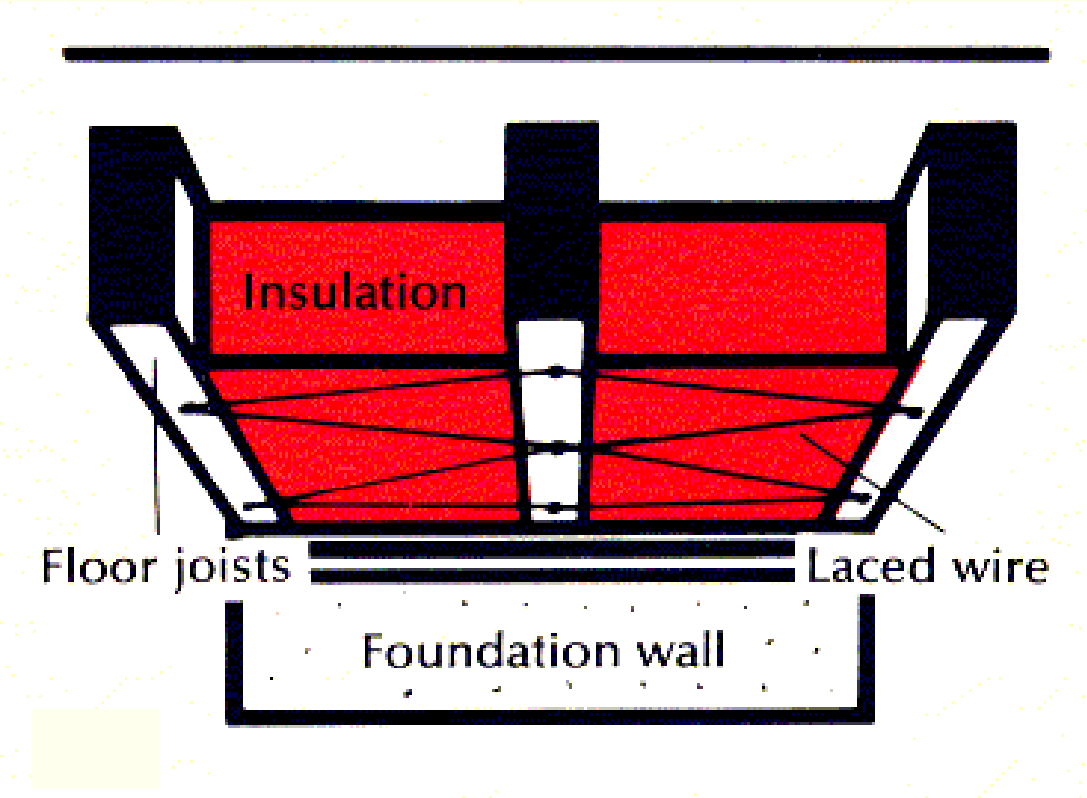
ICF’s




R-21
5½" Fiber Glass Insulation

Floors

- R-30 Climate Zone 1
- R-30 Climate Zone 2



Floor Insulation Installation (502.1.4.7)

- Installed in a permanent manner
- Insulation in substantial contact with the surface being insulated
- Supports 24” o.c. max
- Don’t block vents with insulation batts


01/04/2007
502.1.4.7

502.1.4.7

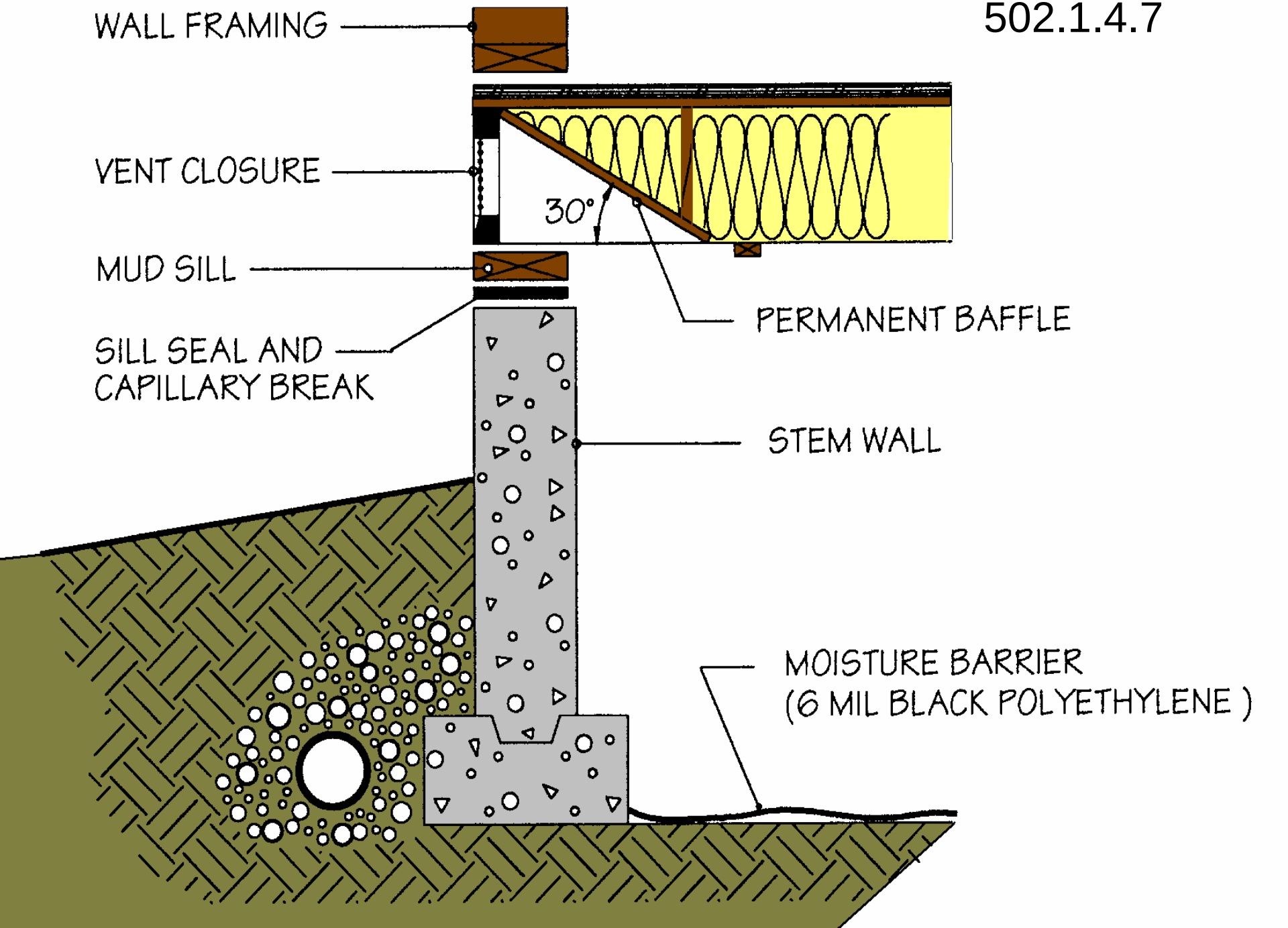
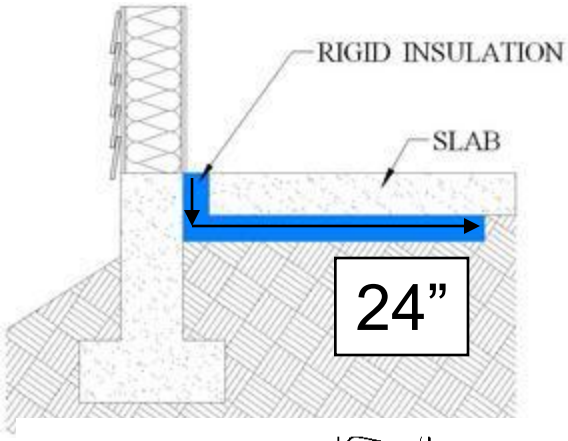
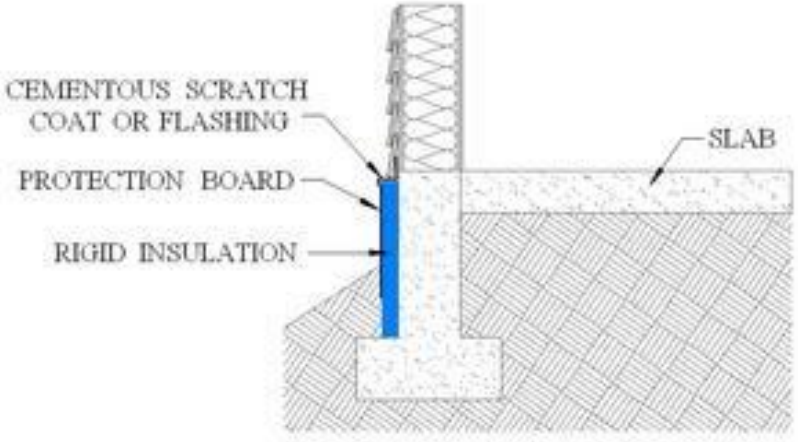
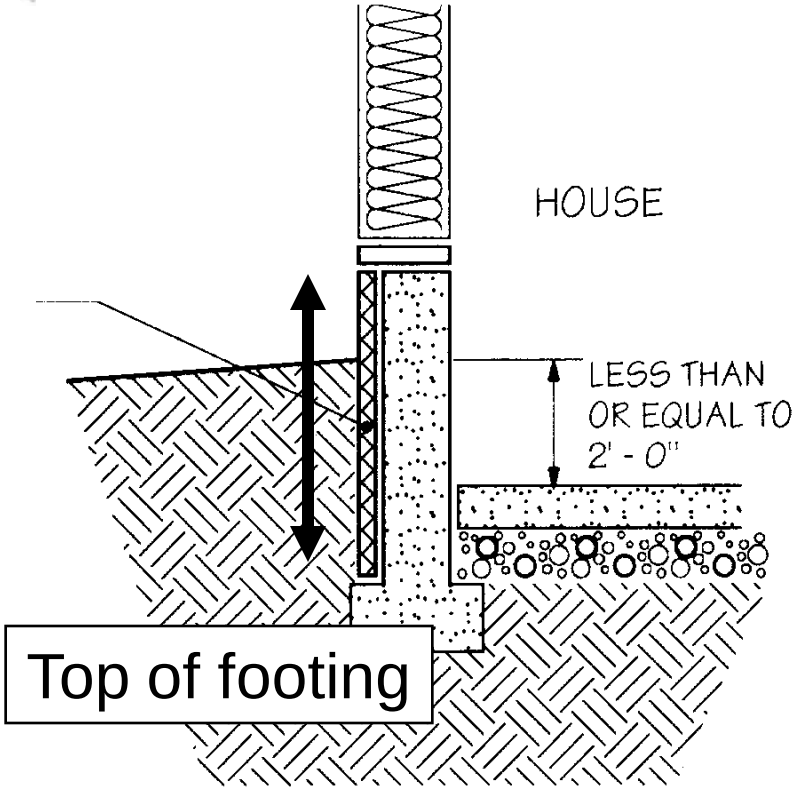
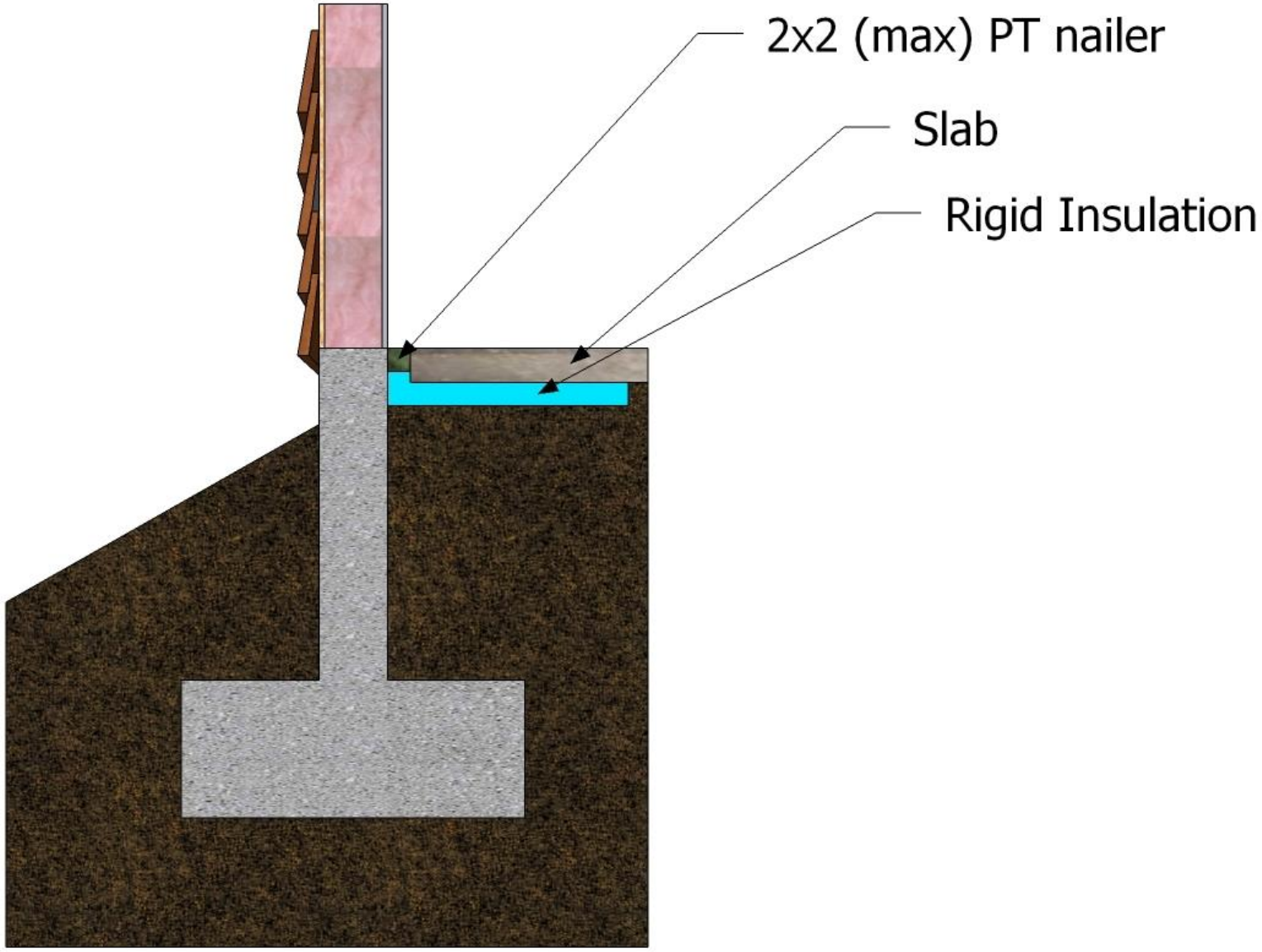

WALL FRAMING
VENT CLOSURE
30°
MUD SILL
PERMANENT BAFFLE
SILL SEAL AND
CAPILLARY BREAK
STEM WALL
MOISTURE BARRIER
(6 MIL BLACK POLYETHYLENE)

photo by Bill Warren, Advanced Energy


RIGID INSULATION
SLAB
24”


CEMENTOUS SCRATCH
COAT OR FLASHING
PROTECTION BOARD
RIGID INSULATION
SLAB

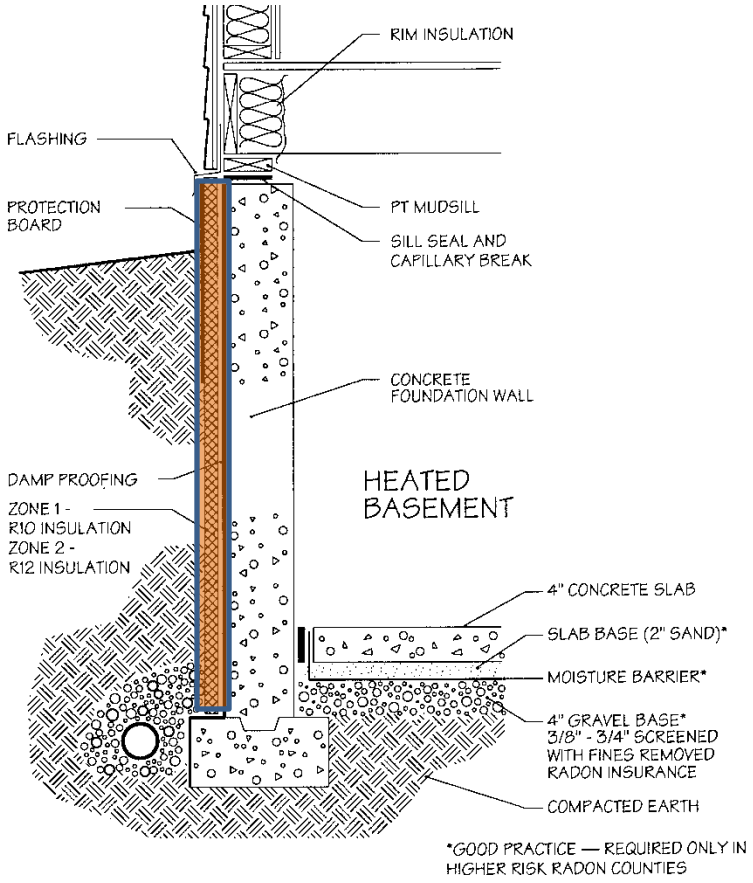

HOUSE
LESS THAN
OR EQUAL TO
2' - 0"
Top of footing

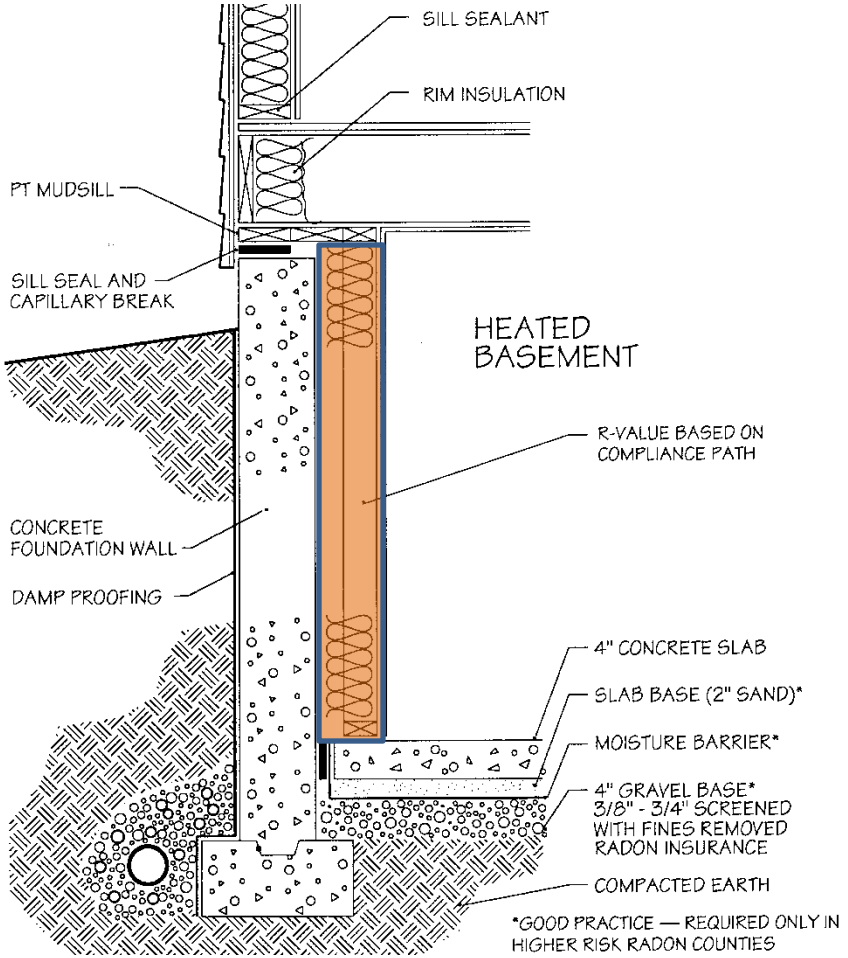

2x2 (max) PT nailer
Slab
Rigid Insulation

Radiant Slabs (502.1.4.9)

- R-10 insulation under the entire slab
- Radiant slab insulation cannot be traded off

Below Grade Wall and Slab






Don’t do this
Moisture
Never cover insulation with plastic


3" DRYWALL SCREWS
TOP PLATE SCREWED TO CEILING JOISTS
R-13 Batt
R-5 Foam
2x4
Do this
PRESSURE-TREATED 2x4 BOTTOM PLATE

Windows

- Climate Zone 1
  - 13% or less = U-.34
  - 25% or less = U-.32
  - Unlimited = U-.30
- Climate Zone 2
  - 12% or less = U-.32
  - 15% or less = U-.32
  - Unlimited = U-.30

Glazing and Door U-Factors (502.1.5)

- U-Factors determined by:

- NFRC Test Methods

  or

- Chapter 10 Defaults
- 3 complicated exceptions have been deleted

Area Weighted U-factors

Area weighted U-factor allowed for single above grade components (602.7.2)

Example of Area Weighted U-Value Calculation:

Window #1 area 10 ft2 U = .34 U x A = 3.4

Window #2 area 15 ft2 U = .28 U x A = 4.2

Total area 25 ft2 Total U x A = 7.6

Area weighted average 7.6/25 = 0.30

Moisture Control

- Vapor retarders required in:
  - Walls
    - Faced batts, sheet goods, vapor retarder paint
  - Floors
    - Decking material typically meets requirement
  - Ceilings
    - Not required if ventilated space above insulation is 12” or greater

Exception for Ventilated Attics

- Unvented, conditioned attics are allowed under certain conditions

See website

Unvented Attic Criteria

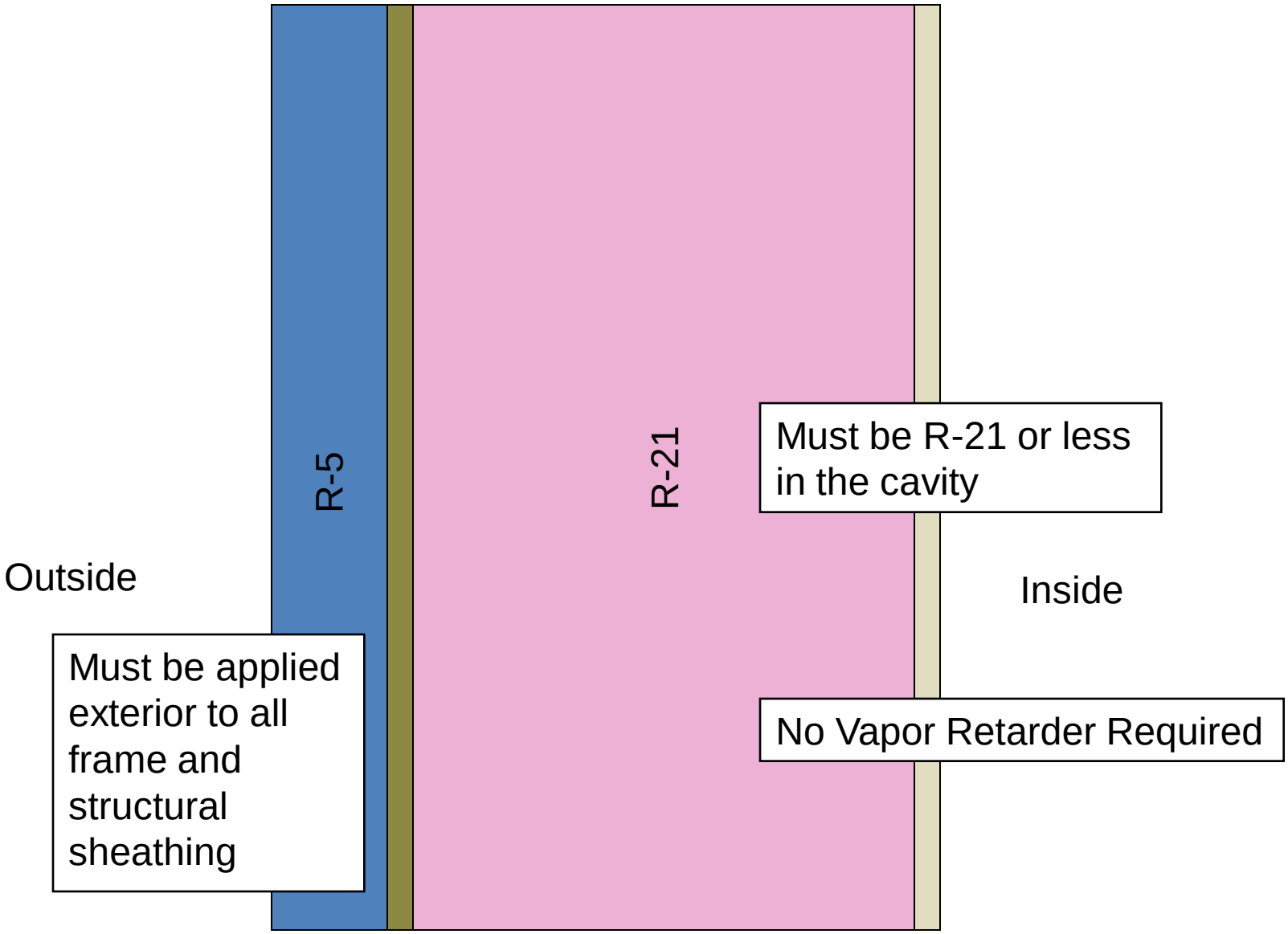
- Unvented attic contained completely within the building thermal envelope.
- NO vapor retarders installed at ceiling level.

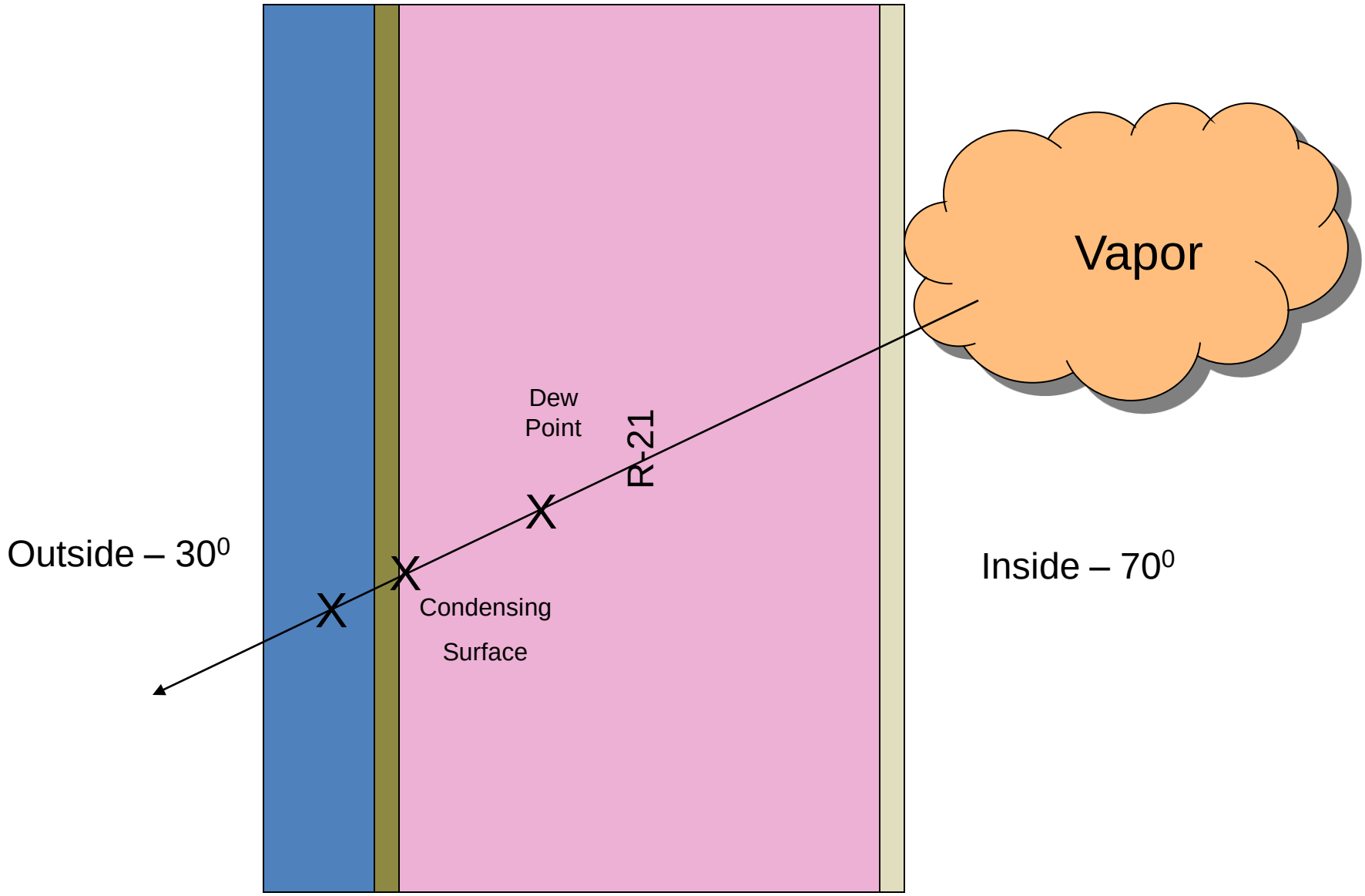
Moisture Control (506.1.6.1)

- **502.1.6.1 Vapor Retarders:** Vapor retarders shall be installed on the warm side (in winter) of insulation as specified in the following cases.
- **EXCEPTION:** Vapor retarder installed with not more than 1/3 of the nominal R-value between it and the conditioned space.

502.1.6.6 Walls:

- **502.1.6.6 Walls:** Walls separating conditioned space from unconditioned space shall have a vapor retarder installed. Faced batt insulation shall be face stapled.
- Exception: No vapor retarders required for walls with exterior foam sheathing
  - R-5 Climate Zone 1
  - R-7.5 Climate Zone 2


R-5
R-21
Must be R-21 or less in the cavity
Outside
Inside
Must be applied exterior to all frame and structural sheathing
No Vapor Retarder Required


Vapor
Dew
Point
R-21
Outside – 30⁰
Inside – 70⁰
Condensing
Surface

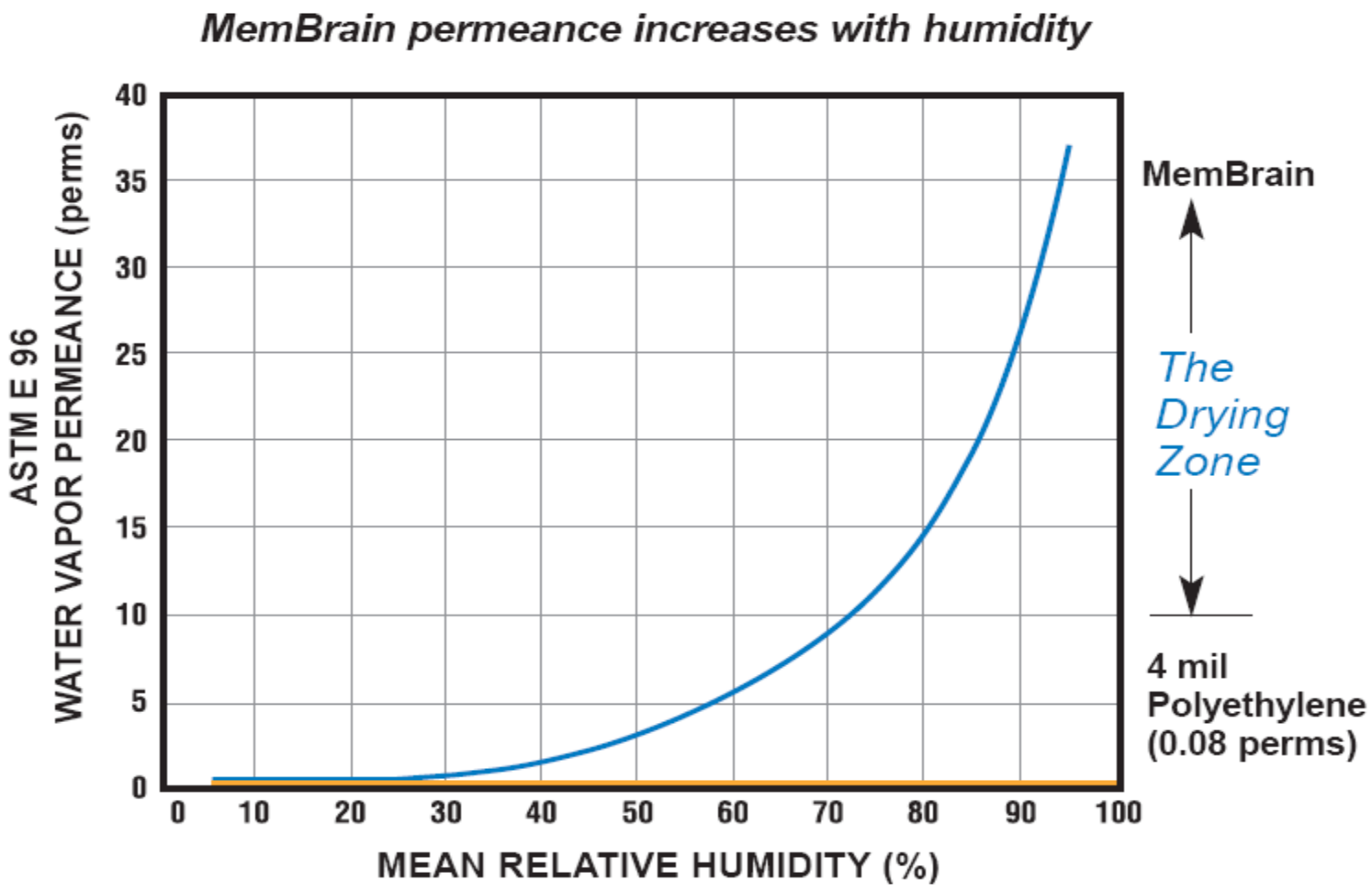
Supplement E

Permeance Values for Common Building Materials*

Materials	Permeance	
Polyethylene (4 mil)	0.08	
Latex Primer/Sealer	6.28	(1 coat = 0.0012")
Vapor Retarder Paint	0.45	(1 coat = 0.0031")
Polyvinyl Acetate Latex (PVA)	5.5	(3 coatings – 4 oz/sf)
Vinyl Acrylic Primer Latex	8.62	(1 coat = 0.0016")
Kraft Paper (Asphalt Impregnated)	0.03	
15 lb Asphalt Felt Paper	1.0	
Gypsum Wall Board (3/8")	50	
Plywood (1/4" w/exterior glue)	0.7	

See Builder's Field Guide www.energy.wsu.edu/code

Variable Resistance Materials



Air Leakage (502.4)

- Typical air infiltration can account for 25% to 40% of a home's heat loss

Air Sealing

- Penetrations in top and bottom plates – all walls

Air Sealing

- Wiring penetrations in electrical boxes – exterior walls only
- Sole Plates – Inside the structure where the bottom plate and sub-floor meet. Easy to install and verify.

Air Sealing

- Rim Joists between heated floors – Can be applied either on the interior or exterior

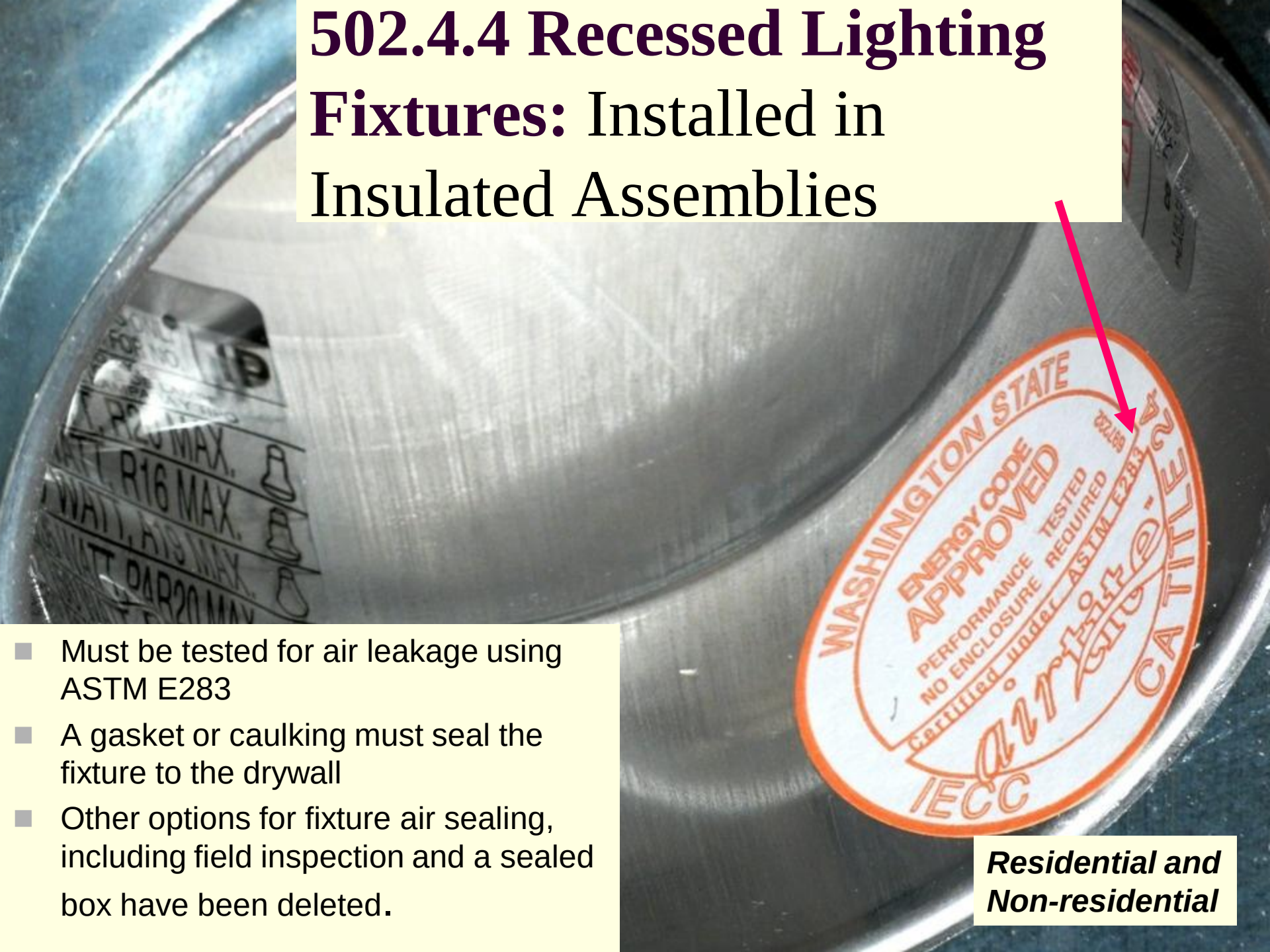
Air Sealing

- Any other penetrations between inside and outside the house

Recessed Lighting

- Leaky recessed lights may account for $5 to $30 each worth of energy loss per year
- Each unsealed light may serve as a conduit for the movement of about 1/3 of a gallon of water daily into a cold attic

502.4.4 Recessed Lighting Fixtures: Installed in Insulated Assemblies



- Must be tested for air leakage using ASTM E283
- A gasket or caulking must seal the fixture to the drywall
- Other options for fixture air sealing, including field inspection and a sealed box have been deleted.

Residential and Non-residential

Building Air Leakage Testing (502.4.5)

- Air leakage testing required for new houses
- Blower door is required
- Maximum leakage allowed:

  .00030 SLA (Specific Leakage Area)

See website

Calculating SLA

(Specific Leakage Area)

- SLA = (CFM50 X .055) / (CFA X 144)
- SLA = (1790 X .055) / (2240 X 144)
- SLA = 98.45 / 322,560
- SLA = .00030

Duct testing Calculator (New Construction)				
At Rough-in (Total Leakage)				
	CFA of Home	Standard[1]	Calculated Target	Test[2] CFM_{25}
Air Handler Present		≤ 6 CFM_{25} per 100 sf of CFA		
Air Handler not Present		≤ 4 CFM_{25} per 100 sf of CFA		
Post Construction				
	CFA of Home	Standard[1]	Calculated Target	Test[2] CFM_{25}
Air Handler Present (Total Leakage)		≤ 8 CFM_{25} per 100 sf of CFA		
Air Handler Present (Leakage to Exterior)		≤ 6 CFM_{25} per 100 sf of CFA		
Air Handler not Present		≤ 4 CFM_{25} per 100 sf of CFA		

1. Test results must comply with one of the Standards options.
2. Test CFM_{25} must be equal to or less than the calculated target.

Air Leakage testing Calculator (Blower Door Test)			
Standard	CFA of Home	Tested CFM_{50}	Test Result
0.00030 SLA ($(CFM_{50}$ X 0.055) / (CFA X 144))			

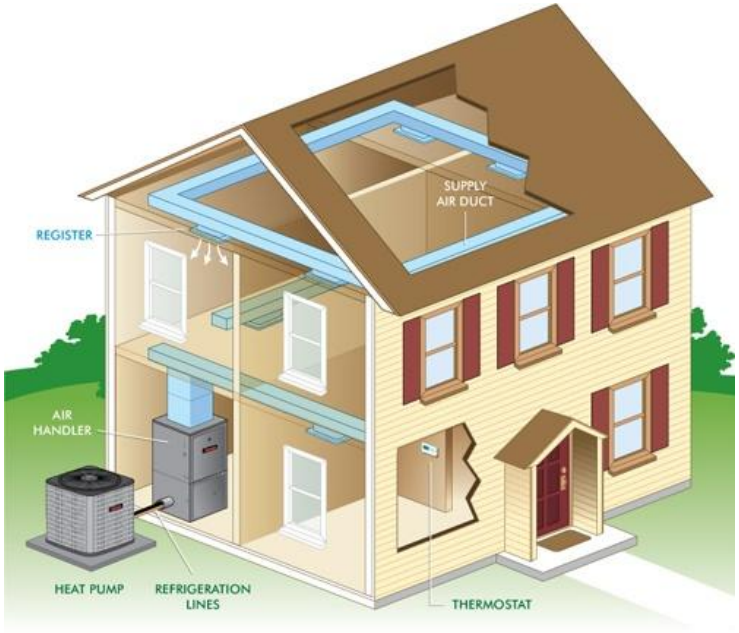
What the numbers mean

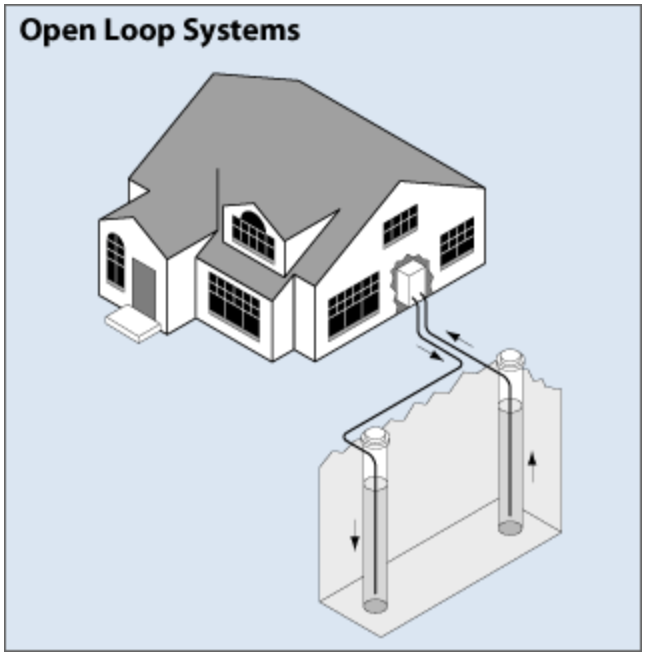
Pressure (in Pascals)

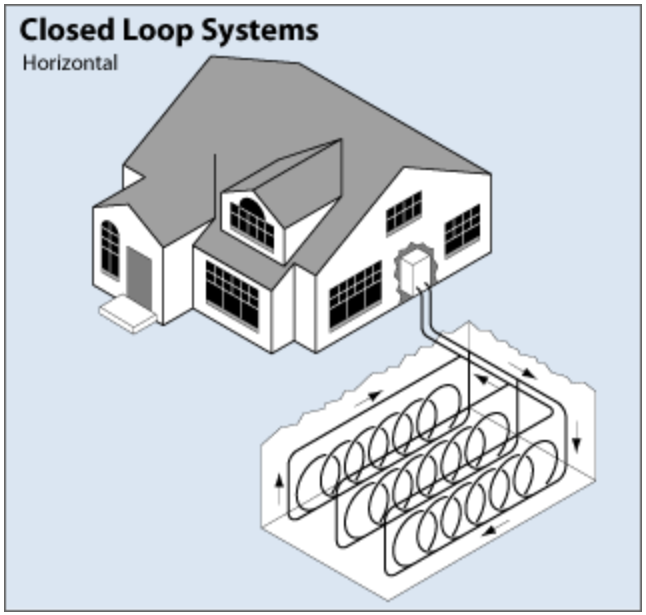
Flow rate (CFM)

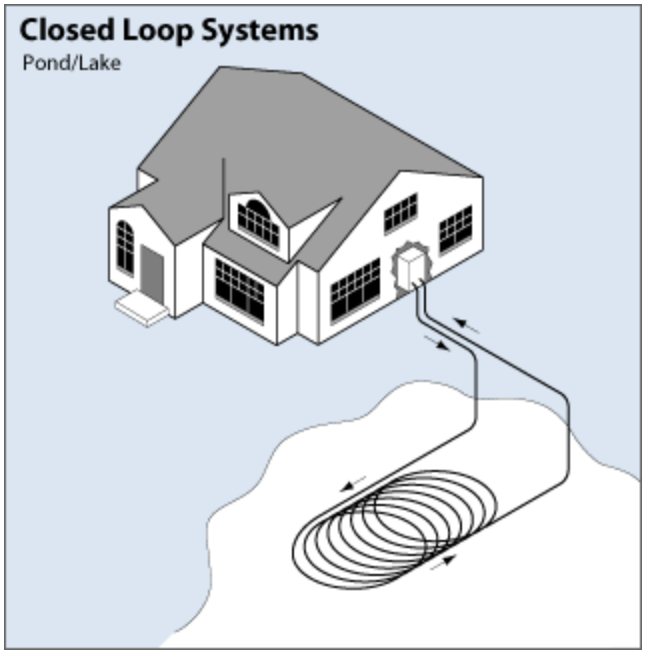
HVAC Controls (503.8)

- Primary space conditioning systems in each dwelling unit require a programmable thermostat
- Each additional system within a dwelling unit must have an adjustable thermostat
- Programmable stat must have a 5-2 schedule (minimum)


SUPPLY
AIR DUCT
REGISTER
AIR
HANDLER
HEAT PUMP
REFRIGERATION
LINES
THERMOSTAT

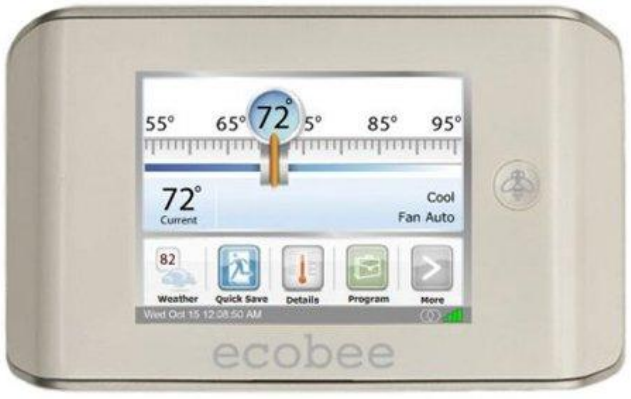

Open Loop Systems


Closed Loop Systems
Horizontal


Closed Loop Systems
Pond/Lake

Heat Pump Controls (503.8.3.5)

- Heat Pumps with supplemental electric resistance heaters shall have controls that:
  - Prevent supplementary heater operation when the load can be met by the heat pump alone
  - Supplementary heat lock out based on outdoor temp.
    - Max. setting of 40^0F
    - Set to 32^0 or less at final inspection



HVAC System Sizing (503.2.2)

- **Heating/cooling systems limited to 150% of design heat load except:**
  - **Systems less than 40,000 Btu/h are exempt from sizing requirements**

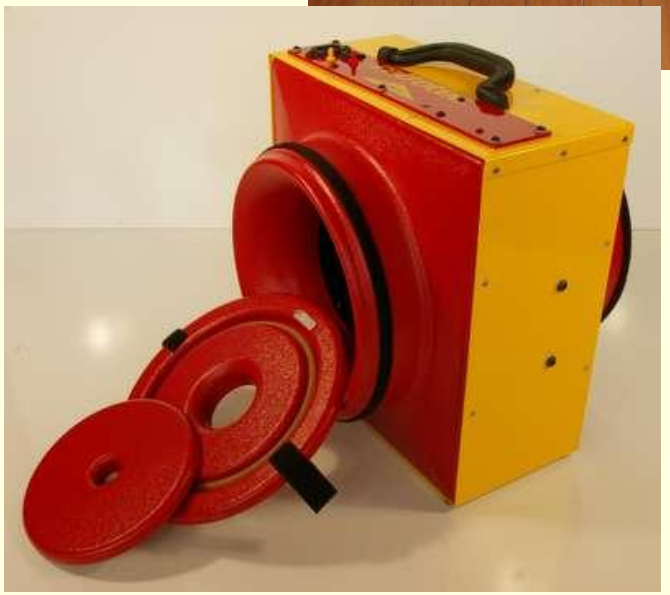
Ducts (503.10.1)

- Installation of ducts in exterior walls, floor or ceilings cannot displace required insulation
- Building cavities cannot be used as ducts

Duct Testing (503.10.2)

- Ducts located outside the conditioned space must be tested

- Maximum leakage rates specified in RS-33



See website

Duct Testing Standards

- Rough-In Testing Targets:
  - Total leakage ≤ 6% of the CFA at 25 Pa

    OR
  - Total leakage ≤ 4% of the CFA at 25 Pa

    if air handler has not been installed
- Post Construction Testing Targets:
  - Total leakage ≤ 8% of the CFA at 25 Pa

    OR
  - Leakage to exterior ≤ 6% of the CFA at 25 Pa

Duct Testing Standards

Exceptions:

Duct tightness test is **not** required if –

- The air handler and all ducts are located within conditioned space.

  or

- The furnace is a nondirect vent type combustion appliance in an unconditioned space with a maximum of 6 feet of ductwork in the unconditioned space.

Resources for Standard and Testing

Energy Code Support — Washington State University Extension Energy Program

Duct Leakage Affidavit

Permit #: _____

House address or lot number: _____

City: _____ Zip: _____

Cond. Floor Area (ft²): _____ Source (circle one): Plans Estimated Measured

☐ Duct tightness testing is not required for this residence per exceptions listed at the end of this document

Air Handler in conditioned space? ☐ yes ☐ no Air Handler present during test? ☐ yes ☐ no

Circle Test Method: Leakage to Outside Total Leakage

Maximum duct leakage:

Post Construction, total duct leakage: (floor area x .08) = _____CFM@25 Pa

Post Construction, leakage to outdoors: (floor area x .06) = _____CFM@25 Pa

Rough-In, total duct leakage with air handler installed: (floor area x .06) = _____CFM@25 Pa

Rough-In, total duct leakage with air handler not installed: (floor area x .04) = _____CFM@25 Pa

Test Result: _____CFM@25Pa

Ring (circle one if applicable): Open 1 2 3

Duct Tester Location: _____ Pressure Tap Location: _____

I certify that these duct leakage rates are accurate and determined using standard duct testing protocol.

Company Name: _____ Technician: _____

Technician Signature: _____ Date: _____ Phone Number: _____

Washington State Energy Code reference:

503.10.2 Sealing. All ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3 of the *International Residential Code* or 603.9 of the *International Mechanical Code*. Duct tightness testing shall be conducted to verify that the ducts are sealed. A signed affidavit documenting the test results shall be provided to the jurisdiction having authority by the testing agent. When required by the building official, the test shall be conducted in the presence of department staff.

Exceptions: 1. Duct tightness test is not required if the air handler and all ducts are located within conditioned space.

2. Duct testing is not required if the furnace is a nondirect vent type combustion appliance installed in an unconditioned space. A maximum of six feet of connected ductwork in the unconditioned space is allowed. All additional supply and return ducts shall be within the conditioned space. Ducts outside the conditioned space shall be sealed with a mastic type duct sealant and insulated on the exterior with R-8 insulation for above grade ducts and R-5 water resistant insulation when within a slab or earth.

Duct Testing Affidavit

Duct testing Calculator (New Construction)

At Rough-in (Total Leakage)

	CFA of Home	Standard[1]	Calculated Target	Test[2] CFM_{25}
Air Handler Present		≤ 6 CFM_{25} per 100 sf of CFA		
Air Handler not Present		≤ 4 CFM_{25} per 100 sf of CFA		

Post Construction

	CFA of Home	Standard[1]	Calculated Target	Test[2] CFM_{25}
Air Handler Present (Total Leakage)		≤ 8 CFM_{25} per 100 sf of CFA		
Air Handler Present (Leakage to Exterior)		≤ 6 CFM_{25} per 100 sf of CFA		
Air Handler not Present		≤ 4 CFM_{25} per 100 sf of CFA		

1. Test results must comply with one of the Standards options.
2. Test CFM_{25} must be equal to or less than the calculated target.

Air Leakage testing Calculator (Blower Door Test)

Standard	CFA of Home	Tested CFM_{50}	Test Result
0.00030 SLA $((CFM_{50} \times 0.055) / (CFA \times 144))$			

Glossary

Rough-In: After installation of the complete air distribution system but before installation of insulation and sheet rock. Allows for access to all duct seams and connections for re-evaluation of seal integrity if standard is not met in intitial test.

Post Construction: At or near final inspection. The home must be complete enough to pressurize the home to 25 pa.

Total Leakage: Aggregation of the entire systems duct leakage in a duct test.

Leakage to Exterior: Aggregation of all duct system leaks to the exterior of the CFA in a duct test.

CFA: Conditioned floor area

CFM_{25}: Cubic feet per minute of air leakage at 25 pascals of pressure

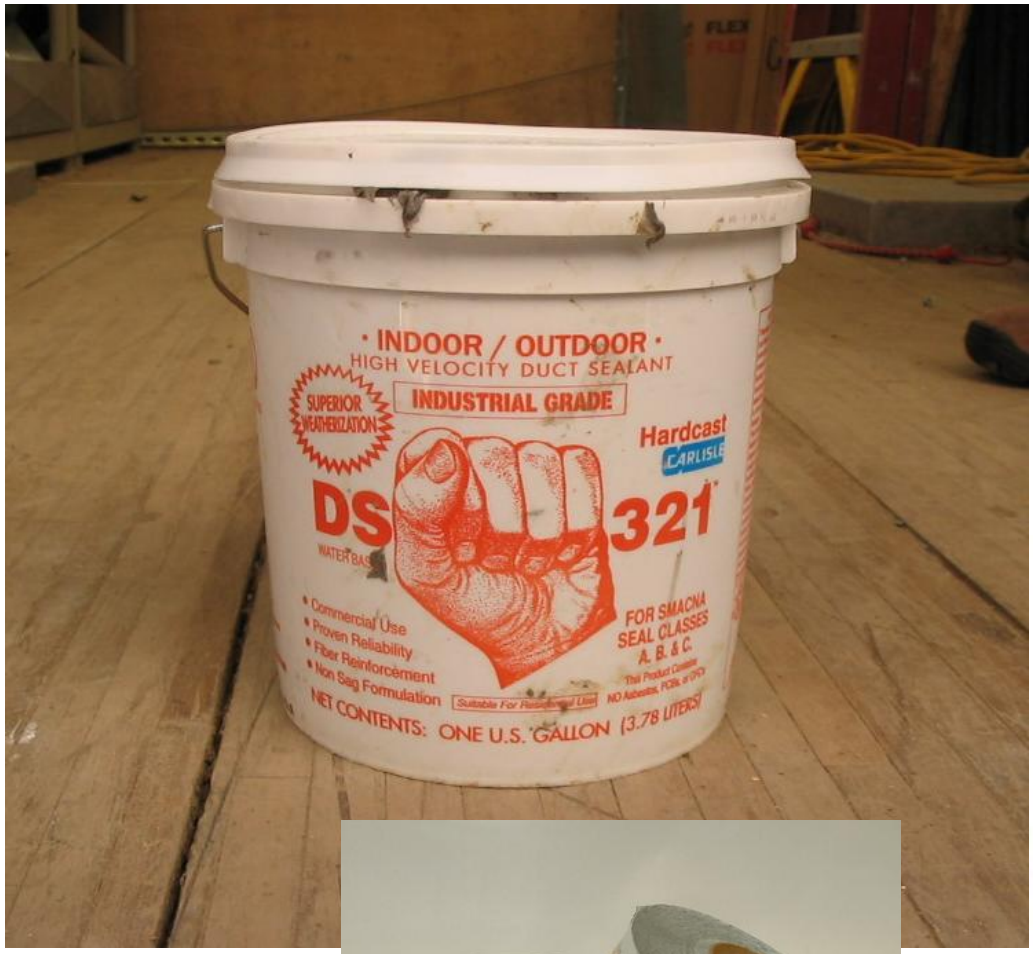
CFM_{50}: Cubic feet per minute of air leakage at 50 pascals of pressure

Pascal (pa): Unit of pressure

SLA: Specific leakage area

Test Result Calculator


R8
16
Carrier
Carrier


• INDOOR / OUTDOOR •
HIGH VELOCITY DUCT SEALANT
INDUSTRIAL GRADE
SUPERIOR WEATHERIZATION
Hardcast
CARLISLE
DS 321
WATER BASED
• Commercial Use
• Proven Reliability
• Fiber Reinforcement
• Non Sag Formulation
FOR SMACNA SEAL CLASSES A, B, & C
NO Asbestos, PCBs, or VOCs
NET CONTENTS: ONE U.S. GALLON (3.78 LITERS)


Shurtape Mastic SF-685


Indoor/Outdoor
PRO seal
VELOCITY DUCT SEALANT

Not so good


What do you expect for $850,000?
A good duct system?
© Erin Hamernyik

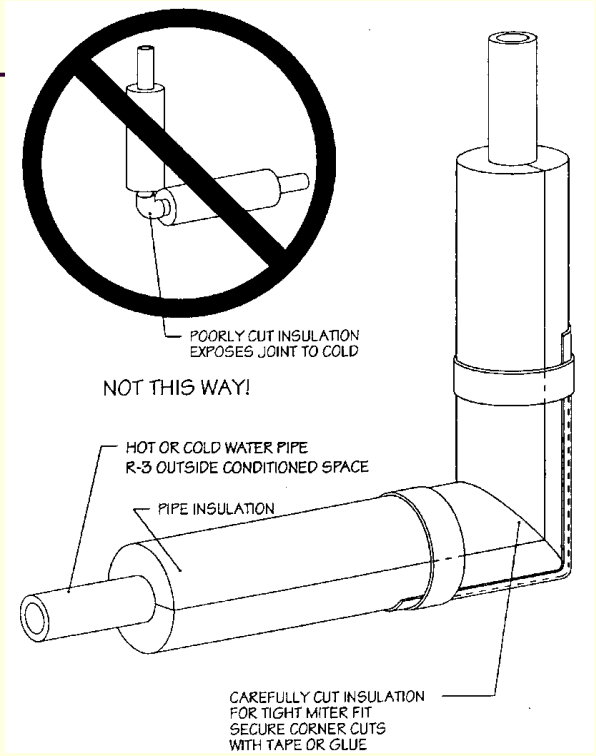
Ducts in Dropped Ceiling in Hall

After Drywall

Demand Water Heaters

Service Water Heating

- R-3 Pipe insulation required outside the conditioned space
- R-10 pad required for electric water heaters on unconditioned floors



Indoor Lighting (505.1)

- 50% of all indoor luminaires (fixtures) shall be high efficacy
- Interpretation from SBCC allows for screw in LEDs or CFLs.

Kichler Lighting

Outdoor Lighting

GU 24 Base

- High efficacy luminaire required for lighting *attached to the building*

or

- Must have photo daylight control and a motion sensor

Lighting: Linear Fluorescent Fixtures

- **505.3 Linear Fluorescent Fixtures:**
  - This rule applies to typical fluorescent tube fixtures
  - Linear fluorescent fixtures must be fitted with T-8 (1” diameter) or smaller lamps (but not T-10 or T-12 lamps)

Table 6-1
Prescriptive Requirements for Single Family Residential
Climate Zone 1

Option	Glazing %	Vertical Glazing	Overhead Glazing	Door U-Factor	Ceiling	Vaulted Ceiling	Wall Above grade	Wall (interior) Below grade	Wall (exterior) Below grade	Floor	Slab On grade
I.	13%	.34	.50	.20	R-49 or R-38 ADV	R-38	R-21 INT	R-21 TB	R-10	R-30	R-10
II.	25%	.32	.50	.20	R-49 or R-38 ADV	R-38	R-21 INT	R-21 TB	R-10	R-30	R-10
III.	Unlimited	.30	.50	.20	R-49 or R-38 ADV	R-38	R-21 INT	R-21 TB	R-10	R-30	R-10

Table 6-2
Prescriptive Requirements for Single Family Residential
Climate Zone 2

Option	Glazing %	Vertical Glazing	Overhead Glazing	Door U-Factor	Ceiling	Vaulted Ceiling	Wall Above grade	Wall (interior) Below grade	Wall (exterior) Below grade	Floor	Slab On grade
I.	12%	.32	.50	.20	R-49 or R-38 ADV	R-38	R-21 INT	R-21 TB	R-12	R-30	R-10
II.	15%	.32	.50	.20	R-49 or R-38 ADV	R-38	R-19+R-5	R-21 TB	R-12	R-30	R-10
III.	Unlimited	.30	.50	.20	R-49 or R-38 ADV	R-38	R-19+R-5	R-21 TB	R-12	R-30	R-10

Energy Credits Chapter 9

- Dwelling units must develop <u>one</u> credit from the following options

High Efficiency HVAC Equipment

- Gas, propane or oil furnace. — 1.0 credit
  - Min. AFUE 92%

  Or
- Air-source heat pump — 1.0 credit
  - Min. HSPF 8.5

  Or
- Ground Source Heat Pump — 2.0 credits
  - Min. COP 3.3

High Efficiency HVAC Equipment

- Ductless split system heat pump
  - House must have electric zonal as primary heating system
  - Ductless heat pump shall provide heating to at least one zone

1.0 credit

High Efficiency HVAC Distribution Components

- All heating and cooling components located inside the conditioned space
  - Must be direct vent or sealed combustion
  - Components located in a conditioned crawl space are not allowed
  - Electric resistance heat is not allowed
  - Direct combustion heating equipment (i.e. room heaters, fireplaces, etc.) with an AFUE less than 80% not allowed

1.0 credit

Efficient Building Envelope #1

- Prescriptive compliance based on Table 6-1 (Climate Zone 1) with modifications:
  - Windows U-.28
  - Floor R-38
  - Slab-on-grade R-10 fully insulated
  - Below grade slab R-10 fully insulated

    or
- Component Performance (Zones 1 and 2)
  - Reduce Target UA 5%

.5 credit

Efficient Building Envelope #2

- Prescriptive compliance based on Table 6-1 (Climate Zone 1) with modifications:
  - Windows U-.25
  - Walls R-21 + R-4
  - Floor R-38
  - Slab-on-grade R-10 fully insulated
  - Below grade slab R-10 fully insulated
  - R-21+R-5 below grade basement walls

  or
- Component Performance (Zones 1 and 2)
  - Reduce Target UA 15%

1.0 credit

Super Efficient Building Envelope #3

- Prescriptive compliance based on Table 6-1 (Climate Zone 1) with modifications:
  - Windows U-.22
  - Walls R-21+R-12
  - Ceiling R-49 ADV
  - Floor R-38
  - Slab-on-grade R-10 fully insulated
  - Below grade slab R-10 fully insulated
  - R-21+R-12 below grade basement walls

    or
- Component Performance (Zones 1 and 2)
  - Reduce Target UA 30%

2.0 credits

Air Leakage Control and Efficient Ventilation

- Air Leakage rate reduced to .00020 SLA

  (3.7 ACH50)

  and

- The Whole House Ventilation System is a heat recovery ventilator

.5 credit

Additional Air Leakage Control and Efficient Ventilation

- Air Leakage rate reduced to .00015 SLA

  (2.8 ACH50)

  and

- The Whole House Ventilation System is a heat recovery ventilator

1.0 credit

Efficient Water Heating

- Gas, propane or oil water heater
  - Min. EF .62
- Electric water heater
  - Min. EF .93

and

- Low flow faucets
  - Shower and Kitchen sink = 1.75 GPM
  - All other lav. Faucets = 1.0 GPM

.5 credit

High Efficiency Water Heating

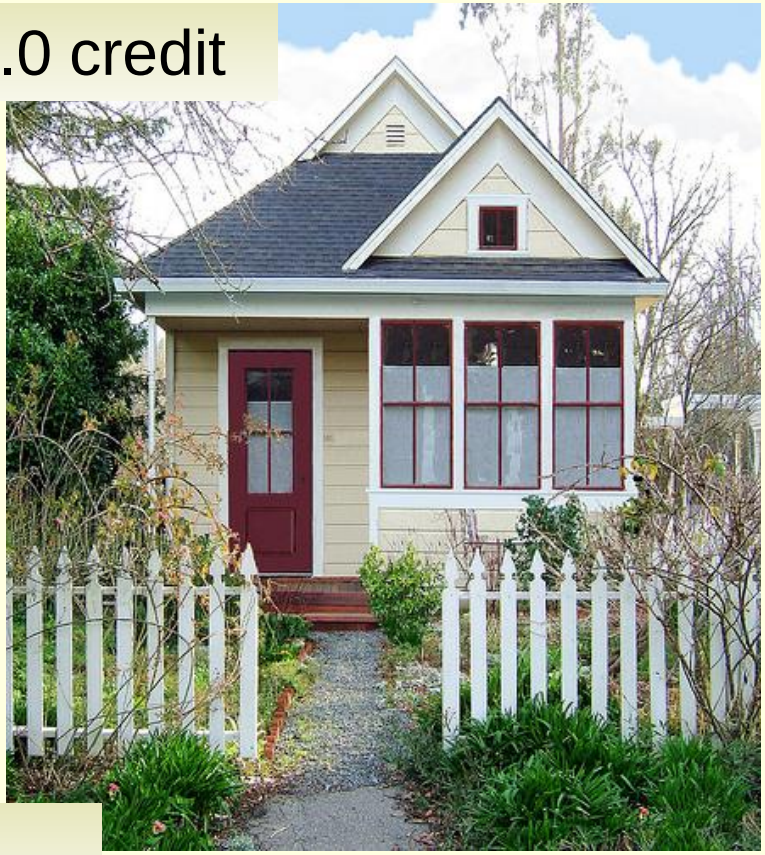
- Gas, propane or oil water heater
  - Min. EF .82
- Solar water heating (supplemental)
  - Min savings 2000 kWh/year
- Electric heat pump water heater
  - Min. EF 2.0

1.5 credit

House size credits and debits

- Dwelling units less than 1500 ft^2
  - Max. window and door area is 300 ft^2
  - Includes additions less than 750 ft^2
- Dwelling units exceeding 5000 ft^2

1.0 credit



-1.0 credit

Renewable Electric Energy

- Solar or wind
  - .5 credits per 1200 kWh of generation provided annually
  - 3.0 credits max