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Hybrid Insulation Systems

RESNET February 2013

Agenda

- The basics of heat, air, and moisture (refresher)
- The goal of energy consumption reduction
- Hybrid Systems
  - Not Just Walls Anymore
- The science of foam
  - Open Cell vs. Closed Cell
- Managing Air Flow
  - Air Barriers in Building Codes
- Managing Moisture Flow
  - Climate Based Recommendations
- Building Code References
- Materials Properties for data bases

Building Physics Basics

- The three principle flows in our buildings are heat, air, and moisture
  - The three flows are inter-related and a change to one creates an influence on the others as well.

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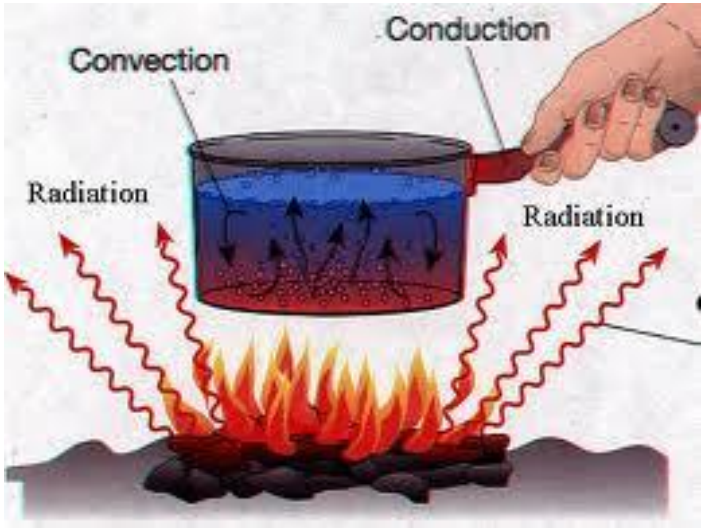
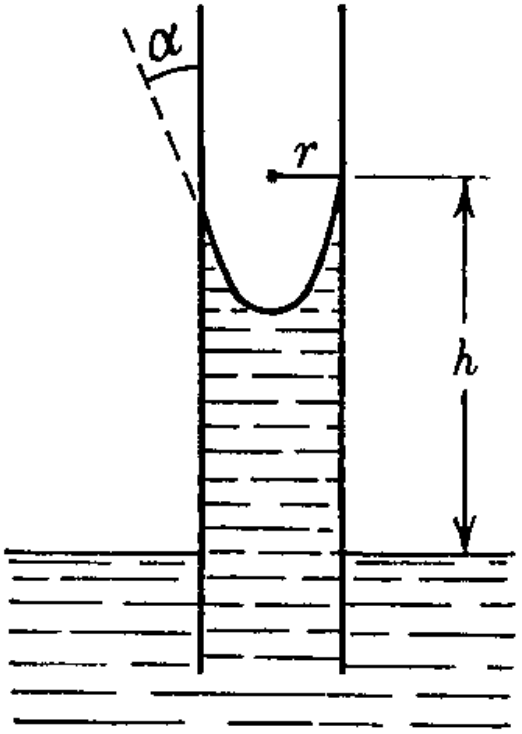
Heat Flow Basics

– The 3 flows occur simultaneously



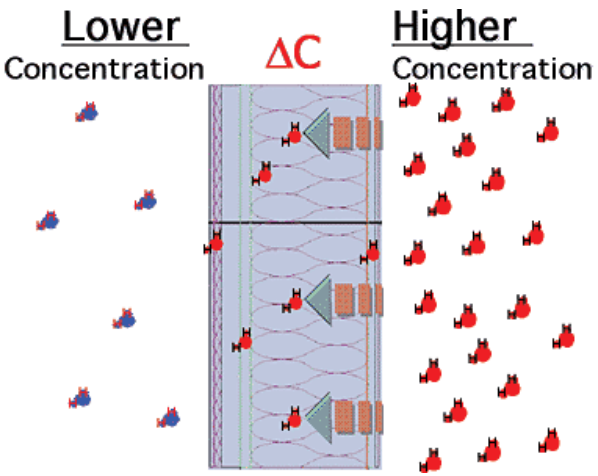
Moisture Flow Basics

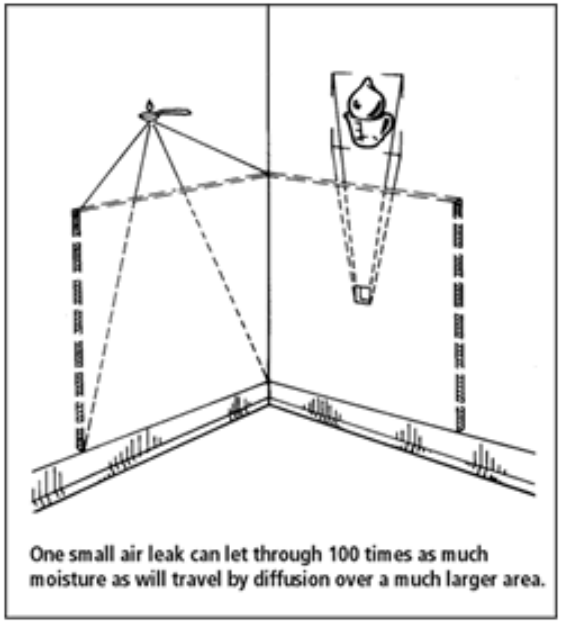
- Gravity
- Capillary suction of water



Moisture Flow Basics

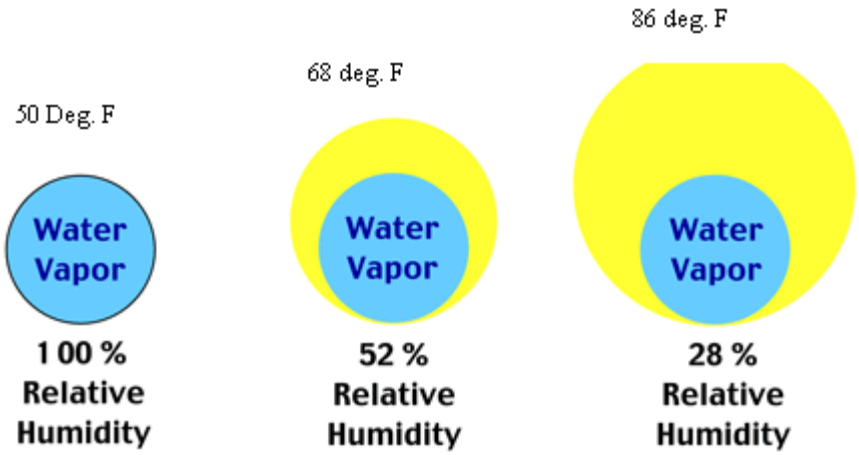
- Air movement of water vapor
- Water vapor diffusion




One small air leak can let through 100 times as much moisture as will travel by diffusion over a much larger area.

Condensation and Dew Point

- Relative Humidity:



Air Flow Basics

- Nature seeks a state of lowest possible pressure
  - If you create a positive pressure air will try to escape
  - If you create a negative pressure air will try to get in

Wind Pressure

Stack Pressure

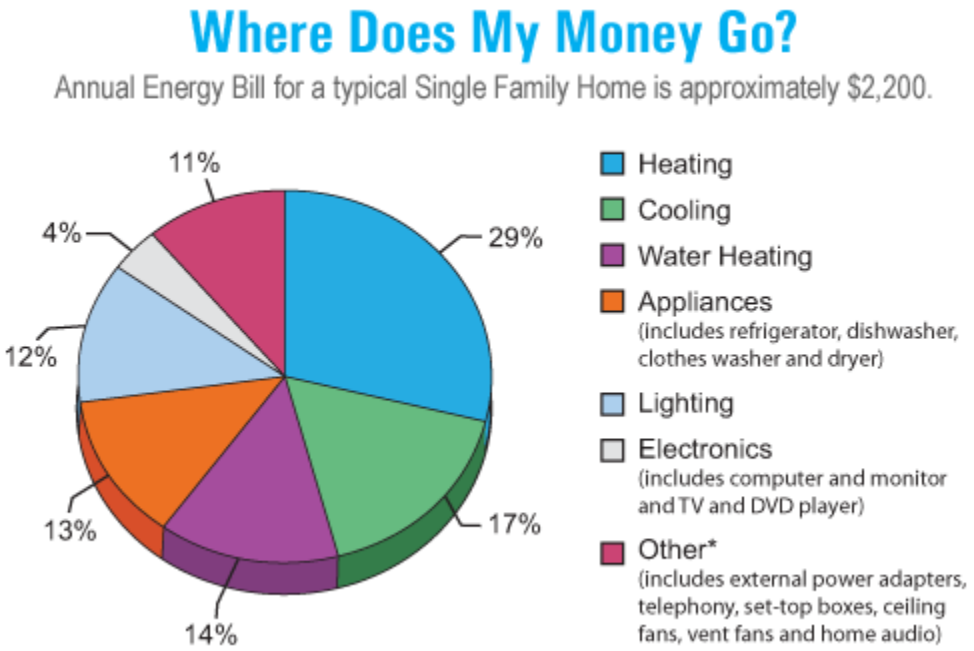
Mechanical Pressure

The goal: reduce energy consumption

Energy Use

- Types: Two paths to one goal

  (Reducing overall energy consumption)



Air Leakage and Energy Efficiency

- EPA estimates that homeowners can typically save up to 20% of heating and cooling costs (or up to 10% of total energy costs) by air sealing their homes and adding insulation in attics, floors over crawl spaces, and accessible basement rim joists
  - » Energystar.gov

Improving Resistance to Conductivity

- 3 ASHRAE Methods for Calculating Thermal Performance of Insulated Assemblies
  1. Isothermal planes method
     - Cross-sections have continuous, homogeneous layers
  2. Parallel path flow method
     - Cross-sections have structural and cavity areas
     - Components have similar thermal resistance
  3. Modified zone method
     - Use with steel framed assemblies
     - Cross-sections have structural and cavity areas
     - Structural components are highly conductive and create thermal bridges

Calculating Heat Flow

- Heat flow is the rate at which heat moves from an area of higher temperature to an area of lower temperature
- Heat flow, Q, is calculated using the following equation:
  $Q = U A \Delta T$

  Where,

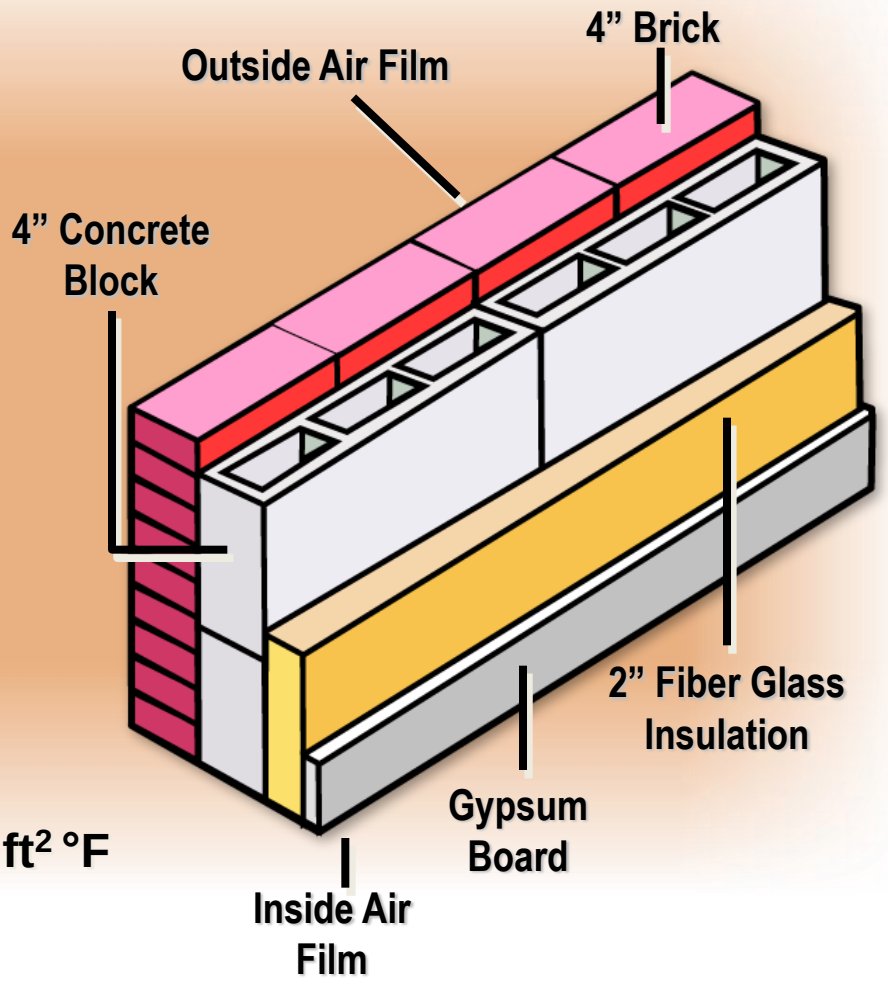
  U = Thermal transmittance (Btu / (hr. ft^2 °F))

  A = Area (ft^2)

  ΔT = Temperature difference through the material (°F)

ASHRAE Isothermal Planes Method

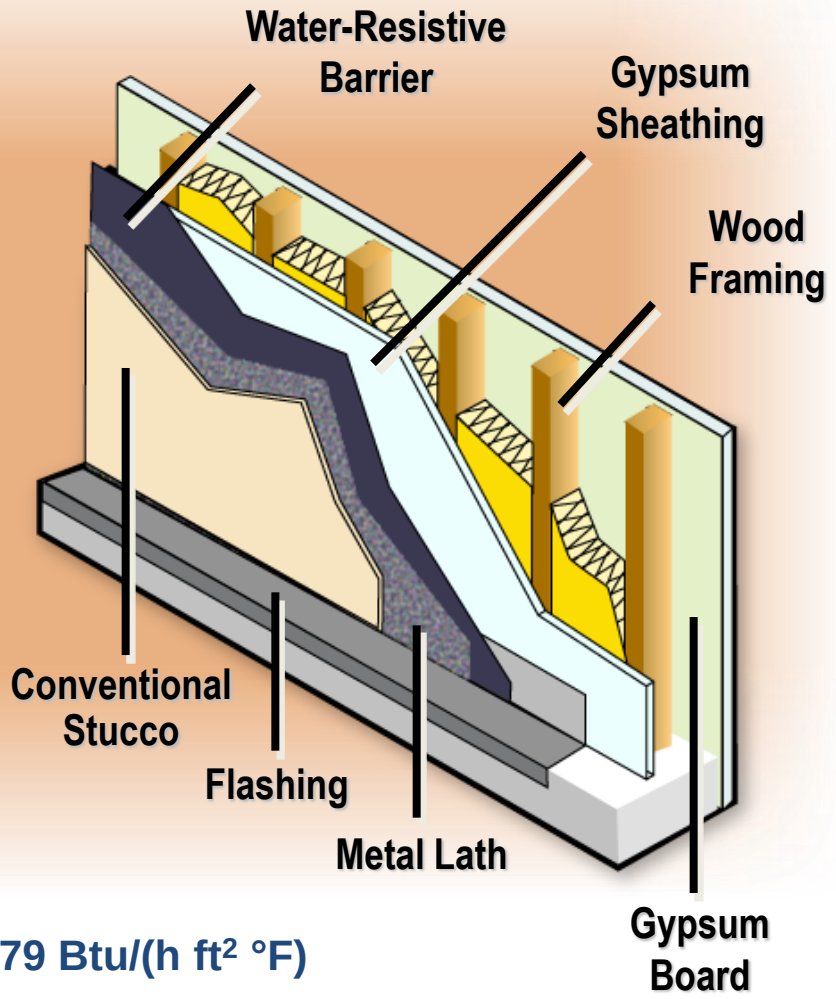
Thermal Resistances	R
Outside Air Film	0.17
4” Brick	0.98
4” Concrete Block	0.63
2” Fiber Glass Insulation	8.70
½” Gypsum Board	0.45
Inside Air Film	0.68
Total Resistance (R_T)	11.61



$$U = \frac{1}{R_T} = \frac{1}{11.61} = 0.09 \text{ Btu/hr. ft}^2 \text{ °F}$$

ASHRAE Parallel Path Flow Method

Building Element	R Cavity	R Frame
Outside Surface (15 mph wind)	0.17	0.17
7/8" Stucco	0.13	0.13
Building Paper	0.06	0.06
½" Exterior Gypsum Board	0.45	0.45
R 13 Fiber Glass Batt	13.0	------
2 x 4 Wood Stud	------	4.38
½" Gypsum Board	0.45	0.45
Inside Surface (Still Air)	0.68	0.68
Thermal Resistance, R	14.94	6.32



$R_T = (0.75 \times 14.94) + (0.25 \times 6.32) = 12.79$ Btu/(h ft^2 °F)

$U = 1/R_T = 0.078$ (h ft^2 °F)/Btu

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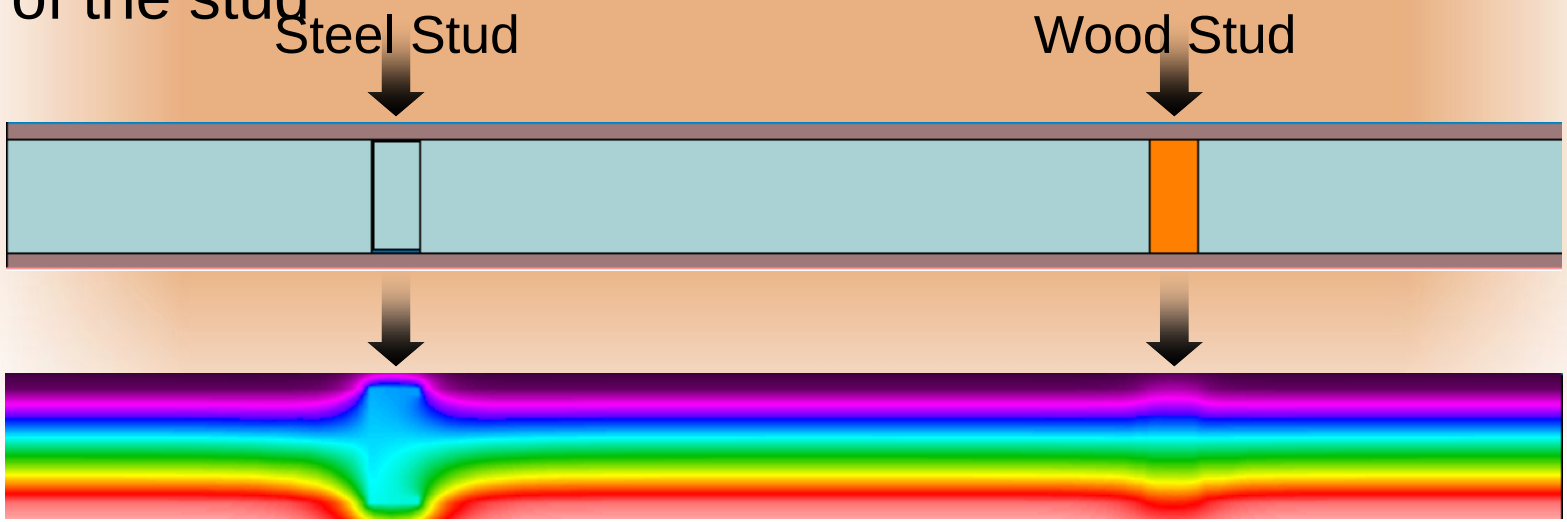
Metal Studs Transfer More Heat Than Other Building Materials

- Metals conduct 300 to 1,000 times more heat than most building materials
- The thermal impact of a metal stud in a framed cavity is greater than the actual surface area of the stud

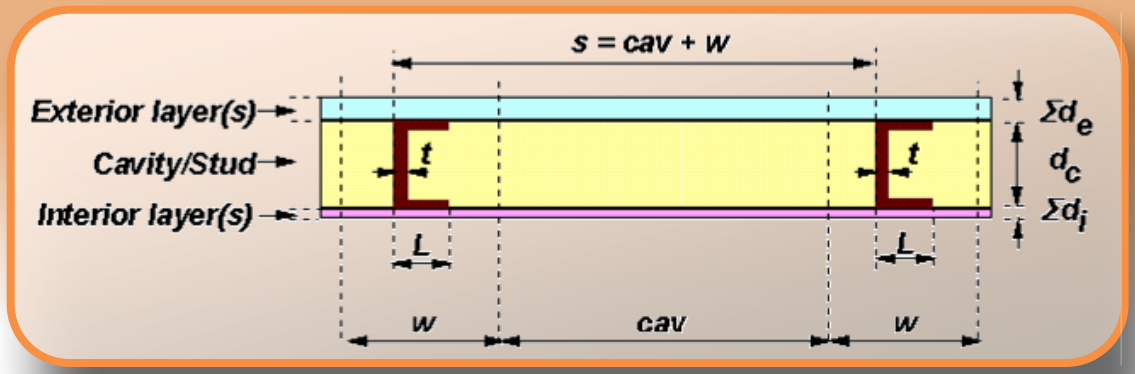


Thermographic Image

ASHRAE Modified Zone Method

- This calculation is very complex
- To calculate use the free online resource available through Oak Ridge National Laboratory

www.ornl.gov/sci/roofs+walls/calculators/modzone/index.html



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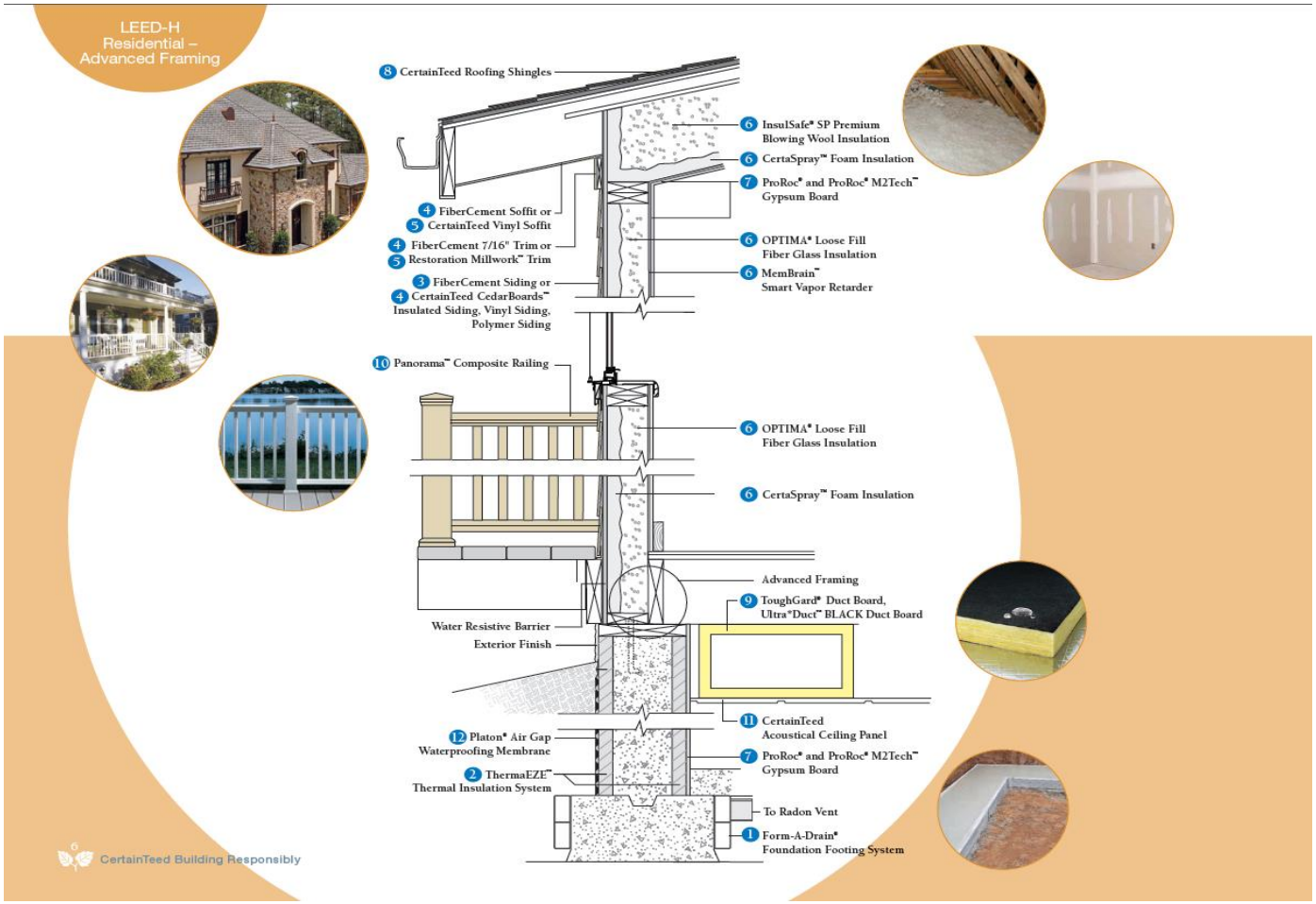
What is a “Hybrid Insulation” System



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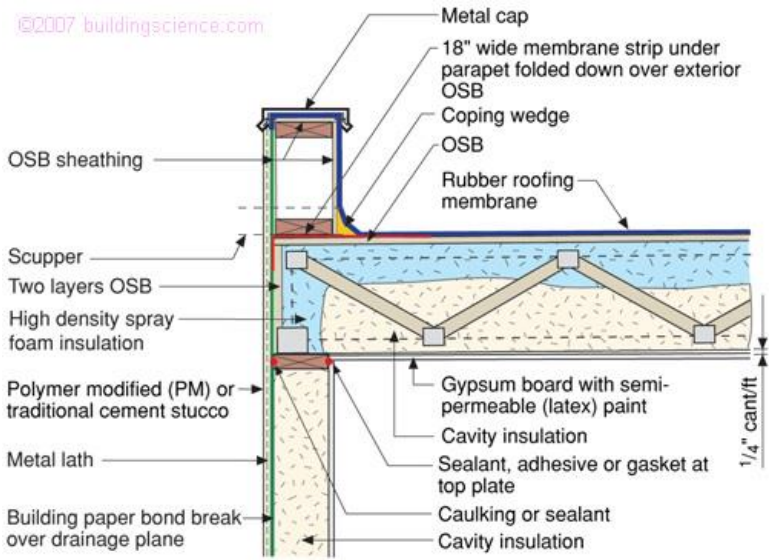

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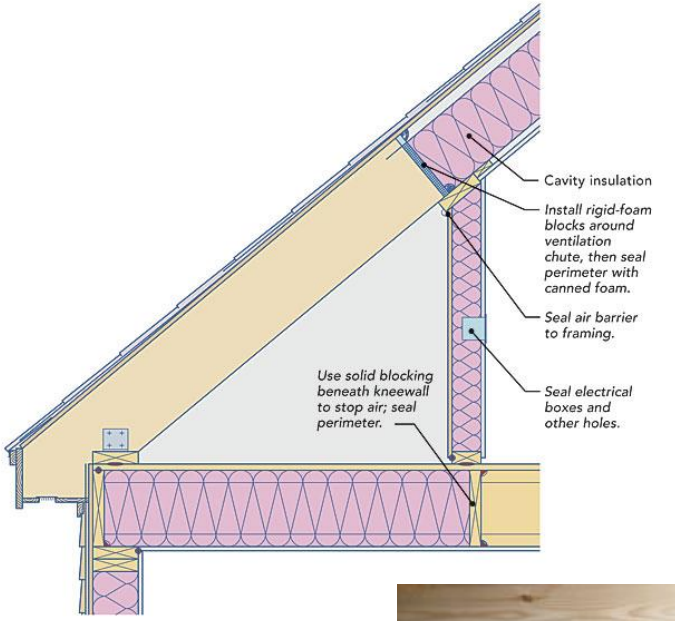
Cavity insulation
Install rigid-foam blocks around ventilation chute, then seal perimeter with canned foam.
Seal air barrier to framing.
Use solid blocking beneath kneewall to stop air; seal perimeter.
Seal electrical boxes and other holes.

Managing Air Flow

The Science of Foam
Material Properties

Material Property	Open Cell / Low Density	Closed Cell / Med Density
Density	0.4 to 1.4 lbs./ft^3	1.5 to 3 lbs./ft^3
Aged R-value per inch	3.4 – 3.7	6.0 – 6.8
Air Leakage Air Barrier Requirement	0.0049 L/s m^2 Less than 0.02 L/s m^2 @75PA	0.000418 L/s m^2 Less than 0.02 L/s m^2 @75PA
Water Vapor Permeance @ 2” thickness @ 3” thickness	11 - 30 perm inch 5.5 – 15 perm 6 – 10 perm	2 - 4 perm inch 0.8 – 2 perm Less then 1 perm
Flame Spread Index Smoke Developed Index	< 25 @ 6” thickness <350 @ 6” thickness	< 25 @ 4” thickness <450 @ 4” thickness
Fire Safety Requirement	Barrier Required	Barrier Required

Air Infiltration Control

2012 IECC Air leakage language relevant to hybrid insula

Table R402.4.1.1

"Exterior thermal envelope contains a continuous air barrier"

"Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier"

"The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed"

Section R402.4.1.2

"The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in climate zones 3 through 8"

Fresh Air Ventilation

"A mechanical exhaust system, supply system, or combination thereof shall be installed for each dwelling unit to provide whole-building ventilation with outdoor air each hour at no less than the rate specified in Table 4.1a and Table 4.1b or, equivalently, Equations 4.1a and 4.1b, based on the floor area of the conditioned space and number of bedrooms."

ASHRAE 62.2

TABLE 4.1a (I-P)
Ventilation Air Requirements, cfm

Floor Area (ft^2)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1500	30	45	60	75	90
1501-3000	45	60	75	90	105
3001-4500	60	75	90	105	120
4501-6000	75	90	105	120	135
6001-7500	90	105	120	135	150
>7500	105	120	135	150	165

Managing Moisture Flow

The Science of Foam
Material Properties

Material Property	Open Cell / Low Density	Closed Cell / Med Density
Density	0.4 to 1.4 lbs/ft^3	1.5 to 3 lbs/ft^3
Aged R-value per inch	3.4 – 3.7	6.0 – 6.8
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Water Vapor Permeance @ 2” thickness @ 3” thickness	11 - 30 perm inch 5.5 – 15 perm 6 – 10 perm	2 - 4 perm inch 0.8 – 2 perm Less then 1 perm
Flame Spread Index Smoke Developed Index	< 25 @ 6” thickness <350 @ 6” thickness	< 25 @ 4” thickness <450 @ 4” thickness
Fire Safety Requirement	Barrier Required	Barrier Required

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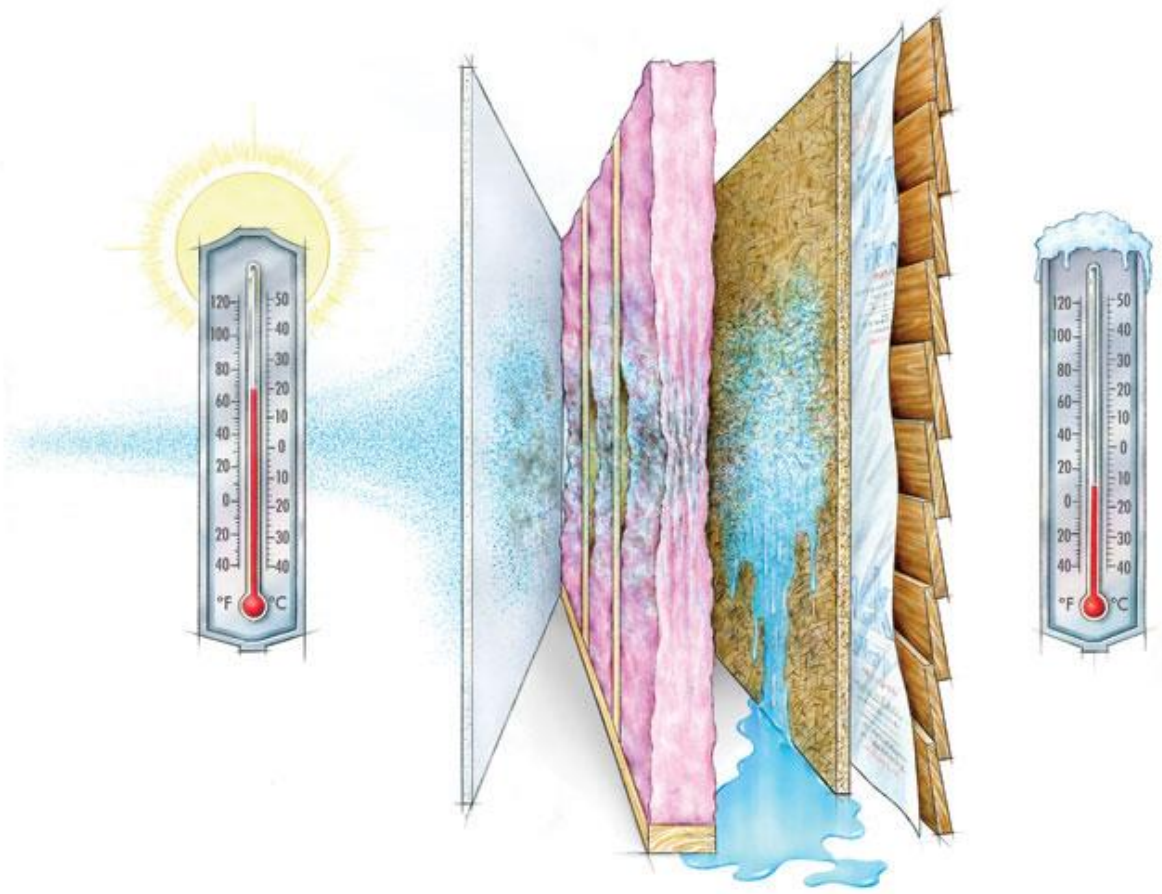
Preventing Dew Point



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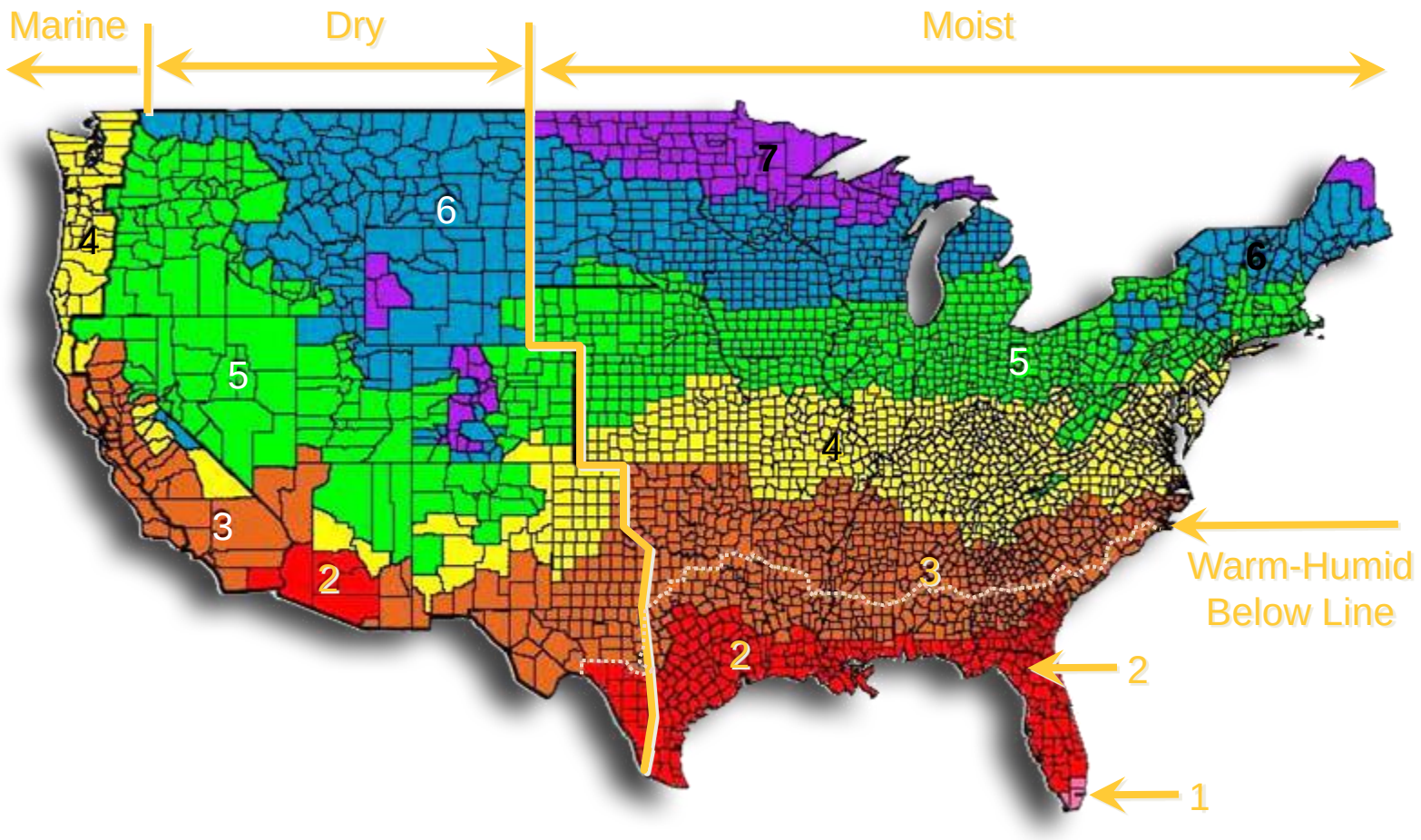
Managing Moisture Flow

- Hybrid system moisture concerns
  - Vapor Drive
    - Water vapor drives from high pressure to low pressure
    - In winter, vapor is usually moving from the building interior towards the building exterior.
    - The rate at which it flows is a function of the pressure on either side and the how easily it can flow through a given material layer (permeance.)
  - Condensing surface
    - As the temperature of the surfaces decreases, the relative humidity increases.
    - 100% RH (Dew Point) is a function of temperature

Preventing Dew Point = Warm Vapor Resistive Planes



Source: *IECC 2003*

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BIBS HP Recommendations

2 x 4 wood stud wall				
Climate Zone	Insulation Thickness		BIBS® HP R-value[1]	Vapor Retarder
	CC SPF (inch)	BIBS® (inch)		
1a	.5	3	R-16	NA
2a, b	.5	3	R-16	NA
3a, b, c	.5	3	R-16	NA
4a, b, c	.5	3	R-16	Class II Smart VR
5a, b	.5	3	R-16	Class II Smart VR
6a, b	.5	3	R-16	Class II Smart VR
7a, b	.5	3	R-16	Class II Smart VR

2 x 4 wood stud wall				
Climate Zone	Insulation Thickness		BIBS® HP R-value[1]	Vapor Retarder
	CC SPF (inch)	BIBS® (inch)		
1a	1	2.5	R-17	NA
2a, b	1	2.5	R-17	NA
3a, b, c	1	2.5	R-17	NA
4a, b, c	1	2.5	R-17	Class II Smart VR
5a, b	1	2.5	R-17	Class II Smart VR
6a, b	1	2.5	R-17	Class II Smart VR
7a, b	1	2.5	R-17	Class II Smart VR

2 x 6 wood stud wall				
Climate Zone	Insulation Thickness		BIBS® HP R-value[1]	Vapor Retarder
	CC SPF (inch)	BIBS® (inch)		
1a	.5	5	R-24	NA
2a, b	.5	5	R-24	NA
3a, b, c	.5	5	R-24	NA
4a, b, c	.5	5	R-24	Class II Smart VR
5a, b	.5	5	R-24	Class II Smart VR
6a, b	.5	5	R-24	Class II Smart VR
7a, b	.5	5	R-24	Class II Smart VR

2 x 6 wood stud wall				
Climate Zone	Insulation Thickness		BIBS® HP R-value[1]	Vapor Retarder
	CC SPF (inch)	BIBS® (inch)		
1a	1	4.5	R-25	NA
2a, b	1	4.5	R-25	NA
3a, b, c	1	4.5	R-25	NA
4a, b, c	1	4.5	R-25	Class II Smart VR
5a, b	1	4.5	R-25	Class II Smart VR
6a, b	1	4.5	R-25	Class II Smart VR
7a, b	1	4.5	R-25	Class II Smart VR

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BIBS HP Footnote

- “These guidelines must be followed to ensure proper success of the BIBS HP system. If the use of a vapor retarder in zones 4 or higher is not preferred, please consult your fiber and spray polyurethane foam manufacturer for specification guidelines.”
  - » BIBS HP Technical Data Sheet

Climate Based Recommendations

CertainTeed Hybrid Insulation Winter Season Closed-Cavity Surface Condensation Analysis

	2x4 Wood Stud Wall (No additional vapor retarder)			2x4 Wood Stud Wall (Additional vapor retarder)			
	Insulation Layer Thickness			Insulation Layer Thickness			
Climate Zone	CertaSpray CC SPF (inch)	High Density Fiber Glass (inch)	Hybrid Insulation Cavity R-value	CertaSpray CC SPF (inch)	High Density Fiber Glass (inch)	Hybrid Insulation Cavity R-value	Vapor Retarder Requirement
1a	1/2	3	15.5	1/2	3	15.5	Unfaced
2a	1/2	3	15.5	1/2	3	15.5	Unfaced
2b	1/2	3	15.5	1/2	3	15.5	Unfaced
3a	1/2	3	15.5	1/2	3	15.5	Unfaced
3b	1/2	3	15.5	1/2	3	15.5	Unfaced
3c	1/2	3	15.5	1/2	3	15.5	Unfaced
4a	1	2 1/2	16.3	1/2	3	15.5	Class II or MemBrain
4b	1	2 1/2	16.3	1/2	3	15.5	Class II or MemBrain
4c	1	2 1/2	16.3	1/2	3	15.5	Class II or MemBrain
5a	1 1/2	2	17.1	1/2	3	15.5	Class II or MemBrain
5b	1 1/2	2	17.1	1/2	3	15.5	Class II or MemBrain
6a	2	1 1/2	17.9	1/2	3	15.5	MemBrain
6b	1 1/2	2	17.1	1/2	3	15.5	MemBrain
7a	2	1 1/2	17.9	1/2	3	15.5	MemBrain
7b	1 1/2	2	17.1	1/2	3	15.5	MemBrain
8	Requires custom hygrothermal analysis.			Requires custom hygrothermal analysis.			NA

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Climate Based Recommendations

CertainTeed Hybrid Insulation Winter Season Closed-Cavity Surface Condensation Analysis

	2x6 Wood Stud Wall (No additional vapor retarder)			2x6 Wood Stud Wall (Additional vapor retarder)			
	Insulation Layer Thickness			Insulation Layer Thickness			
Climate Zone	CertaSpray CC SPF (inch)	High Density Fiber Glass (inch)	Hybrid Insulation Cavity R-value	CertaSpray CC SPF (inch)	High Density Fiber Glass (inch)	Hybrid Insulation Cavity R-value	Vapor Retarder Requirement
1a	1/2	5	23.9	1/2	5	23.9	Unfaced
2a	1/2	5	23.9	1/2	5	23.9	Unfaced
2b	1/2	5	23.9	1/2	5	23.9	Unfaced
3a	1/2	5	23.9	1/2	5	23.9	Unfaced
3b	1/2	5	23.9	1/2	5	23.9	Unfaced
3c	1/2	5	23.9	1/2	5	23.9	Unfaced
4a	1 1/2	4	25.5	1/2	5	23.9	Class II or MemBrain
4b	1 1/2	4	25.5	1/2	5	23.9	Class II or MemBrain
4c	1 1/2	4	25.5	1/2	5	23.9	Class II or MemBrain
5a	2	3 1/2	26.3	1/2	5	23.9	Class II or MemBrain
5b	2	3 1/2	26.3	1/2	5	23.9	Class II or MemBrain
6a	2 1/2	3	27.1	1/2	5	23.9	MemBrain
6b	2	3 1/2	26.3	1/2	5	23.9	MemBrain
7a	3	2 1/2	29.7	1/2	5	23.9	MemBrain
7b	2 1/2	3	27.1	1/2	5	23.9	MemBrain
8	Requires custom hygrothermal analysis.			Requires custom hygrothermal analysis.			NA

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IECC References

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	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	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. "15/19" means R-15 continuous insulation 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 insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation 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 Climate 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 R301.1 and Table R301.1.

g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

Conforming to the IECC

- Internal insulation
  - Framing members NOT covered
    - In zones 3 and above you must meet the “whole wall R value” requirement (performance path)
    - In zones 7 and 8, you must have a continuous insulation on the exterior side of the framing
- External insulation
  - Framing members covered with a “continuous” insulation
    - Comply with either prescriptive or performance paths

Conforming to the IECC

- Reduction of building envelope air leakage
  - The air-sealing checklist in the 2012 IECC is called Table R402.4.1.1, “Air Barrier and Insulation Installation.”
    - “Rim joists shall be insulated and include the air barrier.”
    - “Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.”
    - “Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.”
    - “Air sealing shall be provided between the garage and conditioned spaces.”
    - “Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.”
    - “The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.”

A Warning from the IECC

- Note that all of these code requirements are *minimum* requirements. In many climates, the minimum code requirement for the R-value of the continuous insulation (usually rigid foam) is not enough to keep OSB or plywood wall sheathing above the dew point in winter. Builders in Vermont who choose to install R-5 foam on a 2x6 wall will eventually discover that their OSB stays damp and begins to mold. For more information on this subject, see Calculating the Minimum Thickness of Rigid Foam Sheathing.

Material Properties

- Good modeling requires:
  - Accurate material properties
  - Accurate model assembly
  - Practical knowledge (reality check)

Material Properties

- Optima Thickness R-Values

Thickness	1"	1 1/4"	1 1/2"	1 3/4"	2"	2 1/4"	2 1/2"	2 3/4"	3"
R-Value	4.3	5.3	6.4	7.4	8.5	9.6	11	12	13
Thickness	3 1/4"	3 1/2"	3 3/4"	4"	4 1/4"	4 1/2"	4 3/4"	5"	
R-Value	14	15	16	17	18	19	20	21	

Material Properties

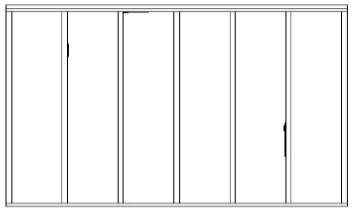
- Fiber Glass Batt Compression Chart

Depth of Cavity	R-6	R-8	R-11	R-13	R-15	R-19	R-21	R-22	R-25	R-30	R-30
	1 3/4"	2 1/2"	3 1/2"	3 1/2"	3 1/2"	6 1/4"	5 1/2"	6 1/2"	8"	8 1/4"	10"
1/2"	3.5										
1 1/2"	5.5	5.6	6								
2 1/2"	6	8	9	10	12						
3 1/2"	6	8	11	13	15	14	15	15			
4"	6	8	11	13	15	15	17	16	16	17	
5 1/2"	6	8	11	13	15	18	21	20	20	22	21

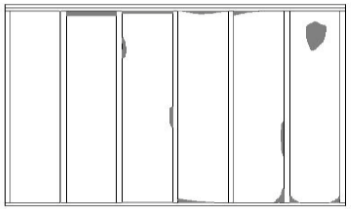
Material Properties

Grade I Insulation

Very Small Gaps



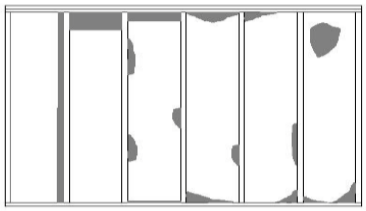
<2% compressions @ 70% installed R-value



Grade II Insulation

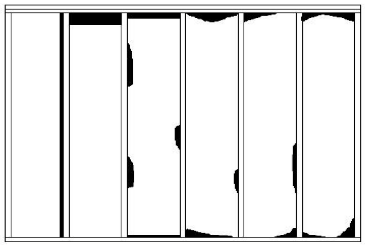
2% or Fewer Gaps

10% compressions @ 70% installed R-value

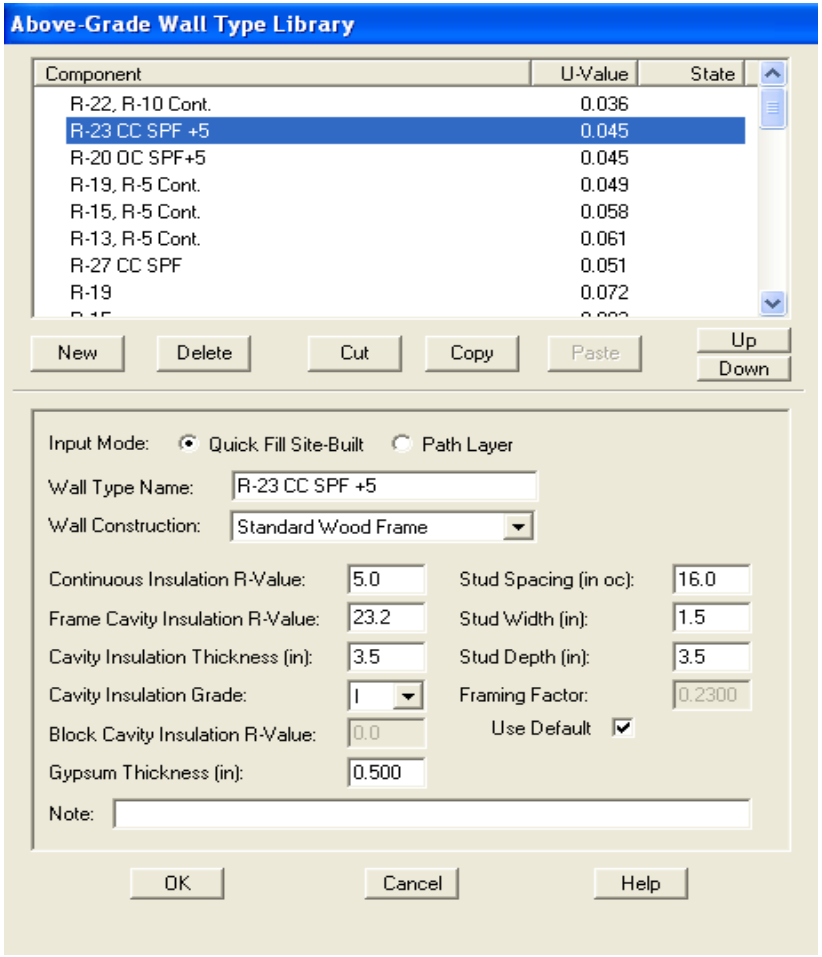


Grade III Insulation

5% or Fewer Gaps



Gaps greater than 5% are required to be modeled as separate, uninsulated surfaces.



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Summary

- The basics of heat, air, and moisture (refresher)
- The goal of energy consumption reduction
- Hybrid Systems
  - Not Just Walls Anymore
- The science of foam
  - Open Cell vs. Closed Cell
- Managing Air Flow
  - Air Barriers in Building Codes
- Managing Moisture Flow
  - Climate Based Recommendations
- Building Code References
- Materials Properties for data bases

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Spray Foam “101”

RESNET
2013 CONFERENCE
February 27 - March 1, 2013
Orlando, FL

Topics covered:

- What is spray foam?
- What equipment is required to install spray foam?
- Proper jobsite preparation
- Health & safety
- Installing spray foam
- Fire safety
- Codes

What is spray foam?

Product Category

Three types of SPF in Construction

	Spray Foam		
	LD	MD	Roof
Density (lb/ft^3)	0.5 - 1.4	1.5 -2.3	2.5 - 3.5
Thermal Resistivity (R/in)	3.6 - 4.5	6.2 - 6.8	6.2 - 6.8
Air Impermeable Material	✓	✓	✓
Integral Air Barrier System	✓	✓	✓
Integral Vapor Retarder		✓	✓
Water Resistant		✓	✓
Cavity Insulation	✓	✓	
Continuous Insulation	✓	✓	✓
Low-Slope Roofing			✓
Structural Improvement		✓	✓

History of SPF in Buildings

SPF in construction for 50 years

- Late 60's - Medium Density (agricultural and industrial)
- Mid 70's - Roofing (high density)
- Mid 90's - Low Density (residential)

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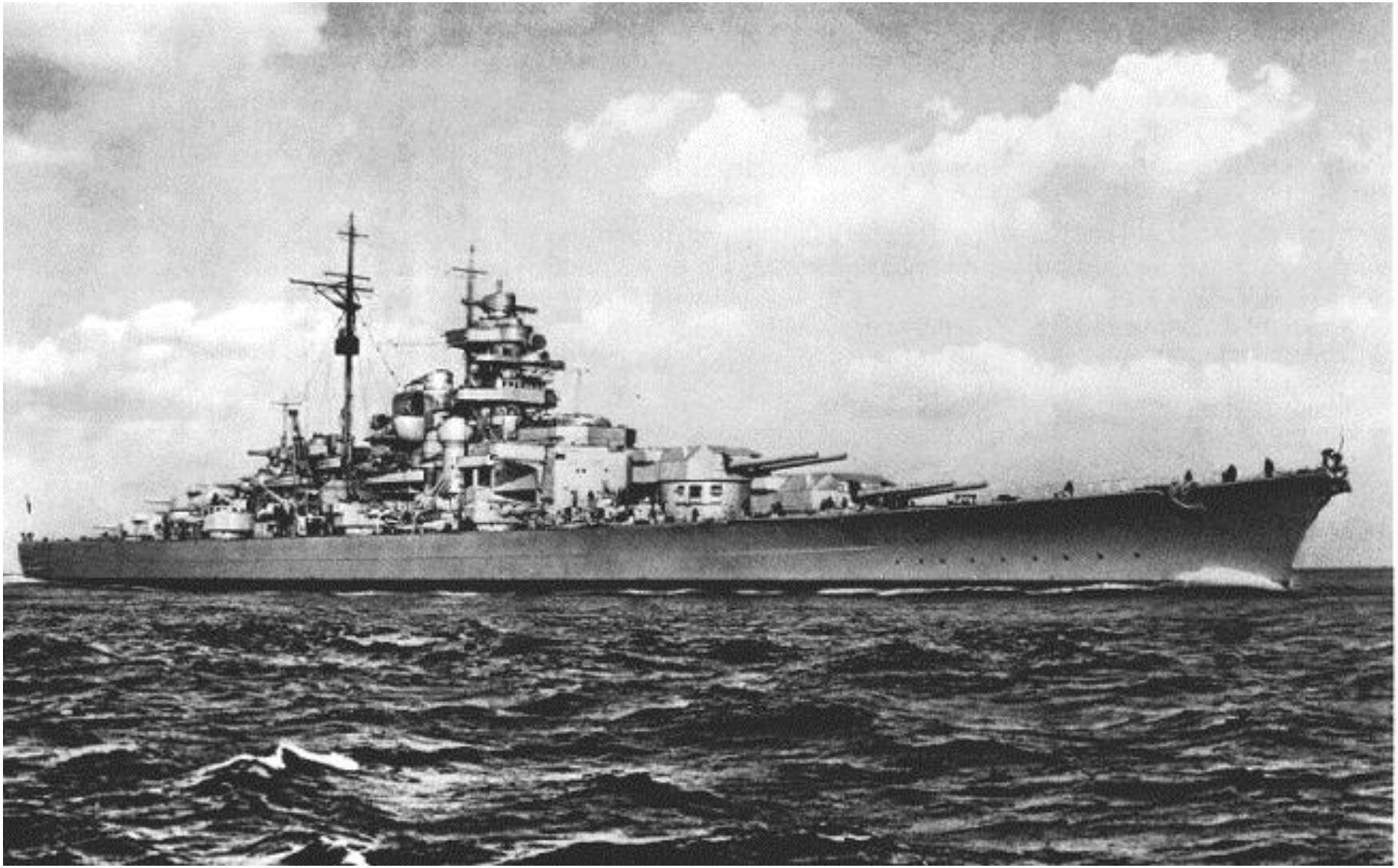

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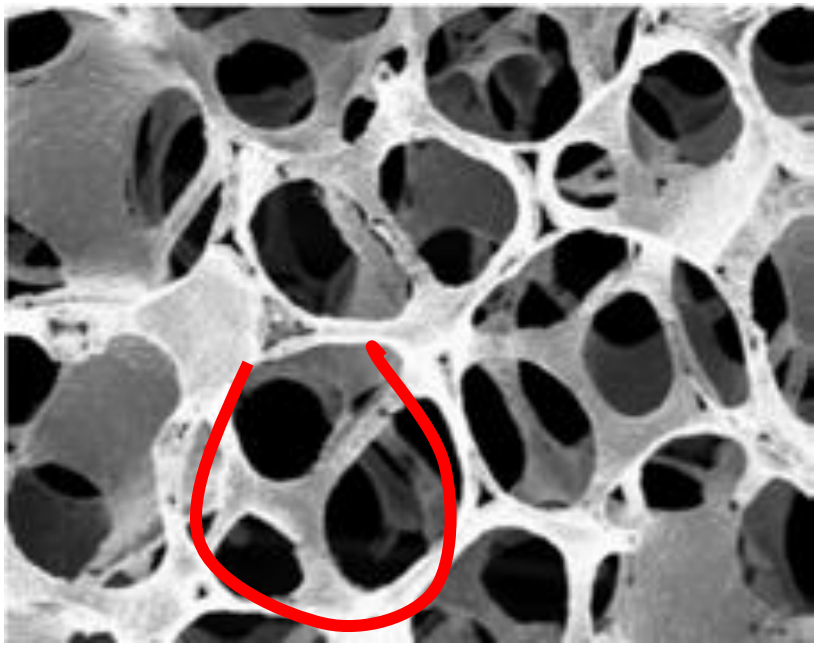
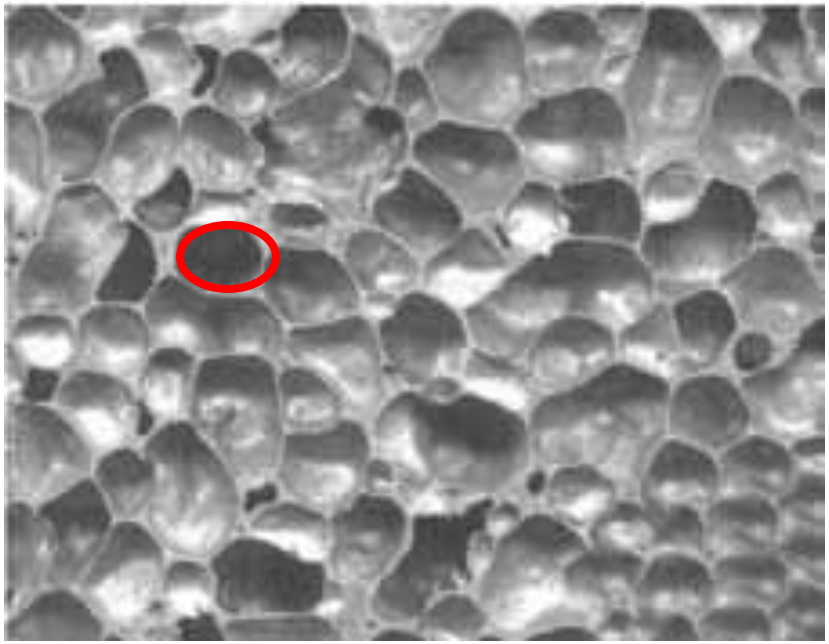
Two types spray foam for insulation



OPEN CELL
~100x expansion
0.5 to 0.8 pcf
R-3.6 to R-4.5 per inch (air)



CLOSED CELL
~30x expansion
1.7-3.5 pcf
R-5.8 to R-6.8 per inch
(trapped low-k gas)

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Basic Chemistry

Reaction of 1:1 mixing of two liquids

- **A-Side**: Blend of monomeric and polymeric MDI

  (MDI=Methylene diphenyl diisocyanate)

- **B-Side** or Polyol
  - polyols
  - blowing agents
  - flame retardants
  - surfactants
  - catalysts

Proprietary blend of additives affect cell formation and foam performance

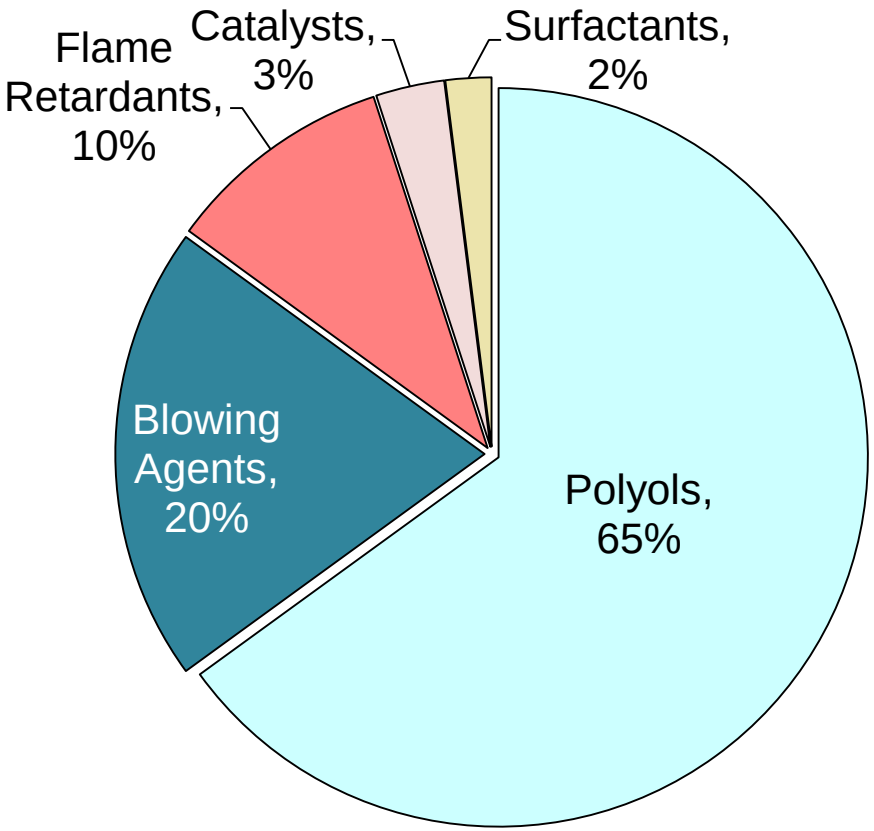
Basic Chemistry

A-Side:

- Typically brown or amber liquid unless colors have been added
- Evaporates slowly
- Most people cannot smell the A-side at room temperature
- Is reactive and may undergo chemical reactions with various chemicals, including water
- OSB, Gorilla Glue

Basic Chemistry

B-Side Formulation:



- These are the five basic categories of B-side chemicals.
- Percentages will vary based on foam type (oc vs cc) and manufacturer.

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B-side Components - Catalyst

- The *Catalyst* affects how quickly the A-side (Iso) and B-side react.
- Some people may smell an ammonia or fish-like odor when exposed to catalysts.

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B-side Components - Blowing Agent

•The *Blowing Agent* makes the foam expand by making tiny bubbles, or cells, in the foam.

B-side Components – Flame Retardant

- *Flame retardants* affect how the finished, fully reacted foam resists combustion.

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B-side Components - Surfactant

- *Surfactants* help the foam cells form.

Why Spray Polyurethane Foam (SPF)?

- Increase thermal performance with high-density SPF insulation
- Increase building envelope air tightness using SPF insulation and improve energy efficiency
- Increase building envelope structural integrity
- SPF applications allow more design options for complex cavities and small hard to reach spaces

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What equipment is required to install spray foam?

Spray Rigs


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ELL INSULATION.
OU CAN TRUST.
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CERTASPRAY
Spray Foam Insulation


Builders Insulation
& Building Products
"Since 1958"
688-5576
AUG 30 200

Spray Rigs

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Proportioner
Pumping/Heating System

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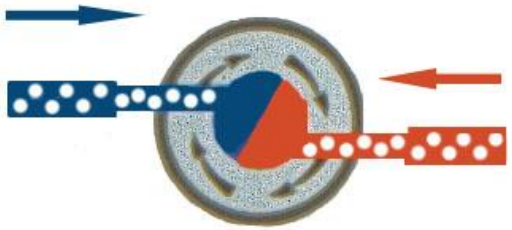
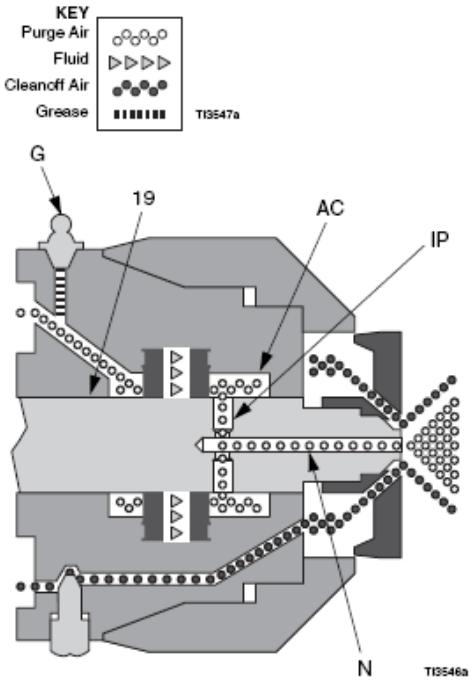
Material Delivery Hose System

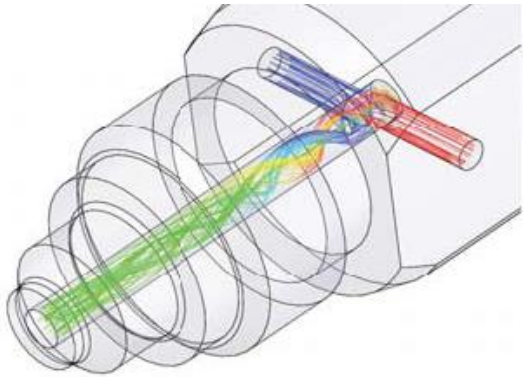
The Spray Gun

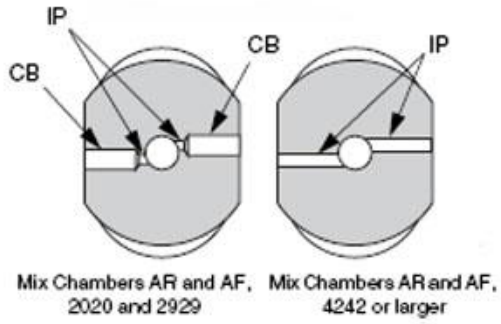
Gun Assemblies

- The “Gun Assembly” is the primary point of mixing for the foam components.









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FUSION OPERATION

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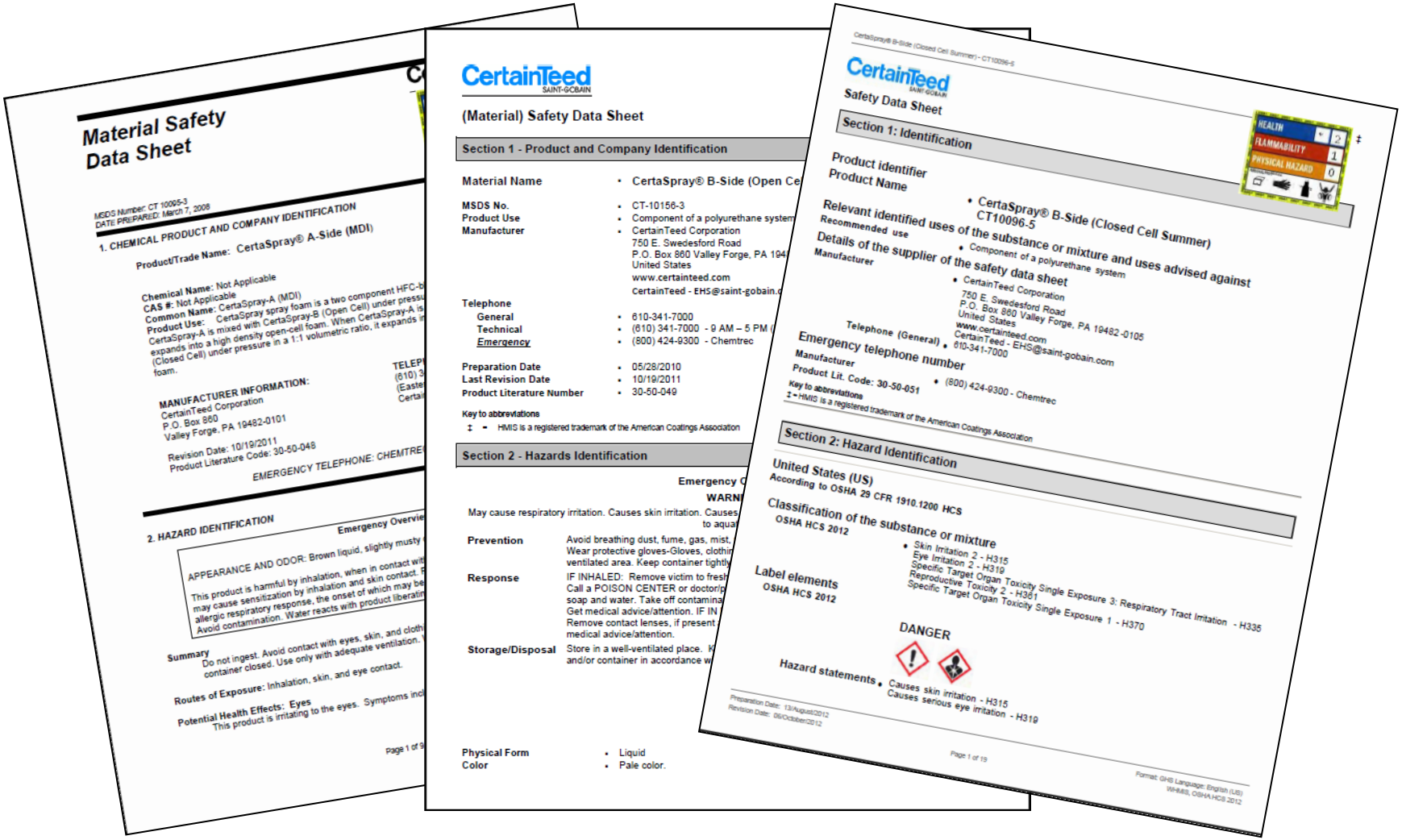
MSDS Sheets



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Proper jobsite preparation

Site Preparation

Create cross ventilation

Occupant Outreach

- Educate building occupants, including other trades, about potential health hazards associated with spray foam.
- Notify occupant and other trades that **no one should be in the house during application without proper PPE**.
- Notify occupant no one should enter house for **24 hours** or longer.
- Post job signs: Do Not Enter .

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Health & Safety

Example - Exposure

Example – Overexposure

Exposure - Acute Effects

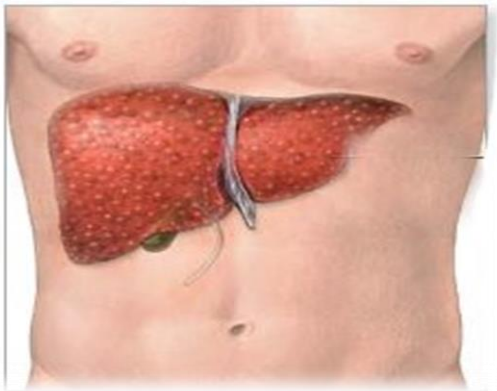
Acute effects are short-term effects typically reversible after exposure ceases.

Exposure - Chronic Effects

Chronic effects are long-term, sometimes permanent, health effects due to repeated exposure to certain chemicals. Sometimes, chronic effects can occur at concentrations below which acute effects are experienced.

Exposure-
Examples of Chronic Effects

Chronic exposure to alcohol can cause liver damage



Chronic exposure to A-side (Iso) can cause reduced lung function

Exposure to SPF Chemicals

Spraying a fine mist of heated SPF chemicals during SPF application puts a significant amount of SPF chemicals into the air which can present an inhalation and skin exposure hazard.

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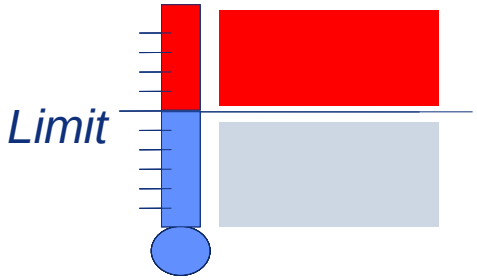
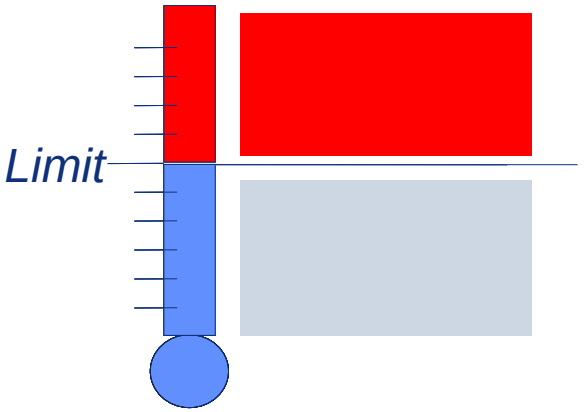
Examples of Exposure Limits

- OSHA *Permissible Exposure Limit - PEL*
- National Institute of Occupational Safety and Health (NIOSH)
  Recommended Exposure Limit - REL
- American Conference of Governmental Industrial Hygienists (ACGIH)
  Threshold Limit Values - TLV



Understanding Exposure Limits

- Applicable exposure limits can be found on the MSDS.
- Some chemicals you work with may not have exposure limits.
- Consult the MSDS for appropriate precautions when working with these chemicals as well.



Some Risk Factors for Chemical Exposure

Improper selection or use of personal protective equipment (PPE) could lead to chemical exposure.

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Some Risk Factors for Chemical Exposure

Handling SPF chemicals in poorly ventilated areas could lead to chemical exposure.

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A-side (Iso) Exposure Effects - Eyes

•Possible A-side (Iso) irritation eye effects include:

- tearing
- redness
- swelling
- burning
- stinging
- possible temporary injury to the cornea

A-side (Iso) Exposure Effects - Skin

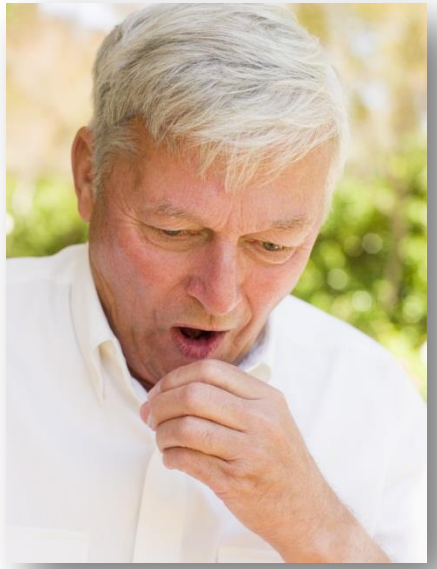
Possible skin irritation effects due to A-side exposure include:

- skin discoloration
- itching
- swelling
- rash

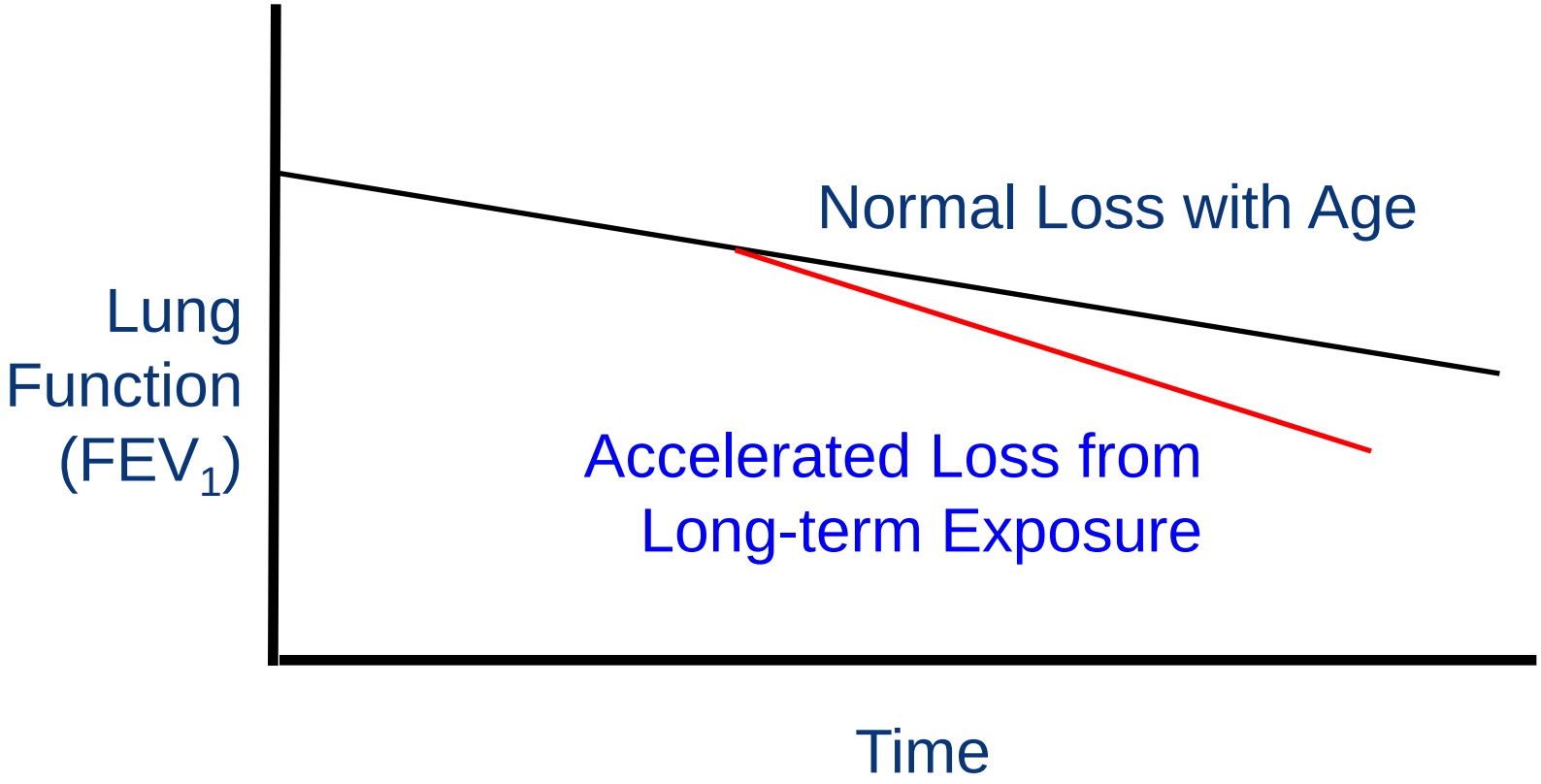
A-side (Iso) Exposure-
Short-term Respiratory Effects

Exposure to the A-side (Iso) may include possible respiratory irritation effects such as:

- sore throat
- coughing
- chest tightness or discomfort
- shortness of breath



A-side (Iso) Exposure – Long-term Respiratory Effects



A-side (Iso) Exposure - Sensitization

Sensitization is the development of an unusual sensitivity to a substance resulting in an allergic response after future exposures.

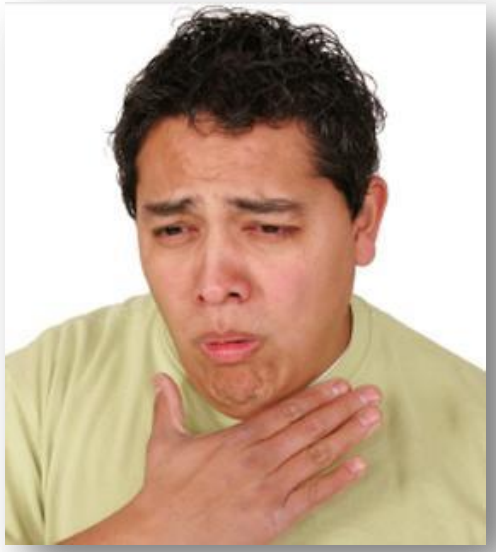
Potential effects due to A-side (Iso) sensitization:

- skin rash
- asthma-like respiratory response

A-side (Iso) Exposure - Sensitization Symptoms

Once sensitized, a respiratory sensitization reaction may occur immediately after exposure or be delayed, including:

- coughing
- shortness of breath
- wheezing
- chest tightness
- asthma attack



Asthma attacks may be life-threatening.

B-side Constituents

•The B-side is a blend of different chemicals with the the principal component being polyol and various additives including:

- catalysts
- blowing agents
- fire retardants
- surfactants

- Health effects due to exposure to additives vary.

Inhalation Exposure Effects - Catalysts

Catalysts in the B-side can cause respiratory irritation including:

- coughing
- sore throat
- runny nose

Skin Contact Effects – B-Side

Catalysts in the B-side may cause skin irritation including:

- reddening
- itching
- swelling
- possible allergic reaction

Eye Contact Effects - **B-Side**

Catalysts in the B-side can cause eye irritation including:

- reddening
- tearing
- swelling
- burning
- temporary condition of impaired vision known as “Blue Haze” or “Halovision”

Safety Equipment

Who needs to wear PPE?

•Everyone working in the immediate spray area while SPF is being applied needs to wear appropriate PPE for protection from A-side (Iso) and B-side chemicals.

This includes <u>sprayers</u>, <u>helpers</u>, and even <u>other trade workers</u>.

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When is PPE Required?

PPE is required ***during*** and ***for a period after*** spraying. Contact your supplier for specific information on the formulation.

For interior high pressure SPF applications, up to 24 hours is common.

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Skin Protection

•The most important consideration in selecting protective clothing is to completely cover all clothing and skin.

- disposable suits are typically used
- if clothing becomes contaminated with hazardous chemicals, dispose of the clothing. ***Do not*** wear contaminated clothing home.

Gloves

- What type of gloves?
  - for applicators: fabric gloves fully coated with nitrile, neoprene, butyl rubber, or PVC
  - for helpers and during liquid chemical handling, consider nitrile, neoprene, butyl rubber or PVC gloves
  - some workers like to wear work gloves over the chemical resistant gloves

Eye and Face Protection

The use of a full face tight-fitting or loose-fitting (hooded) respirator can provide eye and face protection.

Eye and Face Protection

When working with liquid chemicals and not wearing a full face or loose-fitting (hooded) respirator such as during liquid chemical handling, use goggles or safety glasses with side shields.

Supplied Air Respirator (SAR)

- Supplied Air Respirator (SAR):
  - facepiece is connected to a breathing air source outside the spray area using a hose
  - may have a tight-fitting or loose-fitting (hooded) facepiece
  - are typically used for interior and some exterior SPF applications
  - may provide a cooling effect due to air moveme

Air-Purifying Respirator (APR)

- Air-Purifying Respirator (APR):
  - provides the user with a breathing source by drawing air through the cartridges
  - only tight-fitting facepieces are available with APR
  - primarily used for exterior applications and some well-ventilated areas

Installing spray foam

Low-Density Open Cell Foam

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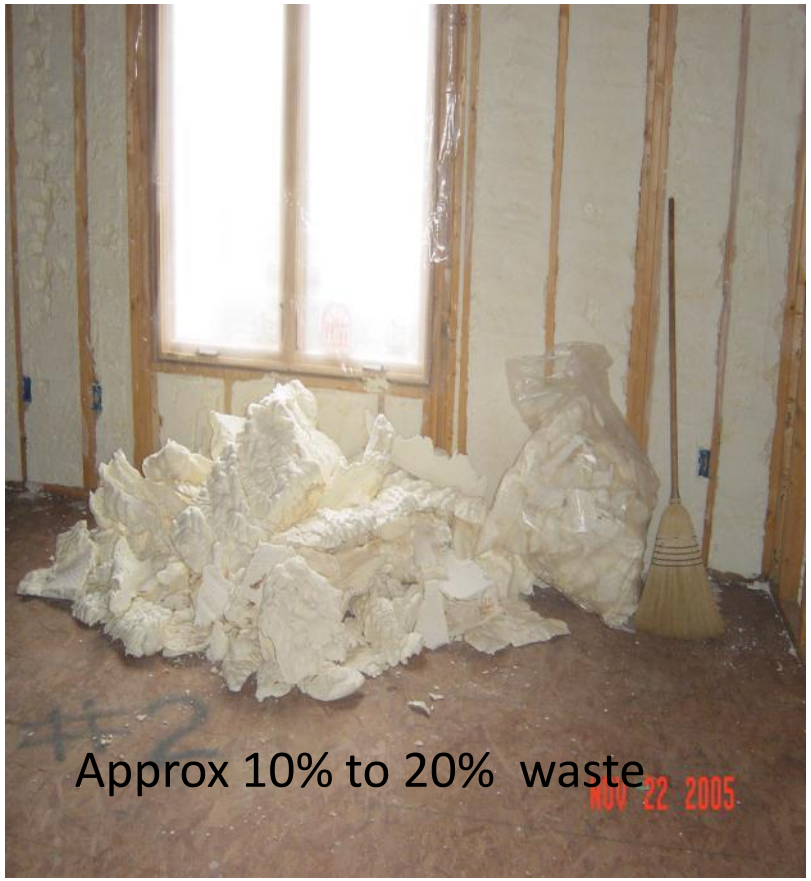
Open Cell Scarfing

Open cell after scarfing



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Closed Cell Target Thickness 1 ½-2” per pass

Closed Cell Foam

Crawlspaces

Metal Buildings

Exterior Applications

Many possibilities…

Spray Foam and Fire Safety
Or
Thermal Barrier or Ignition Barrier?

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What Is A Thermal Barrier ?

A thermal barrier is a material, applied between spray polyurethane foam and interior spaces designed to slow the temperature rise of the SPF during a fire situation, to delay the SPF's involvement in a fire.

Thermal barriers limit the temperature rise of the SPF to not more than 250 F after 15 minutes of fire exposure complying with the standard time temp curve of ASTM 119. The thermal barriers meeting this are termed a "15 minute thermal barrier" classified having an "index of 15".

What Is A Thermal Barrier ?

- ½ Gypsum Board
- .016 Steel
- 2” Mineral Fiber
- .032 Aluminum
- 1” Masonry or Concrete
- 1 ½” K 13 cellulose
- 5/8 Rated grid Suspended Ceiling Systems

Where Is A Thermal Barrier Needed ?

All model building codes require a building code approved thermal barrier **on the habitable side of a structure between the interior of the structure and the SPF**. SPF should not be applied to the interior of a building without an approved thermal barrier.

Building codes may exclude the installation of a thermal barrier over certain applications of SPF. Review the specific code requirements on a case - by - case basis.

What Is an Ignition Barrier ?

A Ignition barrier is a material applied to foam when used in attics or crawlspaces with limited access into the space.

What Is an Ignition Barrier ?

The International Residential Code defines an IB as one of the following:

- 1/4 Ply wood
- 3/8 Particleboard
- ¼ Hard Board
- 3/8 Gypsum Board
- 0.016 Corrosion resistant steel
- 1 ½ Mineral fiber
- Intumescent coating **Tested as a System**

SPF & Code Changes

2012 IECC Code Requirements

What's new?

The 2012 code requires more insulation, a tighter envelope, tighter ducts, better windows, and more efficient lighting than the 2009 code.

Important Changes

- **Blower-door testing requirements have become mandatory** and more stringent; the 2009 threshold of 7 ach50 has been changed to 5 ach50 for climate zones 1 and 2, and 3 ach50 for homes in all other zones.
- ***Wall insulation requirements have become more stringent*** in climate zones 3, 4, 6, 7, and 8; for the first time, builders in climate zones 6, 7, and 8 will be required to install exterior rigid foam insulation (or to use some other comparable wall insulation strategy).
- The 2012 International codes will require new homes in cold climates to have exterior foam sheathing, or some similar layer of continuous insulation **that interrupts thermal bridging** through studs.

Introduction To Spray Foam

THANK YOU

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