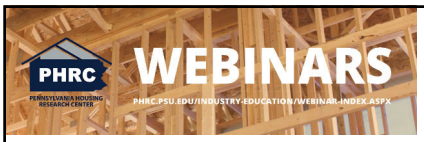

Best Practices for Understanding, Diagnosing, and Avoiding Problems in Polyurethane Foam Installations

www.phrc.psu.edu

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Description

This program provides a general overview of foam plastic products, then introduces the most common causes of material and IAQ problems in field-applied spray and injection foam applications. Finally, it concludes with fire protection code requirements for foam plastic.

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Learning Objectives

1. Participants will be able to identify foam plastic materials.
2. Participants will be able to avoid the most common post-installation causes of product quality problems.
3. Participants will be able to identify fire protection requirements for typical construction details and building locations.

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1. Introduction to field-applied polyurethane foam plastic

a. "foam plastic" is the code term. It covers all of the field-applied polyurethane products plus all types of rigid foam board (Styrenes, polyisos, and polyurethanes) and foam sealants.
b. Field-applied foam - SPF, IPF, and foam sealants
c. Open-cell and closed-cell products

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Materials in construction - 4 types of polyurethane

1. Polyurethane foam caulking (tubes)
2. Single-component foam sealant (cans)
3. Two-component foam insulation/sealant kits
4. "Bulk" spray-applied and injected foam insulation (SPF/IPF)
   - Open-cell and closed-cell foam formulations
   - Spray-applied and injection foams
   - Molded (Rigid foam board, prefab parts, SIPs)

What is the difference in the chemistries?
When to use each approach?

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Polyurethane Product	Use (does not include adhesive applications)	Closed cell	Open cell	QC - processing	Preparation	QA - during installation	QC - after installation
Sealant single component caulk	seal cracks < 1/8"	NA	NA	product temperature - storage	ambient and subtrate temperature; substrate clean and dry (wood moisture content or metal and masonry surface moisture); compatability	technique; bead thickness	visual inspection*
Single component foam expanding	1/8to 3/4"	Y	NA	chemical temperature		full depth; any required bracing; wet between lifts >3/4"; technique	visual inspection*
Single component foam non-expanding	1/8to 3/4"	Y	NA	chemical temperature		full depth; wet between lifts >3/4"; technique	visual inspection*
Two-part slow-rise foam kit	>1/4"	Y	Y	chemical temperature, pressure, component weight; test shots		maintain preparation conditions during installation; sheathing integrity and fastening	no pass thickness limit; infrared to verify fill; maintain preparation conditions throughout cure period
Two-part spray foam kit	>1/4" or open surface	Y	Y	chemical temperature, pressure, component weight; test shots		lift thickness; time between passes; maintain preparation conditions during installation; cure-lift prevention	visual inspection*; pass thickness limit; thump test; maintain preparation conditions throughout cure period
Injection two-part foam	closed cavities	Y	Y	chemical temperature, pressure, ratio; test shots	ambient RH; ambient and subtrate temperature; substrate clean and dry (wood moisture content or metal and masonry surface moisture); compatability	maintain preparation conditions during installation; sheathing integrity and fastening	no pass thickness limit; infrared to verify fill; maintain preparation conditions throughout cure period
Spray applied two-part foam	open surfaces	Y	Y	chemical temperature, pressure, ratio; test shots		lift thickness; time between passes; maintain preparation conditions during installation; cure-lift prevention	visual inspection*; pass thickness limit; thump test; maintain preparation conditions throughout cure period
Spray applied two-part roofing foam	open surfaces	Y	Y	chemical temperature, pressure, ratio; test shots	This is a handout	lift thickness; time between passes; maintain preparation conditions during installation; cure-lift prevention	visual inspection*; pass thickness limit; thump test; maintain preparation conditions throughout cure period

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What is the difference in the chemistries?

Density

- Controlled primarily by the blowing agent
- Open-cell is usually water-blown
- Closed-cell is usually blown by a low-conductivity gas

Blowing agents

- These have changed over time
- HFOs can have new installation problems vs. 245fa foams

The Chemistry

- The A-sides are typically the same
- The B-sides contain the blowing agent, catalysts, surfactants, fire retardant, etc.

See "physical properties 15C.pdf" handout for more information

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Polyurethane Foam

Figure 1: Typical Composition of Polyol Resin Systems

B-Side

Component	Low Density, Open Cell SPF	Medium Density, Closed Cell SPF
Polyols	60%	20-40%
Blowing Agents	20%	20%
Catalysts	3%	3%
Flame Retardants	15%	20-40%
Surfactants and Glycerin	2%	2%

Additives determine:

1. Cell size and R-value
2. Speed of the chemical reaction
3. Fire resistance
4. Product density
5. Flexibility and dimensional stability

Courtesy: Center for the Polyurethanes Industry (CPI) of the American Chemistry Council

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Advantages - Open-Cell Foam

1. Can have a lower cost even though it usually requires trimming and more waste disposal
2. Dimensional stability is not influenced as much by environmental conditions
3. Pass thickness is usually unlimited
4. One-step convection and conduction control

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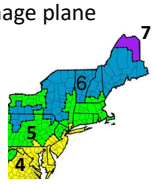
Polyurethane Foam

Foam density

Medium and high-density closed-cell foams

- typically have at least a 90% closed-cell content
- have low-conductivity gasses in the bubbles
- have higher R-values than open-cell foams
- have high resistance to air and vapor flow
- are water tolerant (marine and drainage plane applications)
- are very strong compared to open-cell foams (SIPs, hurricanes, floods)
- meet the code requirements for vapor control in most climate zones



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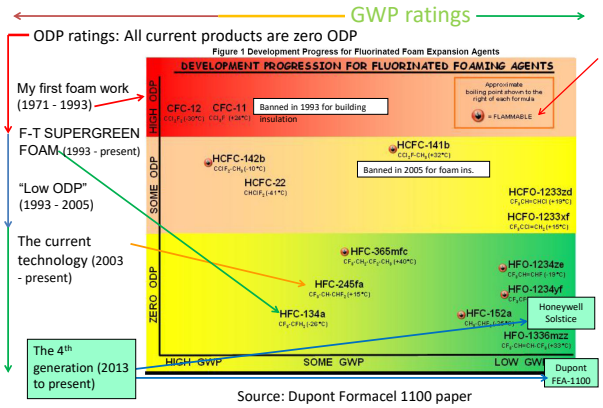
Closed-cell polyurethane foam blowing agents



Source: Dupont Formacel 1100 paper

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Advantages - Closed-Cell Foam

1. Higher R-values are possible in smaller, existing framing cavities
2. Will not be damaged by short-term roof leaks, foundation leaks, or condensation
3. Can function as a drainage plane
4. Not prone to weather damage
5. Can be used below grade
6. Has structural capabilities (SIPs)
7. Self-supporting
8. One-step convection, diffusion, and conduction control – does not require vapor protection

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Advantages - Closed-Cell Foam

Below-grade applications

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Installation Methods

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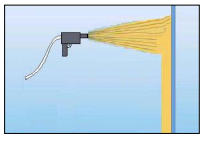
SPF – Bulk foam

The substrate must be dry, clean and firm. The surfaces will be impregnated with the mix in successive passes to obtain the desired foam thickness. This application method assures that the insulation foam will be totally adhered to the substrate and without joints.



In situ sprayed rigid polyurethane foam

Spraying over an interior masonry wall

Courtesy of: BING Federation of European Rigid Polyurethane Foam Associations

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Advantages - Closed-Cell Foam

Unvented roof applications

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Field application methods

What ifs:

a. Empty cavities, but no insulation
b. Old batt insulation in the cavity, but not enough R-value
c. Historic finishes
d. Lath is good, but plaster is not

Injected polyurethane foam (IPF) solves these problems

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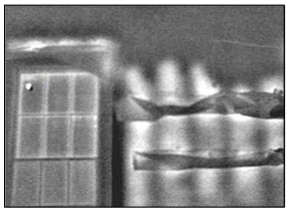
IPF – Bulk foam

How do you know you got it all?

IR quality assurance testing during the installation



Cavity-fill applications

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IPF – Bulk foam

- General building description/use – Single-family residence
- Bedford, NY; Project date: 2001
- Problem addressed with IPF – Excessive heat loss (HAM)
- Why IPF was the best solution – Provides air seal with R-value

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IPF – Bulk foam

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IPF – Bulk foam (portable slow-rise kits)

The remediation process

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IPF – Bulk foam

Infrared QA of foamed-in-place insulation – effective year-round (240F)

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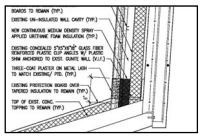
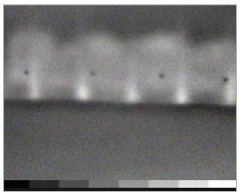
IPF – Bulk foam

Infrared QA of foamed-in-place insulation behind 1" plaster – effective year-round (240F)





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FS - Foam sealants

FS - Foam sealant
a. Open crack/penetration sealing
b. Limited cavity fill

Problems I see:
- Chemicals too cold
- Superficial installs
- Not enough moisture

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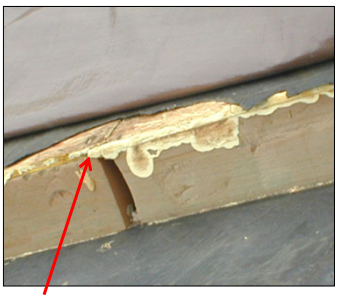

Superficial application does not make a durable seal

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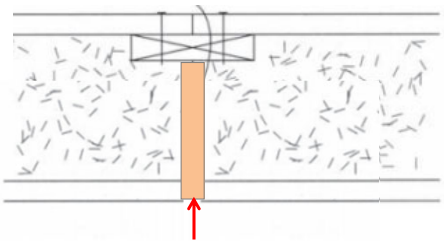
It's all in the details



Full-thickness application – provides visual quality control and a durable seal

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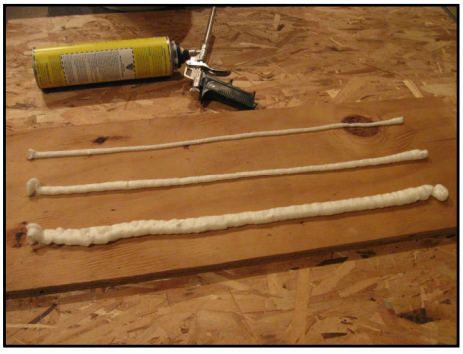
Adjusting Bead Size



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QA for one-component foam sealant

Precondition the containers

1. Shake the cans well (how long is that?)
2. Bring the cans to the proper temperature
   - Minimum is 40F for Pur fill 1G
   - Recommended between 60F and 80F
3. How do you warm them (slow, fast, etc.)?
   - Slowly with a low-flux heat source
   - Never allow the cans to get above 122F
4. How do you measure the temperature?

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One-component foam sealant is water-reactive

Fails to react without adequate moisture - liquifies

"gets hard" with adequate moisture

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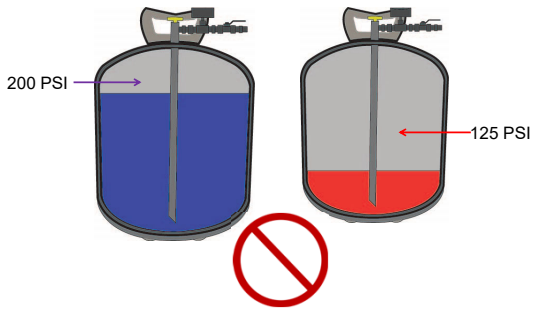
Two-component kits - quality Control

- Liquid levels need to be about the same for the pressures to be the same
- If the levels are the same, the weights should be close



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Foam failures

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2. Introduction to spray foam failures

a. The most common problems I see
   i. Health (mostly respiratory)
   ii. Odor (not always the same as health)
   iii. Building performance (Air barrier, R-value, vapor control - HAM)
   iv. Safety – ventilation, CAZ safety, isolation (evac. and enclosures), fire protection

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2. Introduction to spray foam failures

1. The most common problems I see
   a. Health and Odor issues are due to off-gassing of vapors from the foam
      i. Processing issues – off ratio and improper mix
      ii. Installation issues – burnout

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Building performance

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2. Building Performance problems

R-value (Conduction)
Air barrier continuity (Convection)
Vapor control (Diffusion)

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R-values by PA climate zone

PA301.1 *R*-value computation. Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component *R*-value. The manufacturer's settled *R*-value shall be used for blown insulation. Computed *R*-values shall not include an *R*-value for other building materials or air films.

Table PA301
Insulation and Fenestration Requirements by Component [a]

Climate Zone	Fenestration U-factor	Skylights[b] U-factor	Ceiling R-value	Wood frame wall R-value	Mass Wall R-value[b]	Floor R-value	Basement[c] wall R-value	Slab[d] R-value and depth	Crawlspace[c] wall R-value
South	0.35	0.60	38	13	5/10	19	10/13	10, 2 ft	10/13
Central	0.35	0.60	38	20[e] or 13 + 5[g]	13/17	30[f]	10/13	10, 2 ft	10/13
North	0.35	0.60	49	20[e] or 13 + 5[g]	15/19	30[f]	15/19	10, 4 ft	10/13

Notes:
a. R-values are minimums. U-factors and solar heat gain coefficient (SHGC) are maximums. R-19 batts compressed in to nominal 2 x 6 framing cavity such that the R-value is reduced by R-1 or more shall be marked with the compressed batt R-value in addition to the full thickness R-value.
b. The fenestration U-factor column excludes skylights.
c. The first R-value applies to continuous insulation, the second to framing cavity insulation, either insulation meets the requirement.
d. R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less, in zones 1 through 3 for heated slabs.
e. Low density spray applied foam and cellulose insulation in a 2x6 wall cavity shall be considered in compliance with this requirement.
f. Or insulation sufficient to fill the framing cavity, R-19 minimum. Floor insulation may also be reduced to R-19 if installed above an unconditioned basement.
g. "13 + 5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 s heathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
h. The second R-value applies when more than half the insulation is on the interior.

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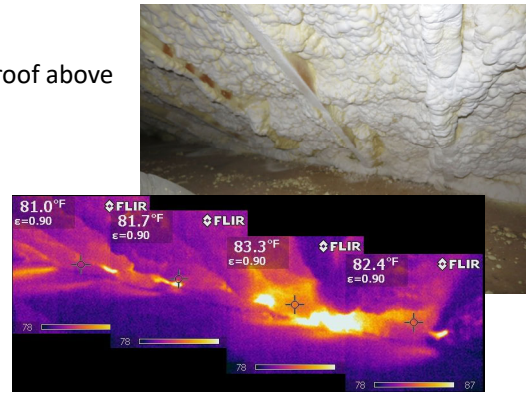
QA using solar gain as the heat source

Hot roof above



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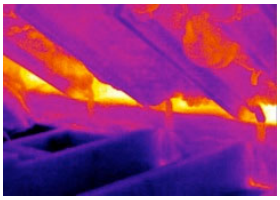
Locating voids in an SPF installation



Courtesy of Zero by Degrees – Jon Haehnel

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Safety

Model Plans and Programs for the OSHA Bloodborne Pathogens and Hazard Communications Standards (OSHA 3186-06R 2003) Handout

IAQ management plan available upon request

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Hazards and Safety – Site protection

Safety is a factor for the Owner, the Installer, and the Contractor.

- PPE required for the installer
- *Hazard communication for the occupants (SDSs, signage, IAQ/ventilation management plan, IAQ verification, Re-occupancy certification, etc.)
- Site protection
  - CAZ safety
  - Evacuation
  - Masking to protect property from overspray
  - Ventilation – during and after SPF

*Model Plans and Programs for the OSHA Bloodborne Pathogens and

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Tips not in the code

- Always check the CAZ
- Always evacuate the Work zone for the full term of the installation plus the cure period
- Consider if an attic or crawl space qualifies as a confined space
- Ventilation requirements (during and after)
  - Only use balanced ventilation
  - Ventilation rates "games" played by some SPF mfgs.
- Verify <u>all</u> manufacturer parameters
- Make up air may be required for large range hood fans
- Re-occupancy period "games" played by some SPF mfgs.
- Some SDSs do not provide adequate chemical data

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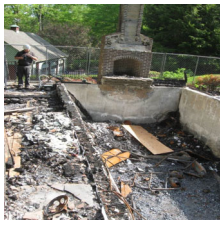
CAZ Safety

Site Protection – check the make-up air requirements!



Air sealing plus proper ventilation can cause back-drafted combustion appliances

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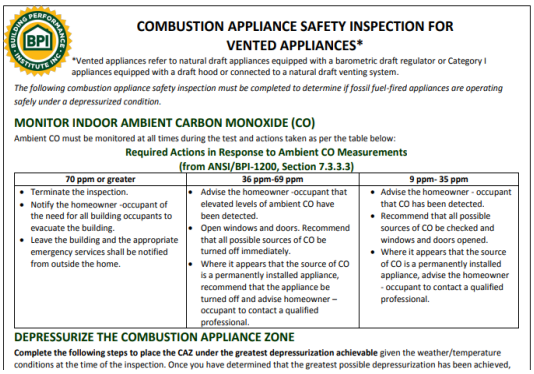
CAZ Safety



COMBUSTION APPLIANCE SAFETY INSPECTION FOR VENTED APPLIANCES*

*Vented appliances refer to natural draft appliances equipped with a barometric draft regulator or Category I appliances equipped with a draft hood or connected to a natural draft venting system.

The following combustion appliance safety inspection must be completed to determine if fossil fuel-fired appliances are operating safely under a depressurized condition.

MONITOR INDOOR AMBIENT CARBON MONOXIDE (CO)

Ambient CO must be monitored at all times during the test and actions taken as per the table below:

Required Actions in Response to Ambient CO Measurements (from ANSI/BPI-1200, Section 7.3.3.3)

70 ppm or greater	36 ppm-69 ppm	9 ppm- 35 ppm
• Terminate the inspection. • Notify the homeowner -occupant of the need for all building occupants to evacuate the building. • Leave the building and the appropriate emergency services shall be notified from outside the home.	• Advise the homeowner -occupant that elevated levels of ambient CO have been detected. • Open windows and doors. Recommend that all possible sources of CO be turned off immediately. • Where it appears that the source of CO is a permanently installed appliance, recommend that the appliance be turned off and advise homeowner – occupant to contact a qualified professional.	• Advise the homeowner - occupant that CO has been detected. • Recommend that all possible sources of CO be checked and windows and doors opened. • Where it appears that the source of CO is a permanently installed appliance, advise the homeowner - occupant to contact a qualified professional.

DEPRESSURIZE THE COMBUSTION APPLIANCE ZONE

Complete the following steps to place the CAZ under the greatest depressurization achievable given the weather/temperature conditions at the time of the inspection. Once you have determined that the greatest possible depressurization has been achieved,

This is a handout

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SDS with undisclosed compounds

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Composition/information on ingredients	%W/W	CAS No.	Hazard Statement(s)
Chlorinated phosphate ester	25 - 35	Trade Secret	
Surfactant	11 - 18	Trade Secret	
Proprietary amine	1 - 8	Trade Secret	
Proprietary amine	1 - 5	Trade Secret	
Proprietary amine	0.5 - 4	Trade Secret	
Polyol resin	< 40	Trade Secret	
Proprietary silicone polymer	0.5 - 2	Trade Secret	
Water	< 30	7732-18-5	

This information may disclose the product name, but does not disclose the chemical compound. What PPE is required?

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Tricks of the trade

Some manufacturers don't explain how to ventilate during or after the work on their TDS. This is what another manufacturer states.

Everyone (other than brand name spray technicians) must vacate the job site, remaining completely out of the building or at least 50 feet away, while the spray is applied and for at least 4 hours* after spraying is completed to allow active ventilation of the job site and to ensure the foam chemicals are completely cured. No exceptions.

Independent studies and third party toxicologist verification indicates that when the prescribed ventilation rates and periods are followed, brand name spray foam insulation is safely cured.

* **For installations of low VOC products** brand name **in the United States only, re-occupancy of the job site is permitted after 4 hours provided that the rate of air exchange during spraying and for 4 hours thereafter equals or exceeds 40 Air Changes per Hour (ACH).**

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Tricks of the trade

To use this method, Installers have to:

1. Be able to calculate the volume of the area that the vapors from your work can impact.
2. Be able to calculate the total CFM required to achieve the 40 ACH specified.
3. Determine the number of fans needed to ventilate at the specified ACH.
4. Have enough fans and ducting to set this up.
5. Come back to get their equipment after the 4-hour minimum post-work cure period is over.

- Most installers can't do this.

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Ventilation – during the installation

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Site protection

Why you should ventilate during and after the installation

1. Exhausts some of the foam overspray that can bond to surfaces
2. Reduces off-gas concentrations (A & B sides)
3. Reduces the impact of third-party chemistry
4. Reduces post-installation odors which cause complaints and health concerns

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Ventilation

Guidance on Ventilation During Installation of Interior Applications of High-Pressure Spray Polyurethane Foam

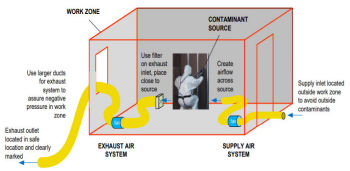

FIGURE 4 - Example of a Two-Fan Ventilation System (active exhaust and supply systems) for Interior SPF Application.

1. Establish air flow across the spraying area
2. A fundamental consideration of any ventilation system is that the system creates an air flow from the make-up air entry location to the exhaust collection point
3. Maintain a net negative pressure in the work zone with respect to the occupied spaces

Courtesy: American Chemical Association - Handout

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Causes of the problems I see

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Processing

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2. Introduction to spray foam failures

b. Causes: Processing and installation
   i. Heat
   ii. Mixing
   iii. Installation
   iv. Change-overs are rarely done properly

See the "Cold Weather SPF" Handout by Robert Naini – Spray Foam Advisor for more information on supply chemical pre-conditioning and keeping equipment warm.

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Processing can cause off-gassing

1. Processing
   a. Improper temperature control is the most common issue
      i. Shipping and chemical pre-conditioning are critical
      ii. Next is the temperature at the gun during the chemical reaction
      iii. Many installers don't have the right equipment to verify these processing parameters
   b. Supply chemicals - before the proportioner – controls the ratio
   c. Reaction chemicals – after the pumps during the delivery to the gun – controls the chemical reaction

Go to Measuring temperatures for how-to program.

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Shipping – Step #1

Shipping and receiving

Maintain chemicals within recommended temperatures

Require "Protect from freezing" or "Min./max. temperature" on P.O.s

Check the chemical temperatures before accepting delivery – reject materials if below freezing (?)

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Pre-conditioning the supply chemicals

Chemical Processing	Parameter ID	Parameter location	Setting/thresholds				
			Low limit, Min.	Alarm	Target	Alarm	High limit, Max.
A Temperature (degrees F)	2 A	Pre-conditioning temperature	50		80		90
B Temperature (degrees F)	2 B		50		80		90

In addition to bringing the supply chemicals to the optimal processing temperatures, maintaining supply chemical quality also includes:

1. Keeping moisture out of the A-side chemicals
2. Mixing the chemicals when necessary

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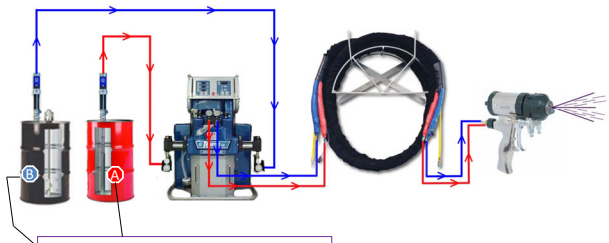
The processing system



Pre-conditioning - Measure supply chemical temperatures at the inlets of the A & B transfer pumps

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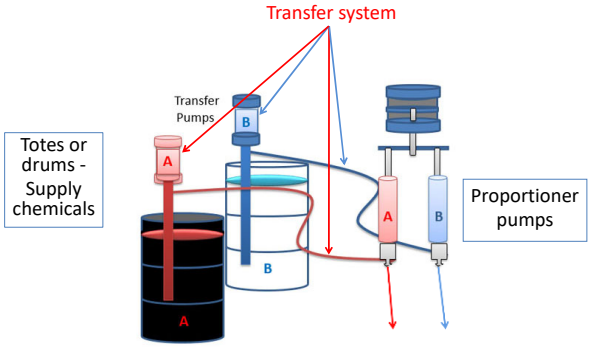
The ratio system

This part of the system controls the ratio



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Processing affects dimensional stability

Before

After

Unconditioned supply chemicals resulted in shrinkage in samples during a cold test

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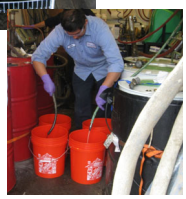
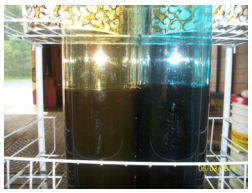
Manual calibration – by volume





These Installers removed the gun manifold to perform their ratio tests

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Ratio monitoring

Graco H-50 has built-in flow monitoring

Graco retrofit system available for some units

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Off ratio – Equipment fluctuations

Layers of A-rich, good quality, and B-rich foam

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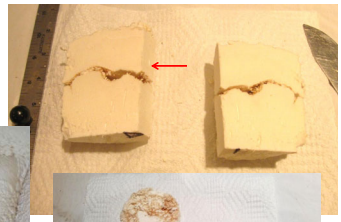
Foam inspections – Product quality

Intermittent processing problem – what should have been done?



68

Off ratio - fluctuations

"Peanut brittle" layer of A-rich material

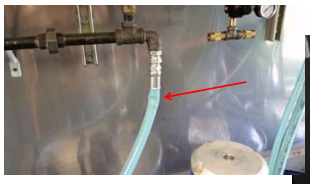
69

Off ratio – consistently misapplied

Drips from the recessed lights gave this one away

70

Supply-side restrictions

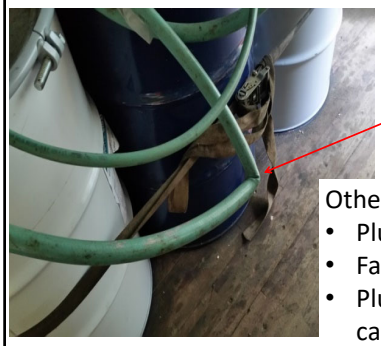


This system was off ratio about 14%

This is also a safety hazard!

71

Supply-side restrictions



Help!

Other restrictions:

- Plugged filters
- Failed check valves
- Plugged make-up air canisters
- Crystalized A side

72

Installation

73

Substrate compatibility

- A cause of delamination, shrinkage, and inadequate air sealing
- Eliminate or plan for known material incompatibilities ("smart" membranes, composite sheathing, etc.)
- Verify unknown material bond strength with a pull test
- Consider heat of reaction bond release
- Verify unknown substrate material bond strength with heat (250 F) stress tests
- Consider cure-pull of adhered substrate layers and mechanical attachment

74

Substrate Compatibility

Substrate material compatibility for foamed-in-place polyurethanes

Substrate Materials - General Description	Product/Brand name	Adhesion rating	Preparation	Maximum moisture content allowed
Plastics / membranes				
Polyethylene films and membranes		Poor	N/A	N/A
Polytetrafluoroethylene (PTFE) products		Poor	N/A	N/A
Polypropelyne products	Tyvek, Typar, etc.	Moderate	N/A	N/A
Glass fiber reinforced products				
Reinforced plastic membranes (Poly, TPO, PVC, etc.)	Reinforced polyethylene (many brands)	Varies with plastics (see this list for the plastic film to assess compatibility)		N/A
Reinforced bituminous membranes	Many	Varies with membrane - note that most bituminous-based product can soften or melt from the heat of reaction - this can temporarilly compromise bond strength of the substrate		N/A
Reinforced in paper membranes (Scrim)	Many	Good	Verify paper is not coated with a plastic or wax that may reduce bond strength	Value unknown, but integrity of the paper is important
Polyester resin sheet goods with integral glass fibers (Corvettes, tub-showers units, translucent roofing, etc.)	Fiberglas	Moderate	Clean and dry*	N/A
Peel-and-stick membranes				
Products with polyethylene film finish	Guess this one	Poor	Torch	N/A
Products modified to accept foam		Moderate	Clean and dry*	N/A
Polyurethane and Isocyanurate board stock	Tuff-R, Thermax	Good	Clean and dry*	N/A
Polystyrene foam				
Expanded	Styrofoam EPS	Good	Clean and dry*	N/A
Extruded	Styrofoam XPS	Good	Clean and dry*	N/A

This is a handout

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Material compatibility

1. Natural cure shrinkage – closed-cell foam
2. Heat of reaction reduces substrate bond

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Substrate Compatibility

Substrate material compatibility for foamed-in-place polyurethanes

Substrate Materials - General Description	Product/Brand name	Adhesion rating	Preparation	Maximum moisture content allowed
Wood products				
Construction grade spruce	Many	Good	Clean and dry*	< 11%
Pressure treated lumber	Many	Varies	Clean and dry*, free of preservative buildup	< 11%
Wood boards	Rough-sawn and planed			
Glue-laminated beams & joists				< 11%
Natural wood face layer	Many	Good	Clean and dry*	< 11%
Waxed finish	Many	Poor	Apply bonding material	< 11%
Plywood				< 11%
Standard wood	Many	Good	Clean and dry*	< 11%
Pressure treated	Many	Varies	Clean and dry*, free of preservative buildup	< 11%
OSB				< 11%
Smooth side	Many	Moderate	Sand and/or prime	< 11%
Rough side	Many	Good	Clean and dry*	< 11%
High and medium-density composite wood panels				< 11%
MDO	Many	Moderate	Sand and/or prime	< 11%
Particle board	Many			< 11%

This is a handout

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Compatibility

Substrate material compatibility for foamed-in-place polyurethanes

Substrate Materials - General Description	Product/Brand name	Adhesion rating	Preparation	Maximum moisture content allowed
Masonry/glass				
Aged poured-in-place or pre-cast concrete	Many	Good	Clean and dry*	
Fresh poured-in-place or pre-cast concrete	Many	Varies	Clean and dry*	
Concrete block	Many	Good	Clean and dry*	
Brick	Many	Good	Clean and dry*	
Stone		Good	Clean and dry*	
Ceramic clay block	Many	Good	Clean and dry*	
Ceramic tile - natural	Many	Good	Clean and dry*	
Ceramic tile - glazed	Many	Moderate	Clean and dry*	
Glass fiber products	Open mesh	Good	Clean and dry*	N/A
Woven roving	Good	Clean and dry*	N/A	
Paper faced gypsum board	Standard gypsum wall board	Good		
Exterior gypsum board (Densglas)		Moderate		
Plaster		Good		
Window glass	Many	Moderate	Clean and dry*	
Foam glass board stock	Many	Moderate	Clean and dry*	

This is a handout

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Compatibility

Substrate material compatibility for foamed-in-place polyurethanes

Substrate Materials - General Description	Product/Brand name	Adhesion rating	Preparation	Maximum moisture content allowed
Metals				
Steel				
Mill-finish cold rolled sections	Many	Moderate	Clean and apply etching agent/primer	
Mill-finish coil stock	Many	Poor	Clean and apply etching agent/primer	
Primed and/or painted	Many	Good	Clean and dry	
Galvanized steel - Spangled	Many	Poor	Apply etching agent	
Galvanized steel - Hot dipped	Many	Moderate	Prime	
Galvanized steel - Cold coated	Many	Moderate	Prime	
Galvanized steel - with paint-prep. galvanization process	Galvalume	Good	Clean, dry, free of oil and grease, or uncured solvent-based materials	
Aluminum				
Mill-finish		Poor	Etching & prime	
Primed and/or painted		Good	Clean and dry*	
Galvanized - Galvalume		Moderate	Clean and dry*	
Aluminum foil facers on RFB		Moderate	Clean and dry*	
Coatings				
Bituminous coatings	Tar, foundation coatings, vapor barrier coatings	Poor	May delaminate from heat of reaction	
Water-based coatings	Foundation coatings, vapor barrier coatings	Varies by product - verify with manufacturer	As directed by manufacturer	
Polyurea	Many	Good	Clean and dry	
Oil and water-based paints	Many	Good	Clean and dry	

This is a handout

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Compatibility

Substrate material compatibility for foamed-in-place polyurethanes

Substrate Materials - General Description	Product/Brand name	Adhesion rating	Preparation	Maximum moisture content allowed
Wood products				
Construction grade spruce	Many	Good	Clean and dry*	< 11%
Pressure treated lumber	Many	Varies	Clean and dry*, free of preservative buildup	< 11%
Wood boards	Rough-sawn and planed			
Glue-laminated beams & joists				< 11%
Natural wood face layer	Many	Good	Clean and dry*	< 11%
Waxed finish	Many	Poor	Apply bonding material	< 11%
Plywood				< 11%
Standard wood	Many	Good	Clean and dry*	< 11%
Pressure treated	Many	Varies	Clean and dry*, free of preservative buildup	< 11%
OSB				< 11%
Smooth side	Many	Moderate	Sand and/or prime	< 11%
Rough side	Many	Good	Clean and dry*	< 11%
High and medium-density composite wood panels				< 11%
MDO	Many	Moderate	Sand and/or prime	< 11%
Particle board	Many			< 11%

This is a handout

80

Preparation

Prepare substrates properly

- Clean, dry, warm
- Primer, etching
- *Supports, mechanical fasteners?*

81

Preparation

82

Foam inspections – Pull tests

Glazed TC tile

Aka Adhesion test – exterior cavity wall

83

Scorching or burn-out

Caused by too-thick passes
Off-gassing from this includes cyanide

Courtesy: SPFA

84

Installation - Foam problem!

This failure occurred six months after the installation

This failure will be loud enough to detect inside

85

Foam inspections – Slit tests

- Dimensional stability
  - If there are locked-in stresses, surface cuts will open up to relieve them.
  - This avoids future failures during seasonal thermal stress.
  - Provide control joints or slit the foam uniformly and seal the gaps after the foam opens up as a remediation method.

This method is a handout

86

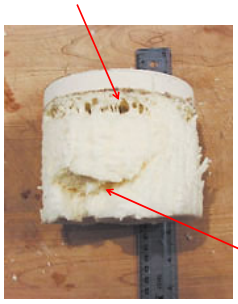
Installation

Slit test that opened up – sounded like a gun shot! Excessive pass thickness was the cause.

87

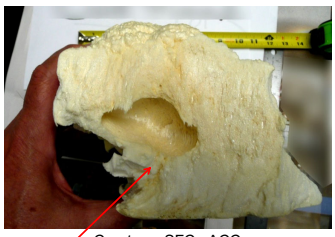
Foam inspections – Product quality

Substrate moisture



Courtesy: SPFA

Cell structure



Courtesy: SFC - ACC

Improper processing

88

"Surfboard" strip test shots

Spray these test strips on plastic. Lift off the plastic when they are firm enough to lift without bending

Mix and cell quality verified!

89

Foam inspections – Project identification

- Identifying the materials used
  - Manufacturer
  - System number
  - Lot number
  - Seasonal formulation
  - Documentation to require
    - Product data
    - SDS forms (A, B, and finished product)
    - ESRs
    - Manufacturer's installation instructions
    - Processing reports (post-work)
- The Insulation Certificate identifies products
  - These are required by code
- Some AHJs do not allow substitutions for products

Change-overs are rarely done properly – combines products = unapproved mixture

90

Foam inspections – Project identification

Trademark colors help identify mixed installations

91

Code requirements

93

3. Code requirements

1. Code violations I see
   a. Inadequate R-value
      i. There is a standard method for measuring average thickness.
      ii. If the Owner did not have a choice, the Installer is the "designer" and is therefore responsible for non-compliance
   b. No vapor control (open-cell usually requires vapor control)
   c. Failure to meet air barrier testing requirements – Rater reporting may qualify
   d. Inadequate or missing fire protection and/or inspection
   e. Improper roof and attic ventilation
   f. No Energy/Insulation certificate (a code requirement)

Sample Energy Certificate is in the handouts

94

Foam plastic code compliance

§2447-B. A. For all such installations, the foam plastic shall be separated from habitable or occupiable spaces by an approved thermal barrier of 1/2 inch gypsum wallboard or equivalent thermal barrier material which will limit the average temperature rise of the unexposed surface to not more than 250°F. after 15 minutes of fire exposure complying with the ASTM E-119 standard time-temperature curve. Thermal barriers shall be installed in a manner that assures they will stay in place for a minimum of 15 minutes under the same test exposure conditions.

95

Fire Testing: Surface Burning

- ASTM E84 Tunnel Test Apparatus
  - 25' x 2' x 2' tunnel
  - 4" material thickness limitation
  - Flame spread index (FSI)
  - Smoke-developed index (SDI

- ASTM E970 Critical Radiant Heat Flux Test Apparatus
  - 1m long test panel
  - Gas burner suspended over panel
  - No material thickness limitation
  - 0.12 W/m2 min heat flux

96

Verification of compliance

1. The Manufacturer's product literature tells us how to do it right.
2. Labeling stickers support the literature and provide visible information on the drums or totes.
3. Third-party evaluations (ESRs and CCRRs) tell us if a product is code compliant and includes some requirements that are not in the code.

ESR = Evaluation Service Report
CCRR = Code Compliance Research Report

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Labeling - Verification of compliance

Product Description

SPF Product name is a two-part, spray-applied, closed-cell polyurethane foam insulation material used to insulate structural steel, ceilings, roof decks, walls and tanks and as an air barrier in building envelope assemblies. **This product is used in occupied/unoccupied spaces and can be left exposed without ignition/thermal barriers or other types of fire protective surfaces**.

TYPICAL PHYSICAL PROPERTIES*

	ASTM Method	
Nominal Density	D 1622	2.3 pcf
Compressive Strength	D 1621	20 psi
Tensile Strength	D 1623	24 psi
Closed Cell Content	D 6226	>90%
Aged R-Value @ 1"	C 518	6.5
Dimensional Stability, Volume Change	D 2126	6.0%
Permeability (perm inch) @ 2"	E 96	.91
Air Permeance @ 1 inch	E 2178	.00025 L/s/m² @ 75Pa

*These physical properties are typical for this material as applied at manufacturing facility under controlled conditions. SPF performance and actual properties will vary with differences in application (i.e. ambient conditions, process equipment and settings. etc). As a result, these published properties should be used as guidelines solely for the purpose of evaluation.

APPROVALS AND CREDENTIALS

ASTM E-84**
Flame Spread Index 25
Smoke Development Index 350

Does not require thermal or ignition barrier protective surfaces for numerous applications based on successful performance when tested in accordance with the UL 1715 full-scale fire test standard. Contact PSI for specific code-compliant assemblies.

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AHJ flexibility

- ESRs can be used as guidelines for making non-prescriptive interpretations, especially items that are due to be approved in upcoming code versions.
- AC 377 is not a code requirement. Building/Code officials may use ESR language as a guideline for making non-prescriptive interpretations.

99

What are barriers?

100

15-minute Thermal Barriers

1. What are 15-minute thermal barriers?
2. Where are they required (Residences and commercial buildings)?
3. Where are they not required?
4. Which products, assemblies, and methods comply?

101

What is a 15-minute thermal barrier?

- Thermal barrier – an insulating material that prevents foam from reaching 250F *above the ambient* (E119 or UL263).
- 15-minutes
  - How long it has to keep the foam cooler than the ignition temperature (E119 or UL263).
  - How long it has to stay in place during specified large-scale fire tests (NFPA 286, etc.).

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Types of 15-minute thermal barriers

- Prescriptive
- Non-prescriptive, but listed as acceptable (equivalent)
- Equivalent/alternate non-prescriptive
  - Not assembly specific
  - Assembly specific
- Typically approved, but not listed or equivalent
- Foam products that do not need a barrier

SPFA/ACC

- Thermal Barriers and Ignition Barriers for the Spray Polyurethane Foam Industry – SPFA/ACC AY-126 Search AY-126 at http://www.sprayfoam.org
- AY-126 is approved by the ICC and on the ICC web site - http://www.icc-es.org/News/Articles/AY126Thermal BarriersSPF2011-51811.pdf

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What is a 15-minute thermal barrier?

Prescriptive - 1/2" gypsum board

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What is a 15-minute thermal barrier?

Non-prescriptive or equivalent/alternative coatings or coverings (not assembly specific)

- Must be tested in accordance with, and meet the acceptance criteria of both the following:
  - Temperature Transmission Fire Test (ASTM E119)
  - Integrity Fire Test (NFPA 286, UL 1715, UL 1040 or FM 4880)
- Or: NFPA 275 (combines both tests above)
- Examples:
  - Cementious coatings of an adequate thickness
  - Fire retarded cellulose of an adequate thickness
  - Some liquid-applied coatings of an adequate thickness

105

What is a 15-minute thermal barrier?

Examples of materials that are not prescriptive, exempt, or tested; but, are generally accepted as a thermal barrier by AHJs:

- ¾ " SE wood boards - Not prescriptive but generally accepted for floors or roof sheathing
- Metal or wood lath and plaster
- Sheet metal siding or decking
- Attics or basements with sprinklers (varies with AHJs)

Always check with the AHJ!

106

Foam plastic code compliance

1. **§2447-B. (1)** Foam plastics may be used without the thermal barrier described in this paragraph when the foam plastic is protected by a minimum of one inch thickness of masonry or concrete.

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ICC Acceptance Criteria – SPF

ICC developed the Acceptance Criteria for any evaluation service. Includes guidelines for:

- products
- Installations
- applications

ICC EVALUATION SERVICE

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

ACCEPTANCE CRITERIA FOR SPRAY-APPLIED FOAM PLASTIC INSULATION

AC377

Approved June 2011

Compliance date June 1, 2013

Previously approved October 2010, June 2010, November 2009, June 2009, May 2008, October 2007

PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (ICC-ES), are based upon performance features of the International family of codes. (Some reports may also reference older code families such as the BOCA National Codes, the Standard Codes, and the Uniform Codes.) Section 104.11 of the *International Building Code®* reads as follows:

> The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

This acceptance criteria has been issued to provide interested parties with guidelines for demonstrating compliance with performance features of the codes referenced in the criteria. The criteria was developed through a transparent process involving public hearings of the ICC-ES Evaluation Committee, and/or on-line postings where public comment was solicited.

New acceptance criteria will only have an "approved" date, which is the date the document was approved by the Evaluation Committee. When existing acceptance criteria are revised, the Evaluation Committee will decide whether the revised document should carry only an "approved" date, or an "approved" date combined with a "compliance" date. The compliance date is the date by which relevant evaluation reports must comply with the requirements of the criteria. See the ICC-ES web site for more information on compliance dates.

If this criteria is a revised edition, a solid vertical line (|) in the margin within the criteria indicates a technical change from the previous edition. A deletion indicator (→) is provided in the margin where wording has been deleted if the deletion involved a technical change.

ICC-ES may consider alternate criteria for report approval, provided the report applicant submits data demonstrating that the alternate criteria are at least equivalent to the criteria set forth in this document, and otherwise demonstrate compliance with the performance features of the codes. ICC-ES retains the right to refuse to issue or renew any evaluation report, if the applicable product, material, or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or if malfunctioning is apt to cause injury or unreasonable damage.

NOTE: The Preface for ICC-ES acceptance criteria was revised in July 2011 to reflect changes in policy.

Acceptance criteria are developed for use solely by ICC-ES for purpose of issuing ICC-ES evaluation reports.

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Appendix X for Attics and CSs

BASF We create chemistry — **Technical Data Sheet**

WALLTITE® US Series
BUILDING ENVELOPE INSULATION AIR BARRIER
ICC-ES ESR-2642, Intertek CCRR-1031

DESCRIPTION:

WALLTITE US is a two-component closed-cell spray polyurethane foam system utilizing an EPA-approved, zero ozone-depleting blowing agent. It is designed for use in commercial construction insulation air barrier system applications. **WALLTITE US** is compatible with most common construction materials, but can only be processed with ELASTOSPRAY® 8000A Isocyanate. The benefits of **WALLTITE US** include:

- Superior insulation
- Controls moisture infiltration
- Controls air infiltration
- Non-fibrous
- Structural enhancement

REACTIVITIES AVAILABLE	AMBIENT TEMPERATURE RANGE
WALLTITE US W	20°F to 65°F
WALLTITE US R	60°F to 120°F

TYPICAL PROPERTIES[1]

PROPERTY	METHOD	WALLTITE US
Resin:		
Specific Gravity @ 70°F	ASTM D 1638	1.175
Viscosity @ 70°F (cps)	Brookfield	500
Cured Foam:		
Density, core (pcf @ 2" lifts)	ASTM D 1622	2.0 – 2.3

ADDITIONAL TESTING, APPROVALS & CERTIFICATIONS:

- ASTM E 84 (Class I) with Product Listing [3] [4]
- NFPA 285 complying assemblies available
- Fire Resistant assemblies available
- ICC-ES Evaluation Report ESR-2642; including Seal & Insulate with ENERGY STAR® Supplement
- INTERTEK Code Compliance Research Report CCRR-1031
- ASTM C 1029 – Compliant with requirements for Type II foams
- AIR PERMEANCE and AIR LEAKAGE

PROPERTY	METHOD	WALLTITE US
Air Permeance ($L/s{\cdot}m^2$ @ 75 Pa ΔP)	ASTM E 2178	0.0003 @ 1.27 inch
Air Leakage		
WALLTITE US alone ($L/s{\cdot}m^2$ @ 75 Pa ΔP)	ASTM E 283	<0.005 @ 1.0 inch
WALLTITE US on Masonry wall ($L/s{\cdot}m^2$ @ 75 Pa ΔP)	ASTM E 2357	0.0076 @1.35 inch
WALLTITE US on LGMF wall ($L/s{\cdot}m^2$ @ 75 Pa ΔP)	ASTM E 2357	0.0086 @1.24 inch

- Thickness is not limited when installed behind a code-prescribed thermal barrier (per ICC-ES AC377)
- Approved for Attics & Crawl Spaces Installations with and without prescriptive ignition barriers per ICC-ES AC377, Appendix A1.2.2 and Appendix X
- Air Barrier Association of America (ABAA) Listed Material (ABAA Model Specification 07263)

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Caution!

AC 377 is not part of the code!

When using products that base their use without an ignition barrier based on Appendix X testing, confirm that the AHJ will accept the product without protection before the installation.

There is nothing worse than having an inspection after the fact and finding out that occupancy will not be allowed until an expensive coating has been applied.

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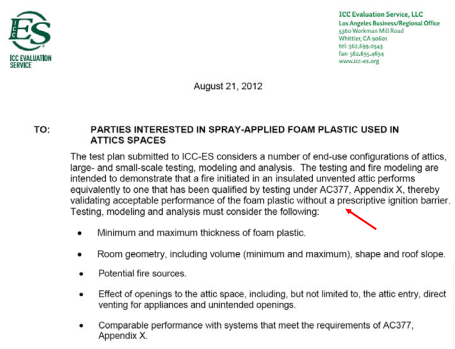
SPRAY-APPLIED FOAM PLASTIC USED IN ATTIC SPACES

Public Notification of Alternate Methods for Qualifying Spray-applied Foam Plastic Insulation Used in Attics without a Prescriptive Ignition Barrier - AC377-1012-R1 (MB/CA) Hearing date: Tuesday, October 2, 2012



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www.icc-es.org

August 21, 2012

TO: **PARTIES INTERESTED IN SPRAY-APPLIED FOAM PLASTIC USED IN ATTICS SPACES**

The test plan submitted to ICC-ES considers a number of end-use configurations of attics, large- and small-scale testing, modeling and analysis. The testing and fire modeling are intended to demonstrate that a fire initiated in an insulated unvented attic performs equivalently to one that has been qualified by testing under AC377, Appendix X, thereby validating acceptable performance of the foam plastic without a prescriptive ignition barrier. Testing, modeling and analysis must consider the following:

- Minimum and maximum thickness of foam plastic.
- Room geometry, including volume (minimum and maximum), shape and roof slope.
- Potential fire sources.
- Effect of openings to the attic space, including, but not limited to, the attic entry, direct venting for appliances and unintended openings.
- Comparable performance with systems that meet the requirements of AC377, Appendix X.

111

Foam plastic code compliance

1. Foam plastics when tested in a thickness of 4 inches may be used in a thickness up to 10 inches when the building is equipped with an approved automatic fire suppression system.
2. For use in rooms within buildings, this requirement shall apply to both the room and that part of the building in which the room is located.
3. This applies mostly to commercial buildings, but some limited-area sprinkler systems in residences may be compliant. Always ask the code official before counting on it!

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Fire Testing: Surface Burning

- ASTM E84 Tunnel Test Apparatus
  - 25’ x 2’ x 2’ tunnel
  - 4” material thickness limitation
  - Flame spread index (FSI)
  - Smoke-developed index (SDI

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Foam plastic code compliance

§2447-B. (4) Foam plastic insulation having a flame spread of 25 or less may be used in a thickness of not more than 4 inches without the thermal barrier when the foam plastic is covered by a metal facing not less than 0.032 inch thick aluminum or No. 26 gauge steel and the building is provided with an automatic fire suppression system.

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Foam plastic code compliance

§2447-B. (5) Foam plastic may be used in a roof covering assembly without the thermal barrier when the foam is separated from the interior of the building by plywood sheathing not less than 1/2 inch in thickness bonded with interior glue, with edges supported by blocking, tongue-and-groove joints or other approved type of edge support, or an equivalent material.

- Foam plastic roof insulation that complies with Factory Mutual Standard 4450 or Underwriters Laboratories Subject 1256 need not meet the requirements of this paragraph.
- For roofing applications, the smoke-developed rating shall not be limited.

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AC-377

As an alternative, the prescriptive 15-minute or ignition barrier shall not be required when satisfactory testing is conducted with exposed foam plastic insulation or with a foam plastic insulation system, such as foam plastic insulation covered by a coating, in accordance with either Appendix A1.0 or Appendix X of this criteria. This is subject to AHJ approval.

116

What is a 15-minute thermal barrier?

Non-prescriptive or equivalent/alternative coatings or coverings

Product-Specific Assemblies must be tested:

- Coating/Covering Brand A applied to Foam Brand B

Handout – AY-126ThermalBarriersforSPFDec2011.pdf

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Fire Testing: Room-Corner

118

The large-scale testing process

Safety First

BUILDING CODE REQUIREMENTS FOR SPF FIRE SAFETY: INTERIOR APPLICATIONS IN OCCUPIED SPACES

By John Stahl

Spray polyurethane foam (SPF) is becoming the popular choice for insulation in buildings for its high thermal efficiency, excellent water vapor and air barrier performance, its seamless quality, and its ability to be installed in locations with limited access.

Along with SPF application comes building code requirements and fire safety tests. I speak daily to architects, engineers, building code officials, contractors, building owners, and even representatives of SPF manufacturers, many of whom do not have a clear understanding of the building code requirements and the test data necessary to show building code compliance. Compliance with building codes and required fire tests must be achieved to provide adequate safety and to avoid liability.

In my experience, determination of code compliance of SPF can be narrowed down to five essential questions for each specific project:

1. What are the code requirements?
2. What fire tests does the code require?
3. Is the data in the fire test reports relevant to the proposed use?
4. Were the fire tests conducted by an organization accredited to conduct the specific tests?
5. Are the products listed and labeled by an organization accredited to perform third-party inspections of the manufacturer's facilities?

These five questions will be covered here for interior applications in occupied spaces.

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Fire Testing: Room-Corner

120

What is a 15-minute thermal barrier?

Non-prescriptive or equivalent/alternative coatings or coverings

Product-Specific Assemblies must be tested:

- Cladding materials that have been tested

121

Tested products

"Thermax" is one of the few RFBs rated for exposed applications

Most foil-faced RFBs are not rated for exposed applications and require protection

122

Product-specific Assemblies or Systems

Rated for exposure in occupied spaces – foam and coating system

B&M Factory – Portland, ME

Before and after

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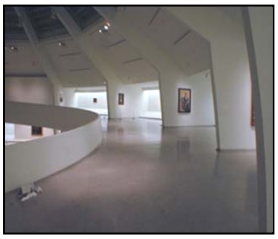
Plaster as a Thermal Barrier in NYC



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Plaster as a Thermal Barrier in OH

- Injection, cavity fill, Poured in place , FIP, IPF

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Where aren't 15-minute thermal barriers required?

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Open floors under structures on stilts

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Exceptions – Specialty Approved Foams

Attic application

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Ignition Barriers

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What is an ignition barrier?

Ignition barriers are intended to prevent foam from reaching flash-over for the minimum time provided by prescriptive ignition barriers. When designing the test, the time chosen was 4:18, which is equivalent to when wood paneling (the worst prescriptive ignition barrier) reached flash over.

- Ignition barriers protect against auto-ignition (650-800°F).
- Ignition barriers (Pass/Fail criteria = 4 minutes 18 seconds) - Modified NFPA 286.

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What are protect from ignition barriers?

Prescriptive ignition barriers for attics and crawl spaces (R316.5.3, R316.5.4)

- All 15-minute thermal barriers
- 1-1/2" Mineral fiber insulation
- 1/4" Plywood
- 3/8" particleboard
- 1/4" hardboard
- 3/8" gypsum board
- .016" corrosion-resistant steel
- 1-1/2" Cellulose - attic floors (Attics only – new in 2012)

Alternative Ignition Barrier Assemblies by Special Approval Testing

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What is an Ignition Barrier?

- Special Approval Tests for Alternative Ignition Barrier Assemblies [IBC 2603.9 / IRC R316.6]
  - Uses the same room-corner burn tests as a thermal barrier
  - Special End-use fire tests
    - Must have equivalent performance to ¼" plywood
    - AC-377 Appendix X Test for SPF in crawlspaces and under roof decks in unvented attics since June 2009 (1)
    - ASTM E970 Radiant Heat Flux Test for SPF on attic floors since June 2011

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Ignition barriers

Why are there so few IB tests?

- Most foam manufacturers make foam that is approved to be left exposed in attics, so why use ignition barriers?
- Some manufacturers are uncomfortable with what may happen with intumescent barriers that have only been tested for 4:18.
- Why 4:18?

International Fireproof Technology, Inc.

DC315's" Testing Matrix

Paint to Protect™

PAINT TO PROTECT DC315 THE PROOF IS IN THE TESTING

www.painttoprotect.com

All tests are full scale tests and meet the applicable requirements of 2006 IBC Section 803.2.1 / 2009 IBC Section 803.1.2 & Section 2603.9 / 2012 IBC Section 803.1.2 & Section 2603.10; Special Approval for Thermal Barrier Alternatives. DC315 also meets the requirement as an Ignition Barrier per AC 377, Appendix X at an incredible spread rate of 400 sq. ft. per gallon.

Thermal Barrier	Wet mils	Dry mils	Coverage Rate	Test Facility Date No.	ESR No.
Arnette Agriculture Base CC 2 lb.	20	13	80 sq. ft. per gal	Intertek, 11/01/09, 3172697SAT-001-A	
BASF Enertite OC 0.5 lb.	21	13	76 sq. ft. per gal	Intertek, 08/06/10, 100128343SAT-012A	ESR-3102
Baysystem BaySeal™ OC 0.5 lb.	22	14	73 sq. ft. per gal	Intertek, 10/26/10, 100208492-001A	
Baysystem BaySeal™ CC 2 lb.	18	12	88 sq. ft. per gal	Intertek, 10/02/09, 3172697SAT-001-C	
Dow Styrofoam CM 2045 CC 2 lb.	18 DC315 4 primer	12 DC315 2 primer	88 sq. ft. per gal 400 sq. ft. per gal	Intertek, 11/22/10, 100224983SAT-002	ESR 1659
Icynene MDC 200 CC 2 lb.	22	14	73 sq. ft. per gal	Intertek, 11/01/09, 3172697SAT-001-A	ESR-3199
Icynene LD_C_50 OC 0.5 lb.	20	13	80 sq. ft. per gal	Intertek, 10/27/10, 100208427SAT-001	ESR-1826
Lapolla FL 2000 CC 2 lb.	22	14	73 sq. ft. per gal	Intertek, 08/25/10, 100142290SAT-002	
Lapolla FL 500 OC 0.5 lb.	20	13	80 sq. ft. per gal	Intertek, 11/23/10, 100220191SAT-022A	
NCFI Sealite™ OC 0.5 lb.	22	14	73 sq. ft. per gal	Intertek,08/10/10,100102948SAT-00A	ESR-1154
NCFI InsulStar® CC 2 lb.	21	13	76 sq. ft. per gal	Intertek, 11/22/10,100220209SAT-002B	ESR-1615
Gaco Western 183M CC 2 lb.	22 DC315 6 primer	14 DC315 4 primer	73 sq. ft. per gal 267 sq. ft. per gal	Intertek, 05/11/11,100339765SAT-001Rev_1	
GacoFire Stop 5500 OC 0.5 lb.	22	14	73 sq. ft. per gal	Intertek, 08/23/11, G100366148SAT-019	
Gaco Green 052N, OC 0.5 lb.	20	13	80 sq. ft. per gal	Intertek, 03/13/12, G100560435SAT-001A	
Corbond MCS™ CC 2lb.	22	14	73 sq. ft. per gal	Intertek	ESR-3159
Corbond OC 0.5 lb.	22	14	73 sq. ft. per gal	Intertek, 06/25/11, 100208492-001A	
Corbond ccSPF™ CC 2 lb.	22	14	73 sq. ft. per gal	Intertek	ESR-3287
Quadrant, Quadfoam 2 lb. CC	22	14	73 sq. ft. per gal	Intertek, 08/13/11, 10040285SAT-001A	
SWD-QuikShield 106 OC 0.5 lb.	24	15	67 sq. ft. per gal	Intertek, 03/07/11,100312665SAT-004B	
SWD-QuikShield 112 CC 2 lb.	22 DC315 4 primer	14 DC315 2 primer	88 sq. ft. per gal 400 sq. ft. per gal	Intertek, 03/07/11,100312665SAT-004A	
Ignition Barrier	**Wet mils**	**Dry mils**	**Coverage Rate**	**Testing Facility and Date**	**ESR No.**
CertainTeed, CertaSpray OC 0.5 lb.	4	3	400 sq. ft. per gal	Intertek, 03/25/12,G100458433SAT-001C	
Gaco Green 052N, OC 0.5 lb.	4	3	400 sq. ft. per gal	Intertek, 03/25/12,G100560435SAT-001B	
Henry PERMAX OC 0.5 lb.	4	3	400 sq. ft. per gal	Intertek, 03/14/12,G100552052SAT-001A	
Icynene, LD_C_50 OC 0.5 lb.	4	3	400 sq. ft. per gal	Intertek, 03/07/11, 100379548SAT-002	ESR 1826
Icynene, LD_R_50 OC 0.5 lb.	4	3	400 sq. ft. per gal	Intertek	ESR 2715
Icynene, MD-R-200 CC 2 lb.	4	3	400 sq. ft. per gal	Intertek, 03/29/12,100648084SAT-008A	
Lapolla, FL 500 OC 0.5 lb.	4	3	400 sq. ft. per gal	Intertek, 03/07/11,100458411SAT-001A	
Quadrant, QuadFoam CC 2 lb.	4	3	400 sq. ft. per gal	Intertek, 08/31/11,100460285SAT-001A	
Quadrant, Quadfoam 500 OC 0.5 lb.	4	3	400 sq. ft. per gal	I Intertek, 08/31/11,100460285SAT-001B	

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Barrier Questions

1. What is the difference between a thermal barrier and an ignition barrier?
   - TBs provide time to escape a fire, IBs prevent a fire from igniting. The test methods for products are also different.
2. Can I spray on intumescent coatings myself?
   - Yes, but the manufacturer may have qualification/training requirements.
3. There's also been mention of the use of fiberglass batts as an ignition barrier…… True?
   - True, 1 ½" mineral fiber is a prescriptive ignition barrier. 2" cellulose is also an IB in AHJs that have adopted the 2012 IRC or later versions.

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Where aren't 15-minute thermal barriers required?

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Where aren't 15-minute thermal barriers required?

Single-family and low-rise multifamily residences

- Occupied spaces with prescriptive approved assemblies
  - Wall, Floor, or Roof (R316.5.1)
    - 1" Masonry or concrete construction
  - Roof decks (R316.5.2 per R803)
    - 15/32" T&G wood planks
    - 15/32" Wood structural panel sheathing
- Prescriptive approved assemblies
  - Floors – ½" wood structural panel (316.5.13)
- Unoccupied spaces
- Sill plates and headers
- Note: some states may have exceptions to the ICC

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Where aren't 15-minute thermal barriers required?

Addition floor, no access under it.

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Foam interior trim

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When aren't thermal barriers required?

Specific approved products or systems that don't require a thermal barrier:

- Great Stuff Fireblock
- Dow Froth Pak
- PSI One Step

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Exceptions – Specialty Approved Foams

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Exceptions – Specialty Approved Foams

Attic application

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Foam and the codes FAQ to the ICC

- Do the protection requirements for bulk foam apply to foam sealants? "Yes, all foam plastic products must be protected, including all types of rigid foam board."
- Follow-up question posed to the ICC: Foam sealants are typically only used to fill cracks and seal penetrations; but, when they are used to seal top plates or rim joists, the application may be wider and thicker than the term "sealant" would seem to imply. Where is the line between foam sealants and foam plastic insulation?
- ICC - No response to where they would draw the line in real-world situations, but generally said "if it is foam plastic, it must be protected as such" (Dow Froth-Paks NFPA 286 tested).

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Posting of Code Compliance Material Documentation

Current model building codes also require an Energy/Installation Certificate. Typically, a copy of this certificate is provided to the building owner or general contractor/builder, and a copy is left in a conspicuous location in the building (e.g., near the main electrical panel or in the utility room). The building owner may need to provide this to code officials, energy raters, or home performance contractors for verification of the work done.

As part of the post-installation inspection report, the SPF contractor typically provides certain documentation to the building owner. Some of the documentation is required by federal, state, or local ordinances or codes.

Guidance on Best Practices for the Installation of Spray Polyurethane Foam, Spray Foam Coalition of the ACC Center for the Polyurethanes Industry - Handout

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R-value and product records

N1101.14 (R401.3) Certificate (Mandatory)
This section specifically is from the 2015 IRC but this requirement has been around since at least 2009.
A code-required permanent insulation certificate is required. The 2015 IRC version of this code requirement can be found in N1101.14 (R401.3) Certificate (Mandatory).

N1101.14 (R401.3) Certificate (Mandatory).
A permanent certificate shall be completed by the builder or registered design professional and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall list the predominant *R*-values of insulation installed in or on ceiling/roof, walls, foundation (slab, basement wall, crawl space wall and/or floor) and ducts outside conditioned spaces; *U*-factors for fenestration and the solar heat gain coefficient (SHGC) of fenestration, and the results from any required duct system and building envelope air leakage testing done on the building. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the types and efficiencies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall list "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be *listed* for gas-fired unvented room heaters, electric furnaces or electric baseboard heaters.

Ultimately, code compliance is the responsibility of the builder or registered design professional, but my opinion is that as experts in their field, to provide good customer service, the trades should provide the information relevant to their scope of work.

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Residential ventilation standards

- ANSI/ASHRAE Standards 62.1-2016 and 62.2-2016 are written in enforceable language to facilitate adoption into the codes.
- These are standards for fresh air volumes.

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Foam inspections – Code compliance

- Verify that the product is code compliant in the AHJ and the climate zone
- Identify the fire protection requirements for each location where foam is used
- Determine if a third-party 1705 coating and bonding inspection is required

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Best Practices for Understanding, Diagnosing, and Avoiding Problems in Polyurethane Foam Installations

www.phrc.psu.edu

QUESTIONS?

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