Intumescent Coatings and Spray Polyurethane Foam

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What is an Intumescent Coating?

• Intumescent (definition): Swelling and charring when exposed to flame.
Building Code Definition:

INTUMESCENT FIRE-RESISTANT COATINGS. Thin film liquid mixture applied to substrates by brush, roller, spray or trowel which expands into a protective foamed layer to provide fire-resistant protection of the substrates when exposed to flame or intense heat.

[2012 IBC, Sect. 202]
Effect in a Fire: The swelling and char insulate substrates with a relatively inert foam matrix.
A Little Demo…

Courtesy of Flame Seal
Intumescent over SPF

- Thermal Barriers
- Ignition Barriers
Thermal Barrier Rule:

2603.4 Thermal barrier. Except as provided for in Sections 2603.4.1 and 2603.10, foam plastic shall be separated from the interior of a building by an approved thermal barrier of \( \frac{1}{2} \)-inch (12.7 mm) gypsum wallboard or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275. Combustible concealed spaces shall comply with Section 718.
Special Approval

2603.10 Special approval. Foam plastic shall not be required to comply with the requirements of Sections 2603.4 through 2603.8 where specifically approved based on large-scale tests such as, but not limited to, NFPA 286 (with the acceptance criteria of Section 803.2), FM 4880, UL 1040 or UL 1715. Such testing shall be related to the actual end-use configuration and be performed on the finished manufactured foam plastic assembly in the maximum thickness intended for use. Foam plastics that are used as interior finish on the basis of special tests shall also conform to the flame spread and smoke-developed requirements of Chapter 8. Assemblies tested shall include seams, joints and other typical details used in the installation of the assembly and shall be tested in the manner intended for use.
Thermal Barrier Choices:

- Prescriptive: \(\frac{1}{2}\)-inch gypsum wallboard
- Exceptions: (ten total)
- Equivalents
- Alternatives
TB Exceptions:

- Ten total; those commonly encountered on SPF projects are:
  - Masonry / concrete construction
  - Roofing
  - Attics / crawlspaces (Ignition Barriers)
  - Sill plates & headers in Type V Constr.
TB Equivalents

- Must insulate the SPF from heat for 15 min. (Max. temperature rise of 250° F)
- Must withstand fire exposure under use conditions
- NFPA 275
- Examples:
  - Cellulosic TBs
  - Cementitious TBs
TB Alternatives

- Any “system” that passes a code approved large or small room corner test [2012 IBC, Sect. 2603.10]
- NFPA 286; FM 4480; UL 1040; UL 1715
- Essentially: No flashover after 15 min.
- Examples:
  - Intumescent coated SPF
  - Bare SPF?
  - Sheet goods? Membranes?
Thermal Barrier Recap

- **Prescriptive**
  - \(\frac{1}{2}\)-inch gypsum wallboard
- **Exceptions**
  - Attics & crawls spaces (ignition barriers)
  - Others
- **Equivalent**
  - Cellulosic, cementitious, etc.
- **Alternatives**
  - Tested “systems”
Where do Intumescent Coatings fit in?

- **Thermal Barriers**
  - Qualified as ALTERNATIVES
  - Intumescent coatings are NOT thermal barriers

- **Ignition Barriers**
  - For use in Attics and Crawl Spaces ONLY
  - Thermal barrier exception
Intumescent Coating Testing

• For Thermal Barrier or Ignition Barrier use, Intumescent Coatings are qualified under the Special Approval section of the building code [2012 IBC Sect. 2603.10]
Alternative System Testing (Thermal Barriers)

- Small Room Corner Test
- NFPA 286; FM 4480; UL 1040; UL 1715
- Essentially: No flashover after 15 min.
Alternative System Testing (Ignition Barriers)

- AC377 Appendix X
- Modified NFPA 286
  - Test is run for 4 min 18 sec instead of 15 min
  - Otherwise, the same as TB alternatives
- Essentially: No flashover after 4:18
Intumescent Coatings over SPF have qualified as BOTH alternative TB and IB systems.

Typically, TB systems require greater coating thickness than IB systems.
Intumescent Coating Characteristics

- Water-based (most)
  - may be 2-component
- Spray, brush or roller
- Typical thicknesses:
  - Thermal Barrier: ~ 18 – 25 mils WFT
  - Ignition Barrier: ~ 4 – 12 mils WFT
Thicknes Measurement

- What’s a “mil”?  
  - 1/1000 of an inch
- WFT: Wet film thickness
- DFT: Dry film thickness
- Application / Coverage rates
Thickness (continued)

- AC377 requires that fire resistant coatings be reported three ways on Evaluation Reports:
  - WFT (wet film thickness)
  - DFT (dry film thickness)
  - Application rate (gallons / ft$^2$)
Thickness (continued)

- Converting WFT to DFT to Appl Rate

\[
\text{DFT} = \text{WFT} \times (\% \text{ solids by vol})
\]

\[
\text{WFT} = \frac{\text{DFT}}{(\% \text{ solids by vol})}
\]
Thickness (continued)

- Actual Application Rate vs Theoretical Application Rate
  - Spills
  - SPF surface texture
  - Overspray
  - Cleanup and residuals
- Losses may add 25% or more
Spray Polyurethane Foam
Estimating Reference Guide

Spray Polyurethane Foam Alliance
Copyright 1994, Revised 6/2004

To order copies of this publication, call 800-523-6154 and request
Stock Number AY-121.
### SPF Estimating Reference Guide

#### Theoretical Coating Requirements

- **NOTE:** Increase these quantities for losses and surface texture.

<table>
<thead>
<tr>
<th>SPF Estimating</th>
<th>3.0</th>
<th>3.4</th>
<th>3.0</th>
<th>3.4</th>
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</thead>
<tbody>
<tr>
<td>SPF Type</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>SPF Coating</td>
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<td>0.02</td>
<td>0.03</td>
<td>0.04</td>
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<tr>
<td>SPF Volume</td>
<td>0.05</td>
<td>0.06</td>
<td>0.07</td>
<td>0.08</td>
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<tr>
<td>SPF Weight</td>
<td>0.09</td>
<td>0.10</td>
<td>0.11</td>
<td>0.12</td>
</tr>
</tbody>
</table>

#### Traditional SPF Roofing

- Use in various thicknesses to achieve desired R-value.
- SPF has 100% solar reflectance.
- SPF has 100% solar absorbance.
- SPF has 100% solar transmittance.

<table>
<thead>
<tr>
<th>SPF Qty</th>
<th>SPF Type</th>
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<th>SPF Coating</th>
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<tbody>
<tr>
<td>0.10</td>
<td>A</td>
<td>0.01</td>
<td>3.0</td>
</tr>
<tr>
<td>0.20</td>
<td>B</td>
<td>0.02</td>
<td>3.4</td>
</tr>
<tr>
<td>0.30</td>
<td>C</td>
<td>0.03</td>
<td>3.0</td>
</tr>
<tr>
<td>0.40</td>
<td>D</td>
<td>0.04</td>
<td>3.4</td>
</tr>
</tbody>
</table>

#### Traditional SPF Roofing Estimating

- SPF Estimating
- SPF Coating
- SPF Volume
- SPF Weight

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<td>0.12</td>
</tr>
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Estimating Application Rates

1. Calculate a theoretical rate based on specified film thickness (wet or dry) and the % solids by volume.

2. Apply a loss factor to account for surface texture, overspray, spillage and residuals.
Measuring Coating Thickness

- Accurately measuring thin coating application on textured SPF surfaces is difficult.
- Optical Comparator method (dry)
- Medallion method (wet)
MEASURING COATING THICKNESS WITH THE OPTICAL COMPARATOR

Edmund Scientific
Stock No. 30-169
Edmund Scientific Comparator
(the scale on other optical comparators may vary from that shown)

Use the scale.

40 mils
10 mils
2
1

Each fine division on the scale equals 5 mils.

Cut two (2) samples at random locations, within 24 inches of the burner corner, approximating the size shown below. Fill the resultant holes with a non-flammable caulk or sealant.

Focus the eyepiece and hold scale against sample.

Measure coating thickness at four random locations, on each of two (2) samples, avoiding thinnest and thickest spots. Average the eight (8) measurements to calculate an average coating thickness.
Measuring Microscope

DL1
L=5.131 mil

DL0
L=8.665 mil

DL2
L=10.123 mil
Measuring Microscope

DL0
L = 5.187 mil

DL1
L = 7.272 mil

DL2
L = 5.172 mil
Medallion Method

1. Install “medallions” on SPF surface prior to spraying coating
2. Use a wet film gauge to measure coating thickness
SPFA Installation Certificate

- SPFA Building Envelope Committee has drafted an insulation Installation Certificate.
- Bldg Codes (IRC & IECC) require jobsite labeling of insulation.
- SPFA form includes insulation and fire protective materials (e.g., TB and IB coatings)
The following spray polyurethane foam insulation systems above have been installed in accordance with manufacturer's installation guidelines regarding proper fire protection:

### SECTION C: Fire Protection

<table>
<thead>
<tr>
<th>Insulated Area</th>
<th>Product (Manufacturer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attic Floor</td>
<td></td>
</tr>
<tr>
<td>Underside of Roof Deck</td>
<td></td>
</tr>
<tr>
<td>Attic Walls (vertical)</td>
<td></td>
</tr>
<tr>
<td>Sloped (Cathedral)</td>
<td></td>
</tr>
<tr>
<td>Above-Grade Walls</td>
<td></td>
</tr>
<tr>
<td>Location:</td>
<td></td>
</tr>
<tr>
<td>Above-Grade Walls</td>
<td></td>
</tr>
<tr>
<td>Location:</td>
<td></td>
</tr>
<tr>
<td>Below-Grade Walls</td>
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<tr>
<td>Below-Grade Walls</td>
<td></td>
</tr>
<tr>
<td>Floors over heated</td>
<td></td>
</tr>
<tr>
<td>Crawlspace Perimeter</td>
<td></td>
</tr>
<tr>
<td>Location:</td>
<td></td>
</tr>
<tr>
<td>Below Slab</td>
<td></td>
</tr>
<tr>
<td>Other (describe)</td>
<td></td>
</tr>
<tr>
<td>Other (describe)</td>
<td></td>
</tr>
</tbody>
</table>

1. If area is not insulated, enter "NONE" under product info.
2. Must include manufacturer and product name, should include batch or lot number if available.
3. Nominal thicknesses are representative of field, spray

### SECTION D: Installer Declaration

I hereby certify that I have installed the listed spray foam thermal insulations and fire protection per manufacturers’ installation instructions and product listings, and in a manner compliant with local building codes in effect at the time of installation.

Lead Installer: Name (print): ______________ SPFA Certification (opt) ______________

Signature: ___________________________ Date: ______________

SPFA Spray Polyurethane Foam Insulation Model Certificate

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Summary

1. Definition
2. Effect in fires
3. Building Code requirements for Thermal Barriers / Ignition Barriers
4. Application methods
5. Thickness and use calculations
6. Measurement techniques
QUESTIONS?