The Spray Foam Coalition (SFC) champions the use of spray polyurethane foam in U.S. building and construction applications and promotes its economic, environmental and societal benefits while supporting the safe manufacture, transport, and application of spray polyurethane foam. SFC consists of manufacturers of spray polyurethane foam systems as well as suppliers of raw materials and machinery used to apply the foam.
Overview

1. Design Considerations
2. Initial Evaluation (Test-In)
3. Jobsite Preparation and Safety Considerations
4. Application Techniques
5. Final Evaluation (Test-Out)
Disclaimer

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1. Design Considerations

Questions

• Why Unvented Attics (UVA)?
• Why SPF?
• Asphalt Shingle Considerations
• Water Leakage and Detection Considerations
• Fire Safety Issues to Consider
• LD and MD SPF Attributes?
• HVAC and Ventilation Considerations
1. Design Considerations

Why Unvented Attics (UVA)?

1. Places HVAC ducts and equipment inside conditioned building space
   • Operate under more moderate temperatures
   • Keeps leaky ductwork inside envelope
   • Reduces potential for condensation during cooling season

2. Reduces building air leakage

3. Provides additional conditioned space for storage (with approved thermal barrier)

4. Avoids issues with recessed lighting in ceiling

NOTE: Energy losses proportional to roof area, not attic volume
1. Design Considerations

Why SPF for UVA?

1. Air-Impermeable
   • Meets code requirements for insulation in contact with roof deck

2. Remains in-place
   • Adhesively bonds to all surfaces
   • Does not sag or settle

3. Structural benefits
   • Wind uplift resistance from reduced depressurization (MD and LD SPF)
   • Racking resistance and mechanical adhesion of roof deck (MD SPF)

4. Water resistance
   • MD-SPF may provide a secondary water barrier
   • LD-SPF promotes interior drying
1. Design Considerations

Asphalt Shingles Considerations

Any insulation under roof deck increases shingle temperature according to FSEC Study*

- Other significant factors: shingle color, latitude, slope, orientation,
- 7-10°F increase typical in FL
- Insulation has minimal impact on service life (1-2 years on 30-year shingle)

Review manufacturer’s shingle warranty for information on permitting roof deck insulation

1. Design Considerations

Water Leakage and Detection

Many roof water leaks occur at flashings and penetrations
- These leakage sources are generally not concealed by SPF
- Easy to locate

Field Leaks (away from flashings) are not as common
- Leak location possible for LD-SPF
- Water will not pass through MD-SPF
- Recent study shows no additional damage to plywood decking beyond that from a normal water leak*

* Research project in progress at University of Florida (Dr. D. Prevatt)
1. Design Considerations

Fire Safety to Consider

SPF is combustible like other organic materials commonly used in building

Building codes require protective coverings over all foam plastic insulations in attic spaces

- 15-minute thermal barrier or other approved material over foam when attic is used other than for ‘service of utilities’ (e.g., for storage or occasional occupancy)
- Ignition barrier or other approved material over foam in limited-access attics
- Product-specific assembly testing to allow unprotected foam is possible.
- See the building code in your area for more detailed information
1. Design Considerations

HVAC and Ventilation Considerations

Creating an unvented attic (UVA) with SPF can:
- Reduce uncontrolled air leakage through building envelope
- Lower HVAC energy costs from reduced air leakage and improved insulation performance
- Allow the HVAC system inside the building envelope to operate in more moderate temperatures

Most HVAC systems are oversized to account for excess air leakage.
- This affects the energy efficiency as well as effectiveness of moisture removal (dehumidification)
- With SPF, the opportunity exists to downsize (or “rightsize”) the HVAC system for better performance.

Adjustments or downsizing of HVAC system may be needed:
- Good IAQ
- Mechanical ventilation or ERV/HRV
- Avoid short-cycling of AC system for proper dehumidification
- Supplemental humidification/dehumidification to control relative humidity
1. Design Considerations

Low-Density and Medium-Density SPF Attributes

Both product classes are suitable in any climate zone when vapor retarder requirements are met.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Importance</th>
<th>LD-SPF</th>
<th>MD-SPF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tight Clearance (e.g., ice damming, shallow rafters)</td>
<td>Cold Climates</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Wind Uplift / Water Barrier</td>
<td>Hurricanes</td>
<td>✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>Integral Vapor Retarder</td>
<td>Cold Climates</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Water Resistance</td>
<td>Secondary Water Barrier</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Vapor Permeable</td>
<td>Promotes Drying in Hot Climates</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
1. Design Considerations

Code Compliance Considerations

- UVA Permitted by Code?
- Insulation Levels (R-Value)
- Vapor Retarder Needed?
- Fire Protection Needed?
1. Design Considerations

Unvented Attics Permitted?

Since 2006, UVAs (aka *Conditioned Attics*) are permitted in the International Residential Code (IRC)

- Requirements per 2006 and 2009 IRC Section R806.4; 2012 IRC Section 806.5
- Under consideration for 2015 IBC
- Includes air-impermeability requirements and certain limitations for insulations
- IRC and IBC are *model* codes that require adoption by state or local jurisdictions

Confirm that UVAs are included in State/Local Code

- Work with builder/homeowner to confirm state/local codes through local code office
1. Design Considerations

Insulation Levels

Minimum ceiling insulation levels are provided by International Residential Code (IRC), International Energy Conservation Code (IECC) and ASHRAE 90.1

- R-value minimum / U-value maximums prescribed in code
- Levels can depend on climate zone and version of code adopted by local jurisdictions
- Discuss current local code requirements with customer
- Lower ceiling/attic R-values can be permitted under performance path designs

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4AB</th>
<th>5+4C</th>
<th>6</th>
<th>7+8</th>
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<tr>
<td>R-value min</td>
<td>R30</td>
<td>R38</td>
<td>R38</td>
<td>R38</td>
<td>R49</td>
<td>R49</td>
<td>R49</td>
</tr>
<tr>
<td>U-value max</td>
<td>0.035</td>
<td>0.030</td>
<td>0.030</td>
<td>0.030</td>
<td>0.026</td>
<td>0.026</td>
<td>0.026</td>
</tr>
</tbody>
</table>

From Tables R402.1.1 and R402.1.3 of 2012 IECC for standard truss attics. Wrapping top chord / rafters will provide some continuous insulation and can reduce these prescriptive levels. Refer to code.
1. Design Considerations

Vapor Retarders Needed?

Vapor retarders can prevent condensation on underside of roof deck, particularly in colder climates

- Class I or II vapor retarders required in IECC Climate Zones 5-8 and Marine 4
- 2” or more MD-SPF inherently provides vapor retarder per ASTM Standard
- LD-SPF may need supplemental vapor retarder on warm-in-winter side
- Supplemental vapor retarders include:
  - Plastic films
  - Certain paints
  - Do not use vapor retarding paints under fire protective coatings unless the configuration has been fire tested. Check with coating manufacturer.
1. Design Considerations

Fire Protection

For easy access attics or those used for storage, foam surface must be covered with a:

- Prescriptive **15-minute thermal** barrier (1/2” gypsum), or
- Equivalent 15-minute thermal barrier coating or covering
- Approved assemblies and interior finishes meeting certain fire test requirements
- May include uncovered foams

For attics with limited access for service of utilities (NO storage), foam surface must be covered with a:

- Prescriptive **ignition barrier**, or
- Alternate ignition barrier assembly tested per AC-377 Appendix X, or A1.0
- Uncovered foam OK if it passes AC-377 Appendix X
- 15-minute thermal barrier between attic and interior spaces (e.g. finished ceiling of top floor) is still required
- No covering needed for small inaccessible areas such as above collar ties and behind kneewalls
2. Initial Evaluation (Test-In)

Complete Evaluation of Existing Home before Installation

Items to address and check can include:

• Air Leakage Testing
• Existing Attic Insulation
• Inspection of Related Systems
• Combustion Appliances
• Safe Access
• Energy Savings Estimate
• Trained Professionals (BPI and RESNET)
2. Initial Evaluation (Test-In)

Air Leakage Testing

Perform a blower door test on existing homes before and after SPF installation

• Evaluate air leakage and natural ventilation before SPF application
• Use as baseline for quality check and energy savings estimate

Courtesy NREL PIX
2. Initial Evaluation (Test-In)

Existing Attic Insulation

Best practice is to remove existing attic floor insulation wherever practical per 2012 IRC

- Potential source of odor in older homes
- Contributes to potential condensation in attic if left in place, esp. in colder climates
2. Initial Evaluation (Test-In)

Inspection of Related Systems

Perform a thorough inspection of existing systems in the attic space

- Plumbing (no open vent stacks)
- Ductwork (check connections, leaks)
- Wiring (mark junction boxes)
- Ventilation (bathroom vents properly routed)
- Combustion Appliance Ventilation
- Condition of Roof Deck (leaks, mold)
- Non-compliant insulations
- Environmental Hazards

Reducing air leakage in a home can exacerbate other existing problems

Advise building owner of repairs prior to SPF application

“Do No Harm”
2. Initial Evaluation (Test-In)

Safe Access Considerations

Identify safe access to and from attic
- Trip hazards
- Fall-through hazards
- Overhead hazards
- Confined spaces
- Emergency egress

Include evaluation in safety plan and correct conditions where possible
2. Initial Evaluation (Test-In)

Combustion Appliances

Combustion appliances are any devices in the home that burn fuel, including:
- Gas, propane or oil fired heaters and fireplace inserts
- Gas or propane dryers and hot water heaters
- Fireplaces and wood burners
- Kerosene space heaters
- Gas or wood fired ranges and ovens

Improving air tightness can eliminate supplier air and adversely affect ventilation of combustion appliances:
- Many buildings may have existing problems
- Air sealing increases conditions for backdrafting
- Excessive backdrafting can result in dangerously-high CO levels

Do not improve air sealing of home if any UNVENTED combustion appliances are being used.
2. Initial Evaluation (Test-In)

**Energy Savings Estimate**

Help set savings expectations for your customers.

- Evaluate current windows, doors, insulation, HVAC, appliances, lighting
- Use residential energy modeling software to evaluate energy savings from UVA

This is good practice.
2. Initial Evaluation (Test-In)

Trained Professionals

Initial evaluation requires experience, training and specialized equipment
  • Become trained or
  • Hire a professional weatherization expert to perform this evaluation

Examples of weatherization training and professionals
  • Building Performance Institute (BPI) Building Analyst
  • RESNET HERS Rater - EnergySmart Contractor

Check tax incentive and rebate programs
  • Some programs require participation by a certified weatherization professional
3. Jobsite Preparation and Safety Considerations

Safe Workplace Considerations

- Ingress/Egress
- Walking Surfaces
- Lighting
- Isolation, Ventilation and Containment
- Personal Protective Equipment
- Fire Extinguishers and Spill Kits
- Re-Entry Time
- Adjacent Areas

Jobsite Considerations

- Vehicle Parking
- Hose Path
- Attic Clear
- Clean Substrates
- Surface Protection
- Cover Soffits and Attic Vents
3. Jobsite Preparation and Safety Considerations

Ingress/Egress Considerations

- Use proper ladders to access attic hatch
- Have a plan for emergency evacuation
- Properly address confined spaces

(refer to SFC Installation Guidance)
3. Jobsite Preparation and Safety Considerations

Walking Surfaces

• Avoid walking on attic floor joists
• Set up temporary walkways over open joists
• Remove or clearly mark trip hazards
• Clearly mark overhead hazards
3. Jobsite Preparation and Safety Considerations

Lighting

• Provide adequate lighting in all parts of attic
• Minimizes trips and falls
• Improves quality of work
3. Jobsite Preparation and Safety Considerations

Ventilation and Containment

- Attics generally have poor natural ventilation

- As job progresses, natural ventilation decreases

- Use proper workspace ventilation techniques per EPA Design for the Environment:


- Includes supply and exhaust ventilation, with exhaust rate > supply rate (negative pressure)
3. Jobsite Preparation and Safety Considerations

Ventilation and Containment

- Shut down all HVAC systems and seal all attic openings to living space during application
- Vacate occupants during and for a period of time after application. Manufacturers typically have recommended re-occupancy times.

http://www.epa.gov/dfe/pubs/projects/spf/when_is_it_safe_to_re-enter_after_spf_installation.html
3. Jobsite Preparation and Safety Considerations

Personal Protective Equipment

- SPF application in attics is an interior application

- With little or no ventilation, attics will naturally contain and concentrate airborne SPF chemicals

- Complete skin, eye and respiratory protection (SAR) is required at all times by OSHA

- Use head, foot and ear protection as needed

- CPI publishes guidelines for what to consider when selection proper PPE at www.spraypolyurethane.org

- Refer to CPI’s Model Respiratory Protection Program at polyurethane.org
3. Jobsite Preparation and Safety Considerations

Fire Extinguishers

- SPF is a combustible material
- Unprotected SPF can be ignited by flame, sparks or heat from incandescent lighting
- SPF sprayed too thick, or too fast without cooldown between passes, can self-ignite
- Have type ABC dry chemical fire extinguishers present and readily accessible when spraying foam in an attic

Photo courtesy of InterNACHI
3. Jobsite Preparation and Safety Considerations

Vehicle Parking

• Safe for applicators
• Properly cordoned off

Hose Paths

• Chemical and SAR hoses through home
• Vent exhaust safely outside
3. Jobsite Preparation and Safety Considerations

Attic Clear

- Have homeowner make prior arrangements to clear attic
- Verify issues identified during Initial Evaluation have been addressed

Courtesy Building Performance Institute
3. Jobsite Preparation and Safety Considerations

Clean Substrates

- Check that surfaces to be sprayed are free of excessive dust and moisture
- Remove old insulation BEFORE spraying

Protect Surfaces

- Cover finished surfaces to protect from overspray
- Seal penetrations to occupied spaces below the attic
3. Jobsite Preparation and Safety Considerations

Block Soffits

- Install blocking to prevent foam from filling soffit area
- Install on exterior plane of wall for better performance by insulating over top plate

Photo courtesy of InterNACHI
3. Jobsite Preparation and Safety Considerations

Vented Roof Deck

- Install vent chutes from soffit to ridge vent if vented roof deck is needed
3. Jobsite Preparation and Safety Considerations

Cover Attic Vents

- Cover all gable and ridge vents prior to foam application
- Consider using fabric or foam board

Photos courtesy of InterNACHI
4. Application Techniques

Topics to Consider

• Exothermic Temperatures
• Adhesion
• Installed Thickness
• Picture Framing
• Bury Rafters
• Protective Coatings and Coverings
4. Application Techniques

Exothermic Temperatures

High pass thickness and quick successive passes can be a problem with MD-SPF.

Thick passes can generate excessive exothermic temperatures within MD-SPF.

Excessive exothermic temperatures can:

- Reduce performance → reduce energy savings
- Shrink, crack or delaminate → air leakage, moisture
- Cause incomplete reaction → persistent odors
- Char or self-ignite the foam → persistent odor, building fire

Always follow manufacturer’s installation instructions regarding maximum pass thickness and cooling time between passes.
4. Application Techniques

Adhesion

- Proper adhesion is a key to durability and long-term performance
- Check that substrate is clean and dry before application
- Check substrate moisture levels during application
- Check adhesion to avoid air pockets and hidden voids
4. Application Techniques

Picture Framing Spray Technique

• Minimize shrinkage issues (cracking and delamination) as well as air pockets or voids, especially with closed-cell SPF

• Surround perimeter of the stud or rafter cavity. Spray diagonally at the juncture of the stud and the substrate

• Consider applying to perimeter at ~100 sq.ft. at a time

• Return back to the start point to fill in the center of the cavity, using the maximum pass recommended by the manufacturer.

• Spray additional lifts or passes after the initial lift or pass has had adequate time to cool
4. Application Techniques

Installed Thickness Considerations

• Install foam to the thickness specified in contract and per manufacturer’s instructions

• Check local building codes for R-values permitted under performance path designs

• Guidance on thickness measurement techniques and frequency can be found in SFC’s SPF Installation Guidance available on polyurethane.org.
4. Application Techniques

Cover Rafters

- Confirm with homeowner that attic space will not be finished (e.g. gypsum wall board or other paneling installed)

- Covering underside of rafters provides a continuous layer of insulation, reducing thermal bridging and increasing thermal performance of roof assembly...and may allow reduced R-values for the rafter cavities
4. Application Techniques

Protective Coatings and Coverings

• Read ESR and/or Manufacturers Installation Instructions (MII) to determine if fire protection coatings are needed

• Install protective coverings or coatings over foam using product and thickness as specified by ESR/MII, or, if applicable, verify ESR/MII allows uncovered foam in the attic - based on specific product/assembly fire testing

• Do not mix or combine fire protective coatings with vapor retarder coatings, unless fire testing has been performed on this combination or permitted under MII

• Consider installing signs in attic regarding storage
5. Final Evaluation (Test-Out)

Complete Evaluation After Installation can include:

- Clean-Up
- Temporary Ventilation
- Air Leakage Testing
- Combustion Safety (CO Monitoring)
- HVAC Modifications
5. Final Evaluation (Test-Out)

Clean-Up and Shut Down

Remove all temporary protective coverings

Remove all items from premises before leaving
  • Foam scraps and dust
  • Consumables (jump suits, gloves, masking materials)
  • ALL chemicals and chemical containers

Temporary Ventilation

With attic closed-off, ventilate attic space for a period of time as specified by the manufacturer after installation to remove residual odors from foam and coatings

Photos courtesy of InterNACHI
5. Final Evaluation (Test-Out)

Air Leakage Testing suggestions

- Repeat blower door test after installation
- Inspect for air leaks in foam and repair
- Confirm energy savings projections

Combustion Safety

- Concurrent with blower door testing, conduct CO measurements of all combustion appliances

HVAC Modifications

- If application of SPF renders the home to be insufficiently ventilated, work with HVAC contractor to add mechanical ventilation or HRV/ERV.
SUMMARY

1. Design Considerations
2. Initial Evaluation (Test-In)
3. Jobsite Preparation and Safety Considerations
4. Application Techniques
5. Final Evaluation (Test-Out)
QUESTIONS

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