Advanced Best-Practices

Avoiding Problems in Foam Plastic Installation

Rick Duncan - Technical Director, SPFA
Introduction

- A safe, quality SPF installation occurs in five phases
- There are key steps in each phase that should be considered to reduce ‘call-backs’ for every installation
Introduction

- Use common sense
- Follow your company’s safety program
- Install product to meet local building code requirements
- Reference industry best-practices
- Follow Manufacturer’s Installation Instructions (MII)
Introduction

- Nearly all installation issues arise from not following MII and/or monitoring jobsite conditions.
- Keep out of trouble and always follow the MII.
Planning

- Planning
- Pre-Installation
- Installation
- Post-Installation
- Inspection
Customer Meetings

Meet with Customer to discuss all aspects of the project and set expectations

- Design Review
- Product Selection
- Documentation
- Jobsite Readiness
- Safety Plan
- Scheduling and Weather Contingency
- Inspection Criteria
Design Review

- Review Customer’s design regarding location and type of products specified
  - Architectural Details
  - Product Schedules

- Provide manufacturer TDS and SPF industry guidance
  - SPFA ‘AY’ documents
  - SFC Guidance Documents
  - Manufacturer Product Technical Data Sheets
Product Selection

- Agree on SPF type and product for each assembly to address
  - LOCAL Energy Codes
  - LOCAL Building Codes
  - Good Building Science Practices
  - Spray Conditions

**TIP:** Following the building code, even if not required for the project, is a good practice to ensure that installation meets current energy efficiency, fire safety and building science practices.
Provide the following for all SPF products:

- Manufacturer’s Installation Instructions
- Technical Data Sheets
- Code-Compliance Evaluation Reports
- Safety Data Sheets
- Manufacturer/Supplier Accreditation documents

Provide the following contractor information:

- Applicator Certifications and Contractor Accreditation documents
- Completed Jobsite Safety forms (EAP, FPP, etc.)
Jobsite Readiness

- Determine SPF Contractor vs. Customer Responsibilities
  - Rig parking
  - Power requirements
  - Clear workspace (remove equipment, furniture, materials, obstacles)
  - Large cracks, gaps and penetrations on substrate
  - Conditioning of spray zone
  - Masking and Overspray Prevention
  - ...

- Planning
  - Pre-Installation
  - Installation
  - Post-Installation
  - Inspection
Safety Plan

- Address each and every component of the Customer and SPF Contractor’s Jobsite Safety Programs
  - Spill Prevention and Cleanup
  - Emergency Action
  - Fire Prevention
  - Fall Protection
  - Injury and Illness Prevention
  - Lock-Out/Tag-Out
  - …
Scheduling & Weather Contingency

- Review SPF installation tasks
- Define containment and spray zone boundaries (tape, signage)
- Emphasize the importance of PPE inside spray zone during and just after spraying
- Define re-occupancy times and impact on scheduling
- Describe importance of spray conditions defined by MII
- Discuss alternate scheduling due to inclement weather
Pre-Installation
Upon Arrival on Jobsite...

While warming up the rig, verify jobsite conditions and prepare spray zone

- Ambient Air Condition
- Substrate Condition
- Equipment and Material Readiness
- Spray Zone Preparation
Environmental Conditions

- Measure spray zone air temperature and RH to determine dew point temperature [AY-112]
  - DO NOT apply SPF until MII conditions are met
  - SPF industry guidelines: No application if air temperature is within 5°F of dew point
  - Some suppliers: No spraying if RH is greater than 85%

- Establish a plan to measure and record

- Use dry heat source if needed to condition spray zone

**IMPORTANT:** High levels of humidity can add unwanted moisture to the SPF chemistry, resulting in poor cell formation. Airborne moisture can also condense on cold substrates causing adhesion problems.

Use an industrial quality instrument to measure temperature and RH. Having data-logging capability is a plus. **Protect probe end from overspray**
Substrate Conditions

- Ensure the substrate is clean
  - No oils, grease, excessive dust or dirt
  - Check adhesion for unfamiliar substrates
  - Use primers if needed

- Ensure the substrate is within proper temperature and moisture content per MII
  - Use CALIBRATED scanning thermometer and moisture meter

- Establish a plan to measure and record

**IMPORTANT:** Unclean substrates will negatively affect foam adhesion. Substrate moisture reacts with the A-side and can result in off-ratio or poorly-formed foam. Cold substrates extract heat from reaction and will affect foam performance.
Equipment and Material Readiness

- Have the foam chemicals ready
  - Proper handling history
  - Check expiration dates
  - Properly heated

- Equipment ready for the day
  - All equipment in good repair
  - Spare parts and equipment on-hand
  - Proper gun and tip per MII
  - Proper temperatures and pressures per MII

- Establish a plan to measure and record

**IMPORTANT:** Improperly stored chemicals can affect foam quality. Marginally operating equipment or incorrect gun setup can result in poor mixing of foam chemicals. Equipment breakdowns result in scheduling delays.

Monitor operation of all rig equipment regularly throughout the workday.
Spray Zone Preparation

- Establish Spray Zone Boundary
  - Mandatory PPE requirement inside zone
  - NO ENTRY tape and signage
  - Evacuate non-essential personnel
  - Use OSHA compliant jobsite safety signs

- Create containment and ventilation for spray
  - Make practical effort to seal spray zone
  - Cover vents, turn off HVAC
  - Use two-fan system to create negative pressure
  - Reference SFC Guidance Document

**IMPORTANT:** Evacuation and proper containment /ventilation minimizes the chance of chemical exposures and can reduce re-entry times (a current industry research topic)
Installation

- Planning
- Pre-Installation
- Installation
- Post-Installation
- Inspection
Installing Foam...

Regularly check all equipment and use the proper application techniques for the product

- Monitor Equipment
- Monitor Jobsite Conditions
- Spray Technique
- Drumset Changeout Procedures
- Record all results on a daily spray log
## Daily Log

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<td>Lot/Batch Number(s)</td>
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<td></td>
<td>Product #2</td>
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Monitor Equipment

- Regularly check operation of ALL equipment
- Monitor and record equipment settings on a regular schedule
  - Compressor
  - Generator
  - Drum Pumps
  - Proportioner
  - Hose
  - Gun
  - Ventilation Fans

IMPORTANT: Quality foam requires the correct combination of heat, pressure and spray gun configuration. Varying one or more of these elements can result in a poor mix of foam that can lead to problems such as:
  - Poor adhesion
  - Poor cell structure
  - Poor dimensional stability (shrinking or cracking)
  - Low density and compressive strength
  - Voids, fissures and cracks in the foam
  - Lingering odors
Monitor Jobsite Conditions

- Regularly check and record air temperature and relative humidity
  - Watch weather changes
  - Changes by building location

- Regularly check and record substrate temperatures and moisture content
  - Conditions can change by building location

**IMPORTANT:** Moisture on substrate surface will react with the A-side and can result in off-ratio or poorly-formed foam. Cold substrates extract heat from reaction and will create a shellac-like layer in the foam resulting in poor adhesion.
Follow MII regarding min and max lift thickness
- Usually 0.5” minimum, 1.5” maximum but MII may permit greater maximum

Allow proper cooling time between lifts
- 15 minutes or more may be needed between lifts

Use picture-framing technique
- Foam perimeter of cavity
- Foam center, motion parallel to cavity

IMPORTANT: Thick lifts or improper cooling will overheat foam. Overheated foam can cause:
- poor physical properties
- cell distortion
- high open cell content
- discoloration or scorching
- self-ignition (extreme)
- lingering odors
Spray Technique – Open-Cell SPF

- Typically no MIL limits on lift thickness
- Spray from bottom to top of cavity
- Spray left-right motion
- Picture framing may be used in certain situations to assure proper fill
- Avoid excess foam in closed-cavity applications
Material Changeover

- Some projects require installation of more than one foam type
- Follow all available guidance from material and equipment supplier to properly purge equipment of old foam chemicals
- Using separate rigs or systems for open and closed cell foam applications is a surefire solution
- Record in daily log

IMPORTANT: Mixing chemicals from different foam systems can result in a variety of foam issues.
Post-Installation
Finishing the Job Right….

Trimming, cleanup and disposal of all waste is key to doing the job right. Inspection of the foam to assure a quality installation is just as important.

- Trimming
- Cleanup
- Continued Ventilation
Excess foam should be thoroughly removed from framing faces to be ‘drywall-ready’

Trimming is typically needed for open-cell foam, closed-cell foam should require minimal trimming

Bag and properly dispose of all foam scraps and dust

Leave fire warning signs near exposed foam until thermal barrier is installed
Cleanup

- Remove all of these items from the jobsite. Dispose of each item properly
  - masking materials and consumables
  - foam debris
  - disposable PPE
  - chemical drums and containers
Inspection

Planning → Pre-Installation → Installation → Post-Installation → Inspection
Inspect Your Work

- Provide customer with an insulation installation certificate

- Inspection per Planning phase
  - Who will inspect
  - What criteria
  - When
  - Reference SFC Guidance Document on Foam Inspection
Visual Inspection

- Overspray
- Thickness
- Surface Profile & Texture
- Gaps and Voids
- Blisters and Delamination
- Foam Cracking and Separation
- Color Variations
- Persistent Odors
Check thickness at regular intervals throughout the project

Compare to contract and/or R-value requirements
Thickness Inspection

- Use welding rod and bingo dauber
- Set rod to mark when foam is at minimum permissible thickness
- Rapid ‘go/no-go’ check procedure
Surface Profile and Texture

- Rough, non-uniform surface texture
- Undulating thickness
- Less than perfect spray conditions
- Sloppy appearance
- Decreased coating yield

Photo courtesy MK Consulting
Gaps and Voids

- Gaps are small areas missing foam
- Voids are small areas of insufficient thickness
- Sloppy appearance
- Will reduce installed R-value

Photos courtesy SFC Inspection Guide
Blisters and Delamination

- Areas of foam not adhered to substrate
- Found by pushing and/or tapping on foam
- Isolated blistering/delamination will not affect performance but widespread occurrence could indicate other problems requiring repair or replacement

Photo courtesy MK Consulting
Foam Separation and/or Cracking

- Breach of thermal boundary / air-barrier

**IMPORTANT:** Separated or cracked foam can lead to long term issues with thermal performance and moisture. These defects must be repaired or replaced.
Color Variations

- Brown color indicates A-rich, typically stiff or brittle to touch
- Lighter color indicates B-rich, typically soft or tacky to the touch

**IMPORTANT:** Off-ratio foams typically have performance or odor issues and should be replaced

Photos courtesy BASF
Persistent Odors

- Can be odors from other sources due to improved airtightness
- From SPF it is typically a ‘fishy’ odor from unreacted amine catalyst
- Odor is normal during and a few days after installation
- In most cases, it can be eliminated by temporary ventilation
- If the odor persists, permanent ventilation or foam removal may be necessary.
There are several semi-destructive field tests that require removal of foam samples.

These optional tests are standard procedure under some programs (ABAA, CUFC) or may be part of the specification.

These tests include:
- Core Sampling
- Field Density
- Adhesion

Be sure to repair all areas where foam samples are taken that can be used to evaluate foam quality.
Core Sampling

This test cuts and removes a section of the foam.

- Special coring tool used for closed-cell SPF
- Knife or other cutting tool for open-cell SPF
- Enables inspection of cell structure, lift count, substrate adhesion and foam density

Photos courtesy MK Consulting

Photo courtesy Com-Ten
Density of installed SPF can be measured from core samples.

1. Measure sample volume in in$^3$
   1. Water-displacement - closed-cell only
   2. Volume measurement – LxWxH for open-cell
2. Measure sample weight in gms with digital scale
3. Weight ÷ Volume x 3.81 = Density (lb/ft$^3$)
4. Record density on daily log

**NOTE:** If sample includes foam material near skins, substrates and pass lines, it will typically have a higher density than that reported on TDS. TDS typically reports core density measured from the center of a foam pass.
Adhesion can be measured qualitatively or quantitatively

- Qualitative measure removes foam sample and inspects surface for adhesive/cohesive fracture
  - Adhesive failure – little or no foam residue on substrate
  - Cohesive failure (better) – visible foam residue on substrate
- Quantitative measurement requires core cutter and pull-test device.
- Adhesive strength should be close to tensile strength of material TDS
- Record adhesive strength on daily log
Foam Removal

Spray foam may need to be removed for a variety of reasons

- Renovation and demolition
- Wrong product for application
- Customer request due to odors
- Misapplied product (e.g., inspection failure)
Prepare the Jobsite

- Use containment and negative pressure ventilation to avoid spread of dusts and any odors
- Turn off HVAC equipment, seal ductwork to spray zone
- Use appropriate PPE to prevent inhalation of dust and physical injury
- Follow all jobsite safety practices
- For foams that are not properly cured use proper PPE and jobsite evacuation to prevent chemical exposure
Removing Open-Cell SPF

- Use long knife or drywall saw to cut foam from sides of studs and rafters
- Most of the open-cell SPF can be removed by hand-held putty knife
- Watch for wires, cables and exposed nails. Use heavy gloves
- Remainder of foam can be removed by hand scrapers and/or wire brush
- Optional – encapsulate any residual foam with paint
FOAM REMOVAL

Removing Closed-Cell SPF

- Know and mark location of ALL wires, cables, conduits and piping
- Will require use of hand-held power tools. Use (cordless) circular or reciprocating saw or hand saw to cut foam from sides of studs and rafters
- Make bevel cut into foam and use ice-scraper to remove foam from sheathing
- Remainder of foam can be removed by hand scrapers and/or wire brush
- Optional – encapsulate any residual foam with paint
FOAM REMOVAL

Clean-Up

- Remove and bag all foam scraps
- Vacuum all dust
- Remove containment and ventilation equipment
- Restore operation of HVAC equipment
A safe, quality SPF installation is a five-phase operation.

Careful attention to detail in each phase will help ensure an installation that is done safely and will meet or exceed all customer expectations for performance and quality.

There are key steps in each phase that should be considered to reduce ‘call-backs’ for every installation.
Thank You

Acknowledgements

Thanks to Mason Knowles and Jim Andersen for their input and advice in preparing this presentation

Questions and Comments