QUALITY CONTROL
SPF ROOFING
AN INDEPENDENT INSPECTOR’S PERSPECTIVE

The comments and opinions in this presentation do not necessarily represent or reflect those of SPFA.
Disclaimer

- Opinions expressed are those of the presenter and do not necessarily represent those of SPFA or any company. Literature is available from the industry to provide additional information on the topic being presented.
Course Presenter

Robb Smith

- 30 years in the roofing industry
- 20+ years of specifying and inspecting SPF roofs
- Past President of RCI (Roof Consultants Institute), Raleigh, NC
- Registered Roof Consultant
- SPFA Level K Independent Inspector
- SPFA R-1 Course developer and presenter
- SPFA Accreditation Committee member
Previously addressed

- Before application
- Materials
- Job site personnel
- Equipment
- Record keeping
- Factors affecting yield
Daily Log — Inspectors may want the following

- Hours — start and quit
- Ambient temperatures — at least 2x times daily
- Dew point temperatures — at least 2x times daily
  - Record times taken
- Core cut sample — down to the deck
  - Cell structure will indicate existing moisture
  - Moisture will affect adhesion — blistering
  - Retain samples — in a baggie, mark date taken
Daily Log – Inspectors may want the following

- Roof plan – locations
  - Slit & core samples – retain samples in a baggie
  - Foam thickness
- Lbs. of foam applied
- Gallons of coating applied
- General description of work completed
- Number of squares foamed and/or coated
- Name of foreman & number of crew
- Rooftop Equipment shut down & re-started times
Inspectors may ALSO want the following

- A copy of the project specifications available on the job site
- With detail drawings
- Description of how and where materials are stored
  - This should be discussed during the Pre-Construction meeting
Material storage
Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from hazardous waste through proper material use, waste disposal, training of employees and subcontractors.
Temporary containment facility should provide for a spill containment volume equal to 1.5 times the volume of all containers able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest tank within its boundary, whichever is greater.
Masking
Masking
Masking
Masking – the result

Straight lines
Masking – the result

Clean, Professional Image
Wind

- Know the surroundings
  - Rooftop air intakes
  - Neighbors
  - Cars
  - Tenants / Public traffic patterns
  - Prevailing wind direction
  - Wind history – none in AM, 20 mph gust in PM
Tenting
Tenting

Wind control
DETAILING THE ROOF
Raise curbs

Not 8” min. height
Raise curbs

New 2x6

8” min. height
Raise curbs

Clean finished condition
Drains

Overflow drain too tall
Overflow cut down – 2” above low point
Expansion Joints

Cover with new membrane

DON’T foam over
Expansion joint

Existing EJ Covered with TPO membrane
Expansion Joints

Expansion joints used to separate movement between portable bldgs.
Expansion Joints

Metal EJs withstand abuse and joints are not a problem

Waterproof membrane (APP, TPO, PVC, SBS)

Metal EJs not recommended for joints longer than 50 ft.
Expansion Joints

Completed expansion joint
Difficult penetrations

Before

06/04/2009
Difficult penetrations

After
Unobstructed drainage
Clean finished appearance
Under equipment
SPF on ducts

Waterproof & insulate ducts
SPF on ducts

SPF contractor’s unique advantage
Penetrations
Final inspection

☐ Approaching the site
☐ Checking the surrounding grounds
Final inspection

What’s the roof going to look like?
Masking – leftovers
Equipment not lifted

Trimmed and exposed foam
Exposed foam
Surface contamination – UV degradation
Coating lamination problem – blisters
Inadequate coating lamination
Coating blister

Contamination on the base coat surface
Surface contamination
Walls – Tree bark foam

Exposed foam
Folds / rolls in the foam

Exposed foam
Conduit not set on blocks
EQUIPMENT FOR THE CONTRACTOR’S ROOF INSPECTIONS
Tools you should have on site

- Sharp knife – 5” fillet knife better than box cutter – deeper cuts
  - Sharpening stone
- An optical comparator
Optical comparator – Finescale® Comparator

Best tool for measuring DFT
Tools you should have on site

- Sharp knife – 5” fillet knife better than box cutter
- An optical comparator
- Digital anemometer
Digital Thermo – Anemometer

Shows % humidity
Tools you should have on site

- Sharp knife – 5” fillet knife better than box cutter – deeper cut
  - Sharpening stone
- An optical comparator
- Digital anemometer
- 1+ tubes of caulking (compatible with coating)
- Roof coating
- Moisture meter
- Sharpie marking pen
- Paper for drawing roof plan
- Plastic Ziplock baggies
Core cutter – 3” diameter
Roof Sampling – Slits

- Minimum – 5 slits for 10,000 s.f. or less
- At least 1 slit should be from an edge or wall
- 3 additional slits per add. 10,000 s.f.
- Samples from btwn. pass lines and in pass lines
- Probe each slit for foam depth
- Number each slit
- Show location of each slit on roof plan
Roof Sampling – Slits

At least 1 slit should be taken from an edge or wall
Roof Sampling – Slits

At least 1 slit should be taken from an edge or wall.
Roof Sampling — Slits

- Coating thickness —
  - Same at the edge as the middle of the roof
  - Same on the walls as the middle of the roof
  - Same on the flashing as the middle of the roof
  - Same under equipment as the middle of the roof
Roof Sampling – Slits

- Examine slits for:
  - Foam pass thickness
  - Cell structure
  - Evidence of UV degradation
    - Foam on foam surface
    - Coating on foam surface
  - Peel strength at foam to coating surface
  - Evidence of pinholes
  - Evidence of surface contamination
  - Coating thickness
Roof Sampling – Slits

- Know whether **minimum** or **average** mils is spec’d
- Determine
  - Minimum thickness
  - Average thickness
- Don’t consider any thickness reading >120% of spec’d minimum or average
  - i.e. if 30 mil avg. is spec’d, and 45 mil is found it would be ignored since 36 mils is 120%
Roof Sampling – Slits

- Slit samples read immediately and note where DFT is less than spec’d.
- Where thin coating is found, take 4 more in a 5 ft. radius
- If additional slits are thin, 4 more slits are taken in a 10 ft. radius.
Roof Sampling – Slits

Sample A = thin DFT requires more slits

Sample 1 = thin DFT requires more slits
Roof Sampling – Slits

- Seal over slit cuts with sealant compatible with coating
  - i.e. Silicone sealant on silicone roof
  - Polyurethane sealant on urethane or acrylic roof
- Tool sealant to pack it into slit and smooth off the surface
Roof Sampling – Cores

- Cores should be examined for:
  - Number of foam lifts
  - Cell structure
  - Interlaminar foam interface / adhesion
  - Adhesion to substrate
  - Foam / coating interface / adhesion
  - Coating / coating interface / adhesion
  - Soft or spongy foam
  - UV degradation – color variations
  - Total foam thickness
Roof Sampling – Cores

- Core hole must be filled with a replacement core
- Apply sealant around replacement core and rotate slowly while inserting into hole
- Seal over inserted core with sealant
Reference Documents

- Spray Polyurethane Foam Roof System
  - Maintenance Manual – AY 127
- Guidelines for Roof Assembly Evaluation for SPF Roof Systems
  - AY 138
- http://www.sprayfoam.org/ Technical Information
QUALITY CONTROL
SPF BUILDING ENVELOPE

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MASON KNOWLES

More than 40 years of experience in the polyurethane industry as a contractor, material/supplier manufacturer, equipment manufacturer, and trade association professional

Chairman of ASTM Subcommittee on Spray Polyurethane Foam Roofing

Chairman of ASTM Task Group for the spray polyurethane foam standard specification
Course Agenda

Quality Control

Before Application

During Application

After Application
Before Application

- Determine quantity and type of materials
- Determine personnel on job site
- Determine daily work to be performed (quantity of foam and areas to be sprayed, yield expected)
- Check equipment & materials
- Pre-Job meeting with GC and other trades
- Mask and protect area, fixtures, appliances, etc.
Job Site Personnel

- Determine crew size based on project (2 sprayers recommended on each job)
- Pre-installation crew to mask intricate projects
- Assign specific responsibilities to each such as data recorder, drum changer, heat and pressure adjustments
- Change sprayers every 2 hours
Materials

- Determine type of foam required for project
- Stored between $60^0\text{F}$ to $80^0\text{F}$ in dry environment
- Desiccant air on drums (or nitrogen blanket)
- Data sheets with application instructions
- Check for contaminated material
Equipment

- Foam Rig
- Safety Equipment
- Generators
- Compressors
- Ladders/Scaffolding
- Tape & Plastic
- Trimming Tools
- Climate Recording Equipment (temperature/humidity/moisture)
Equipment

- Verify all equipment is in good working condition and fuel tanks are full Before leaving the shop!
Pre-job Meeting

- Indicate safe areas to work,
- Caution against welding and hot work on foam
- Advise when people can enter building safely without protective clothing & respirators
- Estimated schedule for application & trimming
Record Keeping
(before application of foam)

- Substrate moisture content & temperature (morning, noon, afternoon)
- Ambient temperature and humidity within room. (morning, noon, afternoon)
- Lot numbers of material and area that it was sprayed
- Heat and pressure settings of equipment (morning, noon, afternoon)
- Anomalies
**Daily Log**

**SPF Contractor Daily Log**

Date: ____________________________

Job Name: ____________________________

Location-City: ____________________________ State: ____________________________

Applicant(s) Name: ____________________________

Foam System: ____________________________

A side (lot numbers) ____________________________

B side (lot numbers) ____________________________

Coating System, Thermal/Ignition Barrier:

(if applicable) ____________________________

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**Weather Data**

<table>
<thead>
<tr>
<th>AM</th>
<th>Substrate Temp</th>
<th>Humidity</th>
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| Noon |                |          |
|      |                |          |

| PM   |                |          |
|      |                |          |

Target Material/Substrate: ____________________________

Density: ____________________________ Rise: ____________________________ Total: ____________________________

Spray Rig: ____________________________

Proportioner - Type and Model: ____________________________

Spraygun - Model and Tip Size: ____________________________

Hose Length: ____________________________

Primary Heater Settings: ____________________________

Hose Temperature Settings: ____________________________

Proportioner Pressure:

Static: ____________________________ Working: ____________________________

Spray Pattern: (indicate round, oval, flat and any anomalies) ____________________________

Finished Foam Surface: (indicate percentage)

Smooth: _______ Verge of Popcorn: _______ Orange Peel: _______

Rough Orange Peel: _______ troub: _______

Quantity of SPF sprayed: (amount in pounds and inches)

Walls: ____________________________ Ceiling or Attic: ____________________________ Basement: ____________________________

Crawlspace: ____________________________ Other: ____________________________
Determine Yield

Closed cell: 2 lb density

- 6000 bd ft/kit (Theoretical)
- 3500 to 5000 bd ft/kit (Actual)

Open cell: 0.5 lb density

- 24,000 bd ft/kit (Theoretical)
- 15,000 – 18,000 bd ft/kit (Actual)
Factors Affecting Yield

- Temperature of Substrate
- Waste
- Number and type of studs
- Open area vs tight spaces
- Uniformity of application
- Amount of trimming required
Masking

- Mask off floor area with polyethylene plastic 4-6 mil thickness. Tape down edges next to wall area
- Mask off all appliances, windows, doors, hot tubs, vent hoods, etc.
- Tape electrical outlets and junction boxes
- Box recessed lights (do not spray foam directly on recessed lights)
- Wrap spray hoses with fresh tape if they are dirty
Condition Area

- Provide heat if required (space heaters, propane heaters, etc. Note: turn heaters off before beginning application, verify air contains sufficient oxygen
- Close ducts, windows, doors, etc.
During Application

- Verify climate and substrate condition
- Use appropriate spray technique for foam and project
- Check foam quality, thickness and yield regularly
- Anticipate climate changes
- Stop if foam exhibits unusual characteristics
Substrate Preparation (Concrete)

- Allow “green” concrete to cure 28 days
- Use degreasers and/or acid etcher to obtain a contaminant-free surface suitable for foam application
- Primers may be needed on some concrete surfaces (Note: the rougher the better)
Substrate Preparation
(Metal)

- Clean, dry surface
- Remove contaminants
- Ferrous metal requires rust inhibiting primers (prepare surface in accordance with SSPC painting guidelines)
- Galvanized metal requires acid etching (vinegar)
- Polished aluminum, stainless steel require adhesive primers
Substrate Preparation (Wood)

- No more than 18% moisture content
- Clean & dry surface
- Primer typically not required for interior applications
- Do not mask face of studs or use release agent
Contact SPF manufacturer for their specific recommendations on all substrates and surfaces.
Moisture Meter
Delmhorst BD 2100
Humidity and Temperature
Kestrel 3000
Spray Techniques
(Closed Cell SPF)

- Picture frame
- Overlap 60%, make the foam grow at a steady rate
- Spray parallel to direction of the studs or direction of flutes
- 0.5 – 1.5 inch lifts
- Wait 10-15 minutes between lifts
- Check adhesion and cell structure at regular intervals
Picture Frame and Spray Parallel to Studs
Spray Techniques
(Open Cell)

- Full thickness in one pass
- Work pass back and forth
- Aim directly at studs to prevent gaps and voids
- Picture frame may be required if studs are set back from the wall
- Check for voids and gaps
Install Foam to Full Thickness in One Pass
After Application

- Inspect Quality of Foam
- Verify thickness of Application
- Verify foam installed as specified
- Trim
- Clean up
- Final Inspection
Inspection

- Surface profile & texture (1/2 variation)
- Minimum thickness
- Voids or gaps
- Adhesion
- Cell structure (uniform)
- Color variations
- Compressive strength (thumb test)
- Density
Surface Texture affects Yield

(note: off ratio spit of A in left corner)
Measure Foam Thickness at the Low Spots
Check Compressive Strength (using thumb test)
Check High Spots for Potential Blistering
Trimming

Tools required:

☐ Saws: keyhole and rip cut
☐ Trimming tools (air powered or electric)
☐ Long handled scraper
☐ Short handled scraper (paint scraper)
☐ Surform tools
☐ Push brooms
Trimming Open Cell Foam
Testing Samples (Weighing Density)
Testing Samples
(Compressive Strength)
What can go wrong?

- Off ratio foam
- Poor mix
- Poor adhesion
- Strong odor
- Poor physical properties
- Shrinking and cracking
Poor Adhesion & Physical Properties
Causes

- Moisture on substrate
- Poor mix of material
Off Ratio ("A" Rich)
Off Ratio Foam
(A rich)
Causes

- Equipment malfunction
  (transfer pump, dirty gun, clogged screens, etc.)
- Cold or hot material
- Out of material
Gaps or Voids
Air infiltration noted at floor/wall intersection at the upstairs hallway (left wall).
Causes and Prevention

**Causes**
- Non uniform foam expansion
- Spraying at extreme angles from substrate
- Spray technique

**Prevention**
- Overlap Passes
- Let foam grow at uniform rate
- Closed Cell:
  - Picture frame
- Open Cell:
  - Work spray from bottom to top
Foam Cracks and Shrinkage
Excessive Exothermic Heat
Excessive Exothermic Heat
Causes and Prevention

- Exothermic heat build-up
- Pass thickness greater than 2 inches
- Allow sufficient time for exothermic heat to dissipate
Repairs

- Identify off spec foam
- Remove at 45 degree angle
- Closed Cell: Spray 0.5 to 1.0 thick passes until full thickness is achieved. (Allow exothermic heat to dissipate between lifts.)
- Open Cell: Install full thickness in one lift
Whose Fault is It?

**Contractor**
- Equipment
- Substrate Preparation
- Climate
- Spray Technique
- Too Thick
- Not Enough Time Between Lifts
- Storage & Handling
- Wrong Foam for Job

**Supplier**
- Off Spec Foam
- Storage & Shipping
- Old Foam
- Inadequate or Incorrect Application Information
Clean-Up

- Treat overspray areas (if needed)
- Remove all tape and plastic and foam trimmings
- Sweep and clean all areas to remove all traces of foam application
- Clean floors, rugs etc. that may have become dirty during application