Quality Control Guidelines for the Application of Spray Polyurethane Foam-based Roofing

This document is not a specification. It does not supersede job specifications, which are the perogative of designers (specifiers) and/or material manufacturers. It merely provides general guidelines for following accepted spray polyurethane foam-based roofing construction practices.

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Statement of Purpose

This document provides guidelines for on-site evaluation of spray polyurethane foam- (SPF-) based roof systems during the application process.

Introduction

This document addresses on-site evaluation guidelines during the application of SPF-based roof systems. It stresses thorough, continuous inspections during construction to recognize and correct variances as they are detected. It provides guidelines to evaluate the quality of application. This document also provides information about the installation of specific components above the structural deck. Where appropriate, the guidelines describe expected variances in the application of primers, vapor retarders, cover board insulation and base sheets, fasteners, SPFs, surfacings and metal flashings.

The application of an SPF-based roof system involves the skillful arrangement of multiple components in a specified process. The quality of workmanship during the application process is measured by application criteria and inspection procedures and is a critical element to roof system performance. Roof system performance is also determined by other factors, including building design, project specifications and details, material quality and suitability for the specific application, and roof system maintenance.

The application of SPF-based roof systems, similar to other types of roof systems, is not an exact science. It is a craft involving people who handle a broad range of materials, designs, practices and techniques, climates and changing weather conditions. The National Roofing Contractors Association (NRCA) and Spray Polyurethane Foam Alliance (SPFA) recognize the importance of these critical factors as they affect quality SPF-based roof systems.

The guidelines presented in this document are based on the technical knowledge and experience of practicing and knowledgeable roofing professionals, including contractors, manufacturers and roofing technologists. Their collective experience resulted in a consensus as expressed in this document.

The Spray Polyurethane Foam-based Roof System Quality Control Application Checklists have been

developed to assist quality control and quality assurance personnel who perform inspections while SPF-based roof system application is in progress. The checklist is located in Appendix 1.

Terminology

Terminology used in this document can be found in Appendix 4.

System Description

SPF-based roof systems consist of a fully adhered base layer of closed-cell polyurethane foam covered with a protective surfacing.

The polyurethane foam is spray-applied by mixing two chemically reactive liquid components through a high-pressure mixing gun. As the liquid mixture is applied to a roof substrate, the chemical components react immediately, expand 20 times to 30 times their original liquid volume and set to a rigid foam layer. The foam formed is closed-cell, providing thermal insulation and some degree of water resistance.

Elastomeric coatings with or without aggregate and membrane surfacings protect the foam from ultraviolet light and mechanical damage. An elastomeric coating or membrane surfacing provide the long-term weatherproofing characteristics of SPF-based roof systems.

Quality Control/Assurance

Quality control and quality assurance are essential elements of SPF-based roof system construction.

Quality control is performed by a contractor who installs SPF-based roof systems. The roofing contractor designates an individual to be on-site during the entire roof system application process; that individual may be a working member of the crew. This person understands the system being installed and has the authority to correct noncompliant work.

Quality assurance, when performed, is the responsibility of a building owner's representative (e.g., architect, engineer, roof consultant) or representative of the material manufacturer/supplier. The person performing quality assurance also must understand the system being installed and its methods of application. The quality assurance person should verbally notify the roofing contractor immedi-

ately if noncompliant work is observed so necessary corrective action can be taken. Written documentation should follow every inspection with copies distributed the following day to field personnel and offices of all pertinent parties.

Visual Examination

The most effective means to evaluate the quality of an SPF-based roof system installation is by thorough, continuous visual inspection and evaluation at the time of application by a person who is knowledgeable of SPF roofing technology and good workmanship practices.

The following list will assist quality assurance and quality control inspectors before and during roof system inspections of an in-progress roof application. Many items on these lists are discussed in the following sections of this document. A detailed checklist is found in Appendix 1. If deficiencies are found during inspection of a roof system application, corrective action should be taken.

Inspectors should visually ensure the following before and during application:

Before application

- Specifications and drawings are available for review, including specific details.
- All certifications or approvals have been received for the deck and roof system materials where applicable.
- Material manufacturers'/suppliers' literature and application specifications and recommendations are available for information and review.
- Safety precautions and material safety data sheets (MSDS) have been reviewed and are on-site during application.
- Specified materials and quantities, as verified by on-site inspection of product labels, are at the project site and are visually suitable for application (e.g., packaging is not damaged, labels are intact).
- Materials are stored according to manufacturers'/suppliers' recommendations (e.g., materials are at proper temperature, covered, off the ground and on pallets).
- Equipment is in good working order and functioning properly.
- Edge nailers, curbs, drains and penetrations have been installed in the areas to receive SPF.
- Drainage patterns for proper SPF-based roof system installation have been identified.

- When fastener pull-out tests are specified, tests have been conducted and the results have been approved by the specifier and/or manufacturer.

During application

- Weather and project conditions are suitable for application.
- Substrate is sufficiently dry and suitably prepared to receive the SPF-based roof system.
- When specified, rigid insulation cover boards are butted together with joints staggered and offset.
- When specified, a separation layer (e.g., cover board, base sheet) is firmly attached to the substrate with the specified type and number of fasteners or is embedded in the specified adhesive.
- When specified, temporary tie-ins are installed at the end of each day's work as required.
- Surfacing is applied as specified.
- Materials and the applied roof system are not abused by other trades.

Decks—New Construction/Tear-off

The quality assurance and quality control of roof decks are beyond the scope of this document, and therefore, this document does not consider the roof deck as part of an SPF-based roof system. However, there are important roof deck factors that affect final SPF-based roof system performance. These factors include but are not limited to structural load capabilities, slope and drainage, expansion joints and flashing details.

A building owner, designer and deck manufacturer/installer are responsible for providing for the support, attachment, fastener pull-out testing (when specified), proper deck alignment, structural integrity, construction details, and compensation for expansion and contraction of the structural roof deck in a manner that will provide a stable base for an SPF-based roof system.

Roofing contractors inspect and accept roof deck surfaces to schedule roofing applications. Attention to deck surface dryness and cleanliness is essential during application.

Existing Roof Substrates

When re-covering an existing roof system, a designer is

responsible for analyzing the structural roof deck (described under the section Decks—New Construction/Tear-off), including deck integrity, system compatibility, load capacity, damage, moisture condition, wind uplift and building code requirements.

The following chart provides specific criteria and corrective action for the evaluation of existing roof substrates.

Evaluation	
Visual examination at the time of application is the most effective means of evaluating the substrate to which an SPF-based roof system is applied. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.	
Criterion	**Corrective Action**
The substrate surface is sufficiently dry, clean and prepared to receive a new SPF-based roof system.	Delay the installation until substrate conditions have been corrected.
The substrate surface is suitably prepared for a re-cover application. The surface should be secure and clear of loose material. Aggregate embedded in bitumen is considered acceptable.	As appropriate, cut, remove or repair blisters, ridges, splits and other defects that appear likely to affect the security and adhesion of a new SPF-based roof system.
Areas of the existing roof system that are too wet, as determined by the designer, have been removed.	Delay installation of a new SPF-based roof system until the designated areas have been removed and replaced.

Primers

SPF adheres well to most construction materials. Primers are often used to enhance the adhesion and/or increase the surface temperature of a substrate. Primers are not intended as a substitute for a properly prepared surface.

The following chart provides specific criteria and corrective action for the evaluation of primer application.

Evaluation	
Visual examination at the time of application is the most effective means of evaluating primer application. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.	
Criterion	**Corrective Action**
The substrate surface is sufficiently dry, clean and prepared to receive the primer.	Delay the installation until substrate conditions have been corrected.
Primer is applied at the specified rate.	Adjust application to comply with the specified rate.

Vapor Retarders

The entry of water vapor and its subsequent condensation can be detrimental to a roof system's performance. Vapor retarders can be used to control migration of water vapor into a roof system. Determining the need for a vapor retarder, its compatibility with other materials and the details of its construction is the responsibility of the designer.

The following chart provides specific criteria and corrective action for the evaluation of vapor retarder application.

Evaluation	
Visual examination at the time of application is the most effective means of evaluating vapor retarder application. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.	
Criterion	**Corrective Action**
The substrate surface is sufficiently dry, reasonably smooth and clear of potentially damaging objects.	Delay installation of the vapor retarder until substrate conditions have been corrected.

Criterion	Corrective Action
Materials are protected from inclement weather and abuse from other trades.	Cover materials and remove damaged materials from project site.
The location of the vapor retarder is as specified.	Remove vapor retarder from incorrect location, and install it in specified location.
Number of plies is as specified.	Should examination reveal missing plies, install additional plies to comply with the specification.
Adhesive for vapor retarder is applied as specified.	Remove the membrane vapor retarder from the deficient area, and install a new membrane vapor retarder to meet the specification.
Liquid-applied vapor retarder is applied continuously and at the specified rate.	Adjust application to comply with the specified rate.
The vapor retarder extends continuously across the plane of the deck.	Install specified vapor retarder to incomplete or noncontinuous areas.
End laps, side laps, openings and penetrations are sealed as specified.	Add additional plies or sealant to ensure adequate seals.
The vapor retarder is sealed at the perimeter as specified.	Adjust work to ensure perimeter detailing and sealing comply with the specification.
The vapor retarder is tied into any other air or vapor retarders as specified.	Add additional plies or sealant to ensure adequate tie-in, and correct work to comply with the specification.

Separation Layer

A separation layer, typically either an insulation cover board or asphalt base sheet, is often installed over certain structur-

al roof decks or other substrates to provide a physical separation between an SPF-based roof system and substrate. An example is an insulation cover board installed over irregular or uneven substrates, such as a metal roof deck or a precast concrete plank roof deck, to provide a smooth surface to which an SPF-based roof system can be applied.

Separation Layer: General Criteria

The following chart provides specific criteria and corrective action for the evaluation of separation layer application.

Evaluation	
Visual examination at the time of application is the most effective means of evaluating application of a separation layer. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.	
Criterion	**Corrective Action**
Separation layer materials are as specified.	Remove noncompliant materials from the job site.
Separation layer materials are protected from inclement weather before, during and after installation.	Protect the material. Do not use damaged or wet material.
At the end of each day's work, temporary tie-ins are applied to seal the separation layer at the edge of SPF.	Install temporary tie-ins at the end of each day's work. Replace damaged materials.

Separation Layer: Insulation Boards

The following chart provides specific criteria and corrective action for the evaluation of separation layer/insulation board application.

Evaluation
Visual examination at the time of application is the most effective means of evaluating the application of insulation boards as a separation layer. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.

Criterion	Corrective Action
Insulation materials are as specified.	Remove noncompliant materials from the project site.
Insulation is protected from inclement weather before, during and after installation.	Protect the material. Do not use damaged or wet insulation.
Insulation boards are butted together. Because of manufacturing tolerances, dimensional stability, variances during installation and the nature of insulation boards, some variance in joint spacing can be expected. Occasional gaps between boards not exceeding ¼ inch (6 mm) are acceptable as long as the gaps are not continuous for more than the length of one insulation board.	Insulation gaps in excess of ¼ inch (6 mm) should be filled with appropriate insulation board, SPF or compatible material.
Insulation end joints are staggered unless otherwise specified.	Remove nonstaggered insulation boards. Adjust boards to appropriate stagger.
Finished surface of adjacent insulation boards is not vertically offset more than ¼ inch (6 mm).	Correct vertical offset of insulation boards by shaving the insulation board, filling or leveling the gap with compatible material, adding tapered insulation as applicable or adding mechanical fasteners with plates.
When an insulation board is mechanically attached, the type, corrosion resistance, size, and length of fasteners and plates or washers are as specified.	Immediately change to the proper fastener. Remove improper fasteners, if necessary, and add specified fasteners to meet attachment objectives.

Criterion	Corrective Action
When the insulation board is mechanically attached, the minimum number of fasteners are installed and correct fastening pattern specified is followed.	Install additional fasteners as needed and space them appropriately.
When an insulation board is mechanically attached, fasteners are properly driven.	Immediately adjust operations. Remove improperly driven fasteners, if necessary, and add fasteners to maintain the minimum number of fasteners with appropriate spacing.
When an insulation board is applied in hot asphalt, the asphalt is applied at a rate sufficient to visually cover the surface area being bonded. The insulation board is embedded in the asphalt while the asphalt is hot and fluid.	Replace unadhered insulation boards with properly embedded insulation boards.
When an insulation board is adhered with cold adhesive, the adhesive is applied at the specified coverage rate and pattern. Recommended open times should be followed to ensure adequate adhesion.	Readhere or replace unadhered insulation boards with properly adhered insulation boards.

Separation Layer: Base Sheet

The following chart provides specific criteria and corrective action for the evaluation of separation layer/base sheet installation.

Evaluation
Visual examination at the time of application is the most effective means of evaluating the application of a base sheet as a separation layer. Visual examination may include routine measurements where applicable. During

evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.

Criterion	Corrective Action
Base sheet laps should be installed as follows: • Head lap: as specified, with a tolerance of minus 1 inch (25 mm) but with a 1-inch (25-mm) minimum. No maximum limit. • End lap: as specified, less 2 inches (50 mm) but with a 2-inch (50-mm) minimum. No maximum limit. • Side lap: as specified, less 2 inches (50 mm) but with a 2-inch (50-mm) minimum. No maximum limit.	If the examination reveals less than the minimum width for head laps, side laps or end laps, install an additional layer of base sheet material over the deficient area.
When a base sheet is applied in adhesive, the adhesive is applied at a rate sufficient to visually cover the surface area being bonded.	Replace an unadhered base sheet with a properly adhered base sheet.

Application of Spray Polyurethane Foam

SPF can be applied in various densities, each exhibiting different physical properties. The thickness of SPF applied, number of lifts, temperature of the substrate, ambient temperature and humidity affect the in-place physical properties of SPF.

Most SPF manufacturers offer various seasonal grades of foam used for SPF-based roof systems. Grades are formulated according to the anticipated weather conditions for a project and the ambient and surface temperatures that are anticipated during the time of application.

The following chart provides specific criteria and corrective action for the evaluation of SPF application.

Evaluation

Visual examination at the time of application is the most effective means of evaluating SPF application. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.

Criterion	Corrective Action
Materials are as specified.	Remove noncompliant materials from the job site.
Temperature, humidity and ambient conditions are as specified.	Discontinue SPF application until conditions are within specification.
Wind conditions are acceptable for proper application and protection against overspray.	Discontinue SPF application until wind conditions subside, or use wind screens as necessary.
Equipment is operating at the proper pressure and temperature.	Adjust or repair equipment as necessary to provide proper pressure and temperature.
SPF is rising and/or reacting properly.	Remove defective SPF. Adjust work practices.
Minimum lift thickness is ½ inch (13 mm) or as specified except where a feathered edge is necessary to complete a pass.	Adjust work practices.
Minimum overall SPF thickness should be 1 inch (25 mm) or as specified for coated and membrane-surfaced systems and 1½ inches (38 mm) or as specified for aggregate-covered systems and over rough, textured surfaces.	Adjust work practices. Apply additional SPF over any area with less than the specified minimum SPF thickness.

Criterion	Corrective Action
SPF is applied uniformly over the entire surface with a tolerance of plus ¼-inch-per-inch (25 percent) of specified thickness, minus zero except where variations are required to provide for proper drainage or to complete a feathered edge.	Adjust work practices. Remove any excess SPF that will impede proper drainage. Apply additional SPF over any area with less than the specified minimum SPF thickness.
Surface texture is as specified.	Adjust work practices. Consult with SPF and coating manufacturers regarding affected area.
SPF should be terminated neatly above the roof line at all penetrations and building junctions as specified.	Adjust work practices. Remove excess SPF and overspray.
Sprayed-in-place cants and crickets should be relatively smooth and uniform to allow for proper drainage.	Adjust work practices. Remove any excess SPF that will impede proper drainage. Apply additional SPF if necessary.
SPF is applied in the full thickness within the same day.	If SPF is exposed for more than 24 hours, consult the manufacturer for specific surface preparation instructions.

Application of Elastomeric Coating

An elastomeric coating is applied to an SPF-based roof system to protect SPF from ultraviolet rays and mechanical damage and enhance weatherproofing. An elastomeric coating can also be specified to provide for other performance criteria (e.g., fire resistance, chemical resistance, vapor permeability).

The following chart provides specific criteria and corrective action for the evaluation of elastomeric coating application.

Evaluation

Visual examination at the time of application is the most effective means of evaluating elastomeric coating application. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.

Criterion	Corrective Action
Coating materials are as specified.	Remove noncompliant materials from the job site.
Coating materials are mixed as specified.	Consult coating manufacturer for appropriate remedial action.
Temperature, humidity and ambient conditions are as specified.	Discontinue coating application until conditions are within specification.
Wind conditions are acceptable for proper application and protection against overspray.	Discontinue coating application until wind conditions subside, or use wind screens as necessary.
Equipment is operating at the proper pressure and temperature.	Adjust or repair equipment as necessary to provide proper pressure and temperature.
Unless otherwise specified, base coat is applied the same day as SPF.	If SPF or the base coat is exposed for more than 24 hours, consult the manufacturer for specific surface preparation instructions.
Coating is applied at the specified rate.	Adjust application to comply with the specified rate. In the deficient area, apply additional coating material to achieve the minimum specified coverage rate.

Criterion	Corrective Action
Overall coating dry film thickness is as specified.	Adjust application to comply with the specified film thickness. In the deficient area, apply additional coating material to achieve the specified dry film coating thickness.
Layers of coating are applied within the manufacturer's specified time periods.	Consult coating manufacturer for appropriate remedial action.
For granule-surfaced or aggregate-surfaced coatings, surfacing is applied in a continuous uncured coating at the specified coverage rate to achieve a continuous embedded surfacing.	Immediately adjust operations to ensure embedment of the specified amount. Whenever visual observation indicates an inadequate amount of adhered granules, loose granules are to be removed, and coating and granules are to be reapplied.

Application of Aggregate Surfacing Cover

Aggregate can be applied to low-slope SPF-based roof surfaces to protect the SPF from ultraviolet rays and mechanical damage.

Quality control and quality assurance guidelines are provided here for aggregate-surfaced SPF- based roof systems even though NRCA in the Spray Polyurethane Foam-Based Roofing section of The NRCA Roofing and Waterproofing Manual, Fifth Edition, *does not recognize the use of an aggregate surfacing without the use of a water-resistant elastomeric coating over SPF. Guidelines for design and application of aggregate-surfaced SPF are included in APC/SPFA Document AY-110,* Spray Polyurethane Foam Aggregate Systems for New and Remedial Roofing.

The following chart provides specific criteria and corrective action for the evaluation of aggregate surfacing application.

Evaluation	
Visual examination at the time of application is the most effective means of evaluating aggregate coating application. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.	
Criterion	**Corrective Action**
Aggregate type and size are as specified.	Remove noncompliant materials from the job site.
Aggregate application rate is as specified.	Adjust work practices. Add additional aggregate in the deficient area.
Aggregate is distributed evenly over the roof surface without bare spots.	Redistribute aggregate over the deficient area.

Application of Membrane Surfacing Adhered with Adhesive/Low-rise Foam

This section discusses application of membrane surfacings over SPF using an adhesive/low-rise foam. Membrane surfacings are applied to SPF-based roof systems to protect SPF from ultraviolet rays and mechanical damage and to be the primary weatherproofing surface. Membrane surfacings may also provide other performance criteria (e.g., fire resistance, chemical resistance).

The following chart provides specific criteria and corrective action for the evaluation of the application of membrane surfacing adhered with adhesive/low-rise foam.

Evaluation

Visual examination at the time of application is the most effective means of evaluating membrane surfacing application. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criteria should be corrected as soon as possible.

Criterion	Corrective Action
Membrane surfacing materials are as specified.	Remove noncompliant materials from the job site.
SPF surface is acceptable to receive adhesive/low-rise foam application.	Discontinue adhesive/low-rise foam application until SPF surface is within specification.
Temperature, humidity and ambient conditions are as specified.	Discontinue adhesive/low-rise foam application until conditions are within specification.
Wind conditions are acceptable for proper application and protection against overspray.	Discontinue adhesive/low-rise foam application until wind conditions subside, or use wind screens as necessary.
Equipment is operating at the proper pressure and temperature.	Adjust or repair equipment as necessary to provide pressure and temperature.
Unless otherwise specified, adhesive/low-rise foam and membrane are applied the same day as SPF.	If SPF is exposed for more than 24 hours, consult the adhesive/low-rise foam manufacturer for specific surface preparation instructions.
Membrane surfacing is properly positioned, unrolled and folded.	Do not apply adhesive/low-rise foam until membrane surfacing is properly positioned, unrolled and folded.
Adhesive/low-rise foam is applied uniformly over the entire surface. Consult manufacturer for application rate or thickness and tolerances.	Adjust work practices.

Criterion	Corrective Action
Adhesive/low-rise foam is rising and/or reacting properly.	Remove defective adhesive/low-rise foam. Adjust work practices.
Membrane surfacing is folded into the wet adhesive/low-rise foam and rolled with a weighted roller to secure membrane surfacing into adhesive/low-rise foam.	Adjust work practices.
Appropriately seam the membrane surfacing per manufacturer's recommendations.	Adjust work practices. Reference the *NRCA/SPRI Quality Control Guidelines for the Application of Thermoset Single-ply Roof Membranes.*

Metal Flashings

For SPF-based roof systems, the use of metal flashings, when specified, can be divided into the following three general categories:

- Water conveyance flashings include exterior water collector boxes (e.g., conductor heads), gutters and downspouts.
- Independent watershedding flashings are attached, sealed and mounted above the top edge of a roof covering and penetration flashings. These flashings prevent moisture penetration into wall cavities, behind base flashings, through curb-mounted equipment, or into or behind penetration flashings. Metal coping or cap flashings, surface-mounted counterflashing, curb caps, rain collars and through-wall flashings are examples of independent watershedding flashings. Independent watershedding flashings are independent from a roof system.
- Integral component and edge flashings include metal roof jacks; pipe flashings; through-wall scuppers; electrical utility line penetration flashings; and light-gauge (i.e., 24- or 26-gauge [0.64- or 0.48-mm]) low-profile metal edge flashings (e.g., gravel/foam stops). These types of flashings differ from the other categories in one primary characteristic—they require integration or sealing of their metal flanges directly into a roof system. Metal flashing flanges typically provide a minimum of 3½ inches (90 mm) of sealing surface.

The following chart provides specific criteria and corrective action for the evaluation of metal flashing application.

Evaluation	
Visual examination at the time of application is the most effective means of evaluating metal flashing application. Visual examination may include routine measurements where applicable. During evaluation of an application, reasonable variances from specified amounts are to be expected. Significant deviation from any particular criterion should be corrected as soon as possible.	
Criterion	**Corrective Action**
Metal flanges are primed with specified primer.	Prime metal flanges, and allow to dry before sealing in.
Metal flanges are set in a bed of sealant when specified and secured as specified.	Remove flashing and reinstall as specified, or add fasteners as required to meet specified spacing.
Metal edge laps are sealed as detailed with specified sealant.	Remove flashings sufficiently to install inter-lap sealant.
Metal edge is supported by continuous wood blocking or decking, and flanges are not extended past the wood blocking.	Install wood blocking before metal edge flashing to support metal flanges adequately.

Appendix 1

Spray Polyurethane Foam-based Roof System Quality Control Application Checklists

The following checklists are offered to assist quality control and quality assurance inspectors before and during roof system inspections while roof system application is in progress. These are not specifications and do not cover every detail of SPF-based roof system application inspection procedures.

The intent of these checklists is to guide quality control and quality assurance inspectors by highlighting key appli-

cation areas affecting successful SPF-based roof system performance.

Before application

- ❑ Specifications and drawings are available for review, including specific details.
- ❑ All certifications or approvals have been received for the deck and roof system materials where applicable.
- ❑ Material manufacturers'/suppliers' literature and application specifications and recommendations are available for information and review.
- ❑ Safety precautions and material safety data sheets (MSDS) have been reviewed and are on-site during application.
- ❑ Specified materials and quantities, as verified by on-site inspection of product labels, are at the project site and are visually suitable for application (e.g., packaging is not damaged, labels are intact).
- ❑ Materials are stored according to manufacturers'/suppliers' recommendations (e.g., materials are stored at proper temperature, covered, off the ground and on pallets).
- ❑ Equipment is in good working order and functioning properly.
- ❑ Edge nailers, curbs, drains and penetrations have been installed in the area to receive SPF.
- ❑ Drainage patterns for proper SPF-based roof system installation have been identified.
- ❑ When fastener pull-out tests are specified, tests have been conducted and the results have been approved by the specifier and/or manufacturer.

During application

- ❑ Weather and project conditions are suitable for application.
- ❑ Substrate is sufficiently dry and suitably prepared to receive an SPF-based roof system.
- ❑ When specified, rigid insulation cover boards are butted together with joints staggered and offset.
- ❑ When specified, a separation layer (e.g., cover board, base sheet) is firmly attached to the substrate with the specified type and number of fasteners or is embedded in the specified adhesive.
- ❑ When specified, temporary tie-ins are installed at the end of each day's work as required.

- ❑ Surfacing is applied as specified.
- ❑ Materials and the applied roof system are not abused by other trades.

Appendix 2

Slit Samples/Core Samples

Taking slit samples and core samples during the application of SPF and coatings is important for routine quality control and quality assurance for SPF-based roof systems. Taking slit samples and core samples at the completion of an SPF-based roofing project should not be substituted for quality control and quality assurance provided by continuous visual inspection during application.

Final slit samples and core samples of a completed SPF-based roof system are taken at the discretion of the manufacturer/supplier warranting the roof system.

Appendix 3

Spray Polyurethane Foam Surface Texture Photographs

The following photographs show various SPF surface textures that have been established as industry reference standards.

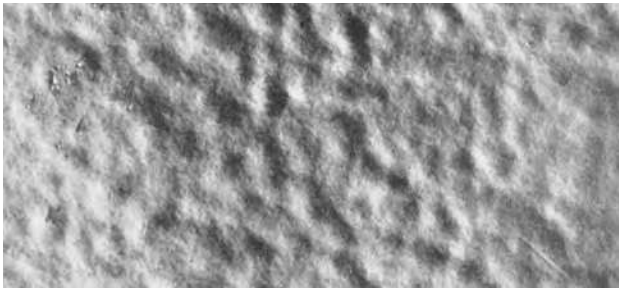

Photo 1: Smooth surface texture
The surface shows spray undulation and is acceptable for receiving an elastomeric coating. Even though the surface texture is classified as smooth, the theoretical coverage rate cannot be used without adding additional material to adequately cover the smooth surface texture to achieve the specified dry film thickness.

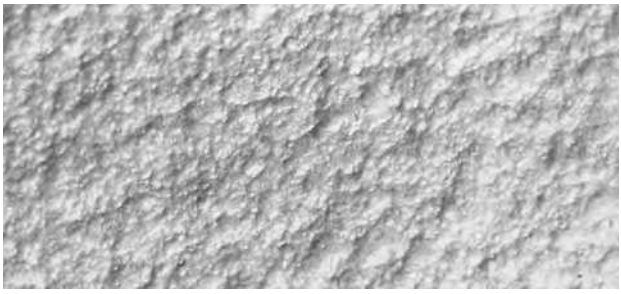

Photo 2: Orange peel surface texture
The surface shows a fine texture that is compared with the exterior skin of an orange. This surface is considered acceptable for receiving a protective coating. The theoretical coverage rate cannot be used without adding additional material to adequately cover the orange peel texture to achieve the specified dry film thickness.

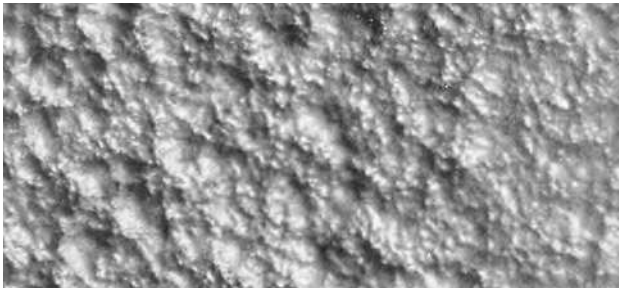

Photo 3: Coarse orange peel surface texture
The surface shows a texture where nodules and valleys are approximately the same size and shape. This surface is acceptable for receiving an elastomeric coating because of the roundness of the nodules and valleys. The theoretical coverage rate cannot be used without adding additional material to adequately cover the coarse orange peel texture to achieve the specified dry film thickness.

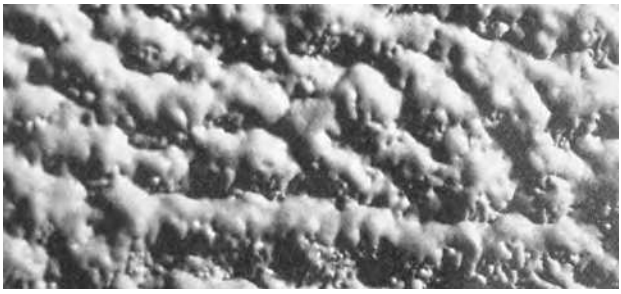

Photo 4: Verge of popcorn texture
The verge of popcorn texture is the roughest texture suitable for receiving an elastomeric coating. The surface shows a texture where nodules are larger than valleys, and the valleys are relatively curved. This surface is acceptable for receiving an elastomeric coating only because of the relatively curved surface texture of the irregularities. However, the verge of popcorn surface texture is considered undesirable because of the additional amount of coating material required to protect the surface properly. The theoretical coverage rate cannot be used without adding additional material to adequately cover the verge of popcorn texture.

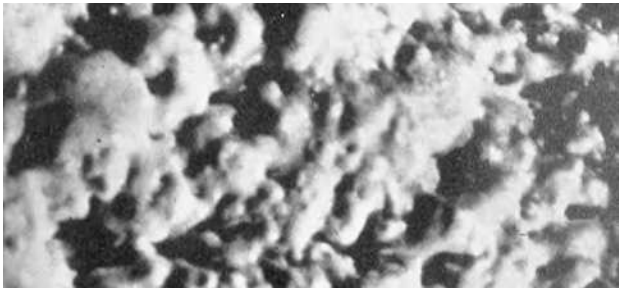

Photo 5: Popcorn surface texture
The surface shows a coarse texture where valleys form sharp angles. This surface is unacceptable for coating.

Photo 6: Treebark surface texture
The surface shows a coarse texture where valleys form sharp angles. It is a "rolling-foam" surface texture where the valleys are sharply angled because the foam is sprayed at an angle. This surface is unacceptable for coating.

Appendix 4

Terminology

For the purpose of this document, terms are defined as follows:

Dry film thickness: the thickness, commonly expressed in mils, of a cured coating material.

Mil: a unit of measure (1 mil is equal to 0.001 inches or 25.4 micrometers) often used to indicate the thickness of a coating.

Slit sample: a small half-moon-shaped cut generally a minimum of 1 inch long by ½ inch wide by ½ inch deep (25 mm by 13 mm by 13 mm) used to measure foam lift thickness and/or coating film thickness.

Spray polyurethane foam (SPF): a material formed by spraying two components, polymeric methylene diphenyl diisocyanate ([A] component and a polyol resin [B]) component], to form a rigid, fully adhered, water-resistant foam plastic.

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