

Manual provides guidelines for SPF roofing professionals

NRCA manual should help advance the art and science needed to produce quality SPF roof systems

by Jim Carlson

The NRCA *Sprayed Polyurethane Foam-Based Roofing Manual* was written to provide unbiased technical information about the design and installation of quality sprayed polyurethane foam (SPF) roof systems. Contractors, manufacturers, consultants, designers and building owners should find this new manual helpful

because it outlines proper roofing practices for SPF roof systems.

The guide begins with a general explanation of SPF roofing. For example, it explains that these systems "are constructed by mixing a two-part liquid that is spray-applied to form the base of an adhered system. The liquid mixture reacts chemically and immediately when applied and

expands from 20 to 30 times its original liquid volume to form a closed-cell foam. As the foam rises, it sets into a solid, and a skin forms on the surface. The foam provides thermal insulation, and the skin provides a water-resistant surface."

Similar to other NRCA roofing manuals, *The NRCA Sprayed Polyurethane Foam-Based Roofing Manual*

Elastomeric coating characteristics chart—part one								
Coating	Solids by volume percentage	Tensile strength (ASTM D 412) PSI (kilopascal)	Elongation (ASTM D 412) percentage	Hardness (ASTM D 2240) shore A	Tear strength (ASTM D 624) lbs/linear inch (kN/m)	Water absorption (ASTM D 471) percentage	Impact resistance (ASTM D 2294) inch-pounds (mJ/m)	Abrasion resistance (ASTM C 501) grams lost
Acrylic	50-65	200-350 [1379-2413]	170-300	40-65	30-40 [23-30]	8-20	20-60 [2260-6780]	0.55-0.85
Butyl	40-60	200-800 [1379-5516]	150-250	45-60	30-50 [23-38]	0.05-1	15-25 [1695-2825]	0.4-0.5
Hypalon	25-35	500-800 [3447-5516]	150-350	70-80	40-80 [30-60]	1-4	35-60 [3955-6780]	0.4-0.6
Silicone	58-65	400-500 [2758-3447]	100-150	40-60	30-40 [23-40]	0.5-1	20-30 [2260-3390]	0.7-1.1
Aromatic urethane	50-100	250-3,500 [1724-24132]	150-600	65-95	100-500 [75-375]	0.5-1	100-160 [11300-18080]	0.015-0.2
Aliphatic urethane	40-85	1,000-3,500 [6895-24132]	150-350	75-95	100-200 [75-150]	0.5-1	40-160* [4520-18080]	0.1-0.25
Modified urethane	80-92	40-200 [276-1379]	50-150	60-70	30-100 [23-75]	0.1-0.5	15-75 [1695-8475]	0.15-0.4

*The low impact resistance of 40 inch-pounds (4520 mN•m) is reported to accommodate aliphatic polyurethane paints that have been modified to become elastomeric in nature.
Source: SPI/PFCD [now known as SPI/SPFD] Coating Committee Document (1986).

Table 1 (part one): Elastomeric coating characteristics.

Source: The Spray Polyurethane Foam Division of The Society of the Plastics Industry Inc., as reprinted in The NRCA Roofing and Waterproofing Manual, Fourth Edition.

is composed of four sections. As stated previously, the document begins with an explanation of SPF roof systems; it is accompanied by sample specifications and specification plates that further define quality SPF roof systems. Also described are acceptable substrates for application, surface preparation and protective surfacings.

In addition, detail drawings are included, depicting general SPF roofing conditions regularly encountered in the field. At the end of the manual is a technical glossary, specific to SPF and its associated concepts and components.

Materials

Quality materials, as well as proper design and application, are the keys to successful SPF installations. Included in the materials section are several important factors for SPF roofing:

■ **Basic physical properties.** Compressive strength and density are two properties critical to achieving quality foam. It is recommended that compressive strength be a minimum of 40 pounds per square inch (280 kPa) and density be a minimum of 2.8 pounds per cubic foot (45 kg/m³).

■ **Thickness guidelines.** Because the two principle components of foam, A (isocyanate) and B (polyolresin), are mixed as liquids and then expand 20 to 30 times their original liquid volumes, establishing minimum and maximum thicknesses for SPF used in roofing is important.

Of course, the thickness of each lift of foam depends on the applicator's skill and spray equipment's metered output. But the SPF manual states, "Optimum pass thickness should be from ½ to 1½ inches (13 to 38 mm)." The manual explains that, except to feather or taper the SPF at termination points, pass thicknesses less than ½ of an inch (13 mm) are not recommended.

The manual further clarifies:

"Single pass thicknesses greater than 1½ inches (38 mm) are acceptable, provided special polyurethane foam formulations are used. However, the manufacturer's recommended maximum pass

thickness for the formulation being used should not be exceeded."

■ **Surface texture.** One of the indications of properly formulated and applied SPF is the appearance of the foam's surface texture. Terms

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used to describe textures are: orange peel, coarse orange peel, verge of popcorn, popcorn, tree-bark, off-ratio foam, and pinholes or blowholes.

The manual states that SPF's surface texture is a function of many variables, but there are three principle contributing factors: 1. proper equipment adjustment; 2. environmental effects (i.e., wind, temperature and humidity); and 3. knowledgeable, skilled applicators.

Protective coatings

Also included in the manual is information about surface coatings (e.g., acrylic, butyl rubbers, Hypalon, silicones and urethane elastomers) used to protect SPF. Information is provided about the coatings' ultraviolet and fire resistances, weatherability, color retention, permeance, required application temperature, cure time, and base and top coat specifics. The manual also contains recommended dry film thicknesses for commonly used SPF coatings.

In addition, tables are included that identify various coating characteristics, along with reference standards that convey information about each coating type (see Table 1, part one). **Note:** Part two of this table can be found in the manual.

Design considerations

To achieve quality SPF roof systems, NRCA recommends that designers specify physical property requirements, as well as consult with material manufacturers and professional roofing contractors so specific project needs can be addressed. Project needs described in the document are: applicability and restrictions, wind resistance, building and thermal movement, drainage, roof deck and substrate requirements, vapor retarders, fire resistance, some relative building code information and recommendations for detailing.

Application specifics

Among the topics explained in the

application chapter are general job-site conditions, safety and material handling, material delivery and storage, and application of SPF and spray-applied coatings.

In addition, information is provided about humidity, temperature, and wind and moisture limitations, including:

■ **Humidity.** "[SPF] should not be applied under humid conditions when the roof deck's surface temperature is less than 5 F (3 C) above the dew point, as measured by a psychrometer at the job site."

■ **Temperature.** "[SPF] should not be applied when the roof deck's surface temperature is below 50 F (10 C), as measured by a surface pyrometer, unless low-temperature-sensitive materials are provided by the foam material supplier. Extremes of temperature, when surfaces for [SPF] application are either too cold (less than 50 F [10 C]) or too hot (more than 160 F [70 C]), can affect foam quality with respect to physical properties, as well as surface texture and adhesion."

■ **Wind.** "[SPF] should not be applied when wind conditions exist that prevent application with acceptable surface texture or cause overspray on surfaces not intended for coverage by either [SPF] or the coating. Wind tends to be the most consistent variable factor."

"In general, practical experience has shown that foam should not be sprayed when wind speeds exceed 12 mph (19.3 km/h) [at roof height] unless some form of wind shield is used. Foam formulation cream times, in combination with severe wind conditions, may have an effect on the foam's surface."

Information also is provided about how to achieve quality SPF roofing applications, as well as troubleshoot off-ratio foam.

For example, if the proportioning of A and B components is off-ratio, and there is excess polyol or resin (B), the foam will exhibit one or

more of the following characteristics: light color; slow or insufficient rise; soft or spongy texture; improper cell structure; mottled surface or coarse, orange-peel texture; or pinholes or blowholes.

On the other hand, if the A and B components are misproportioned, and there is excess isocyanate (A), the condition can be difficult to detect unless the proportioning is off-ratio with a significant excess of isocyanate. Foam formed with a slight excess of isocyanate is not affected as seriously as when there is an excess of polyol.

However, a more extreme case of excess isocyanate will produce foam that exhibits one or more of the following characteristics: dark color; smooth, hard surface; irregular glassy cell structure; brittle or friable; improper density; or improper rise and/or yield.

The application chapter also provides information about coating defects, including pinholing, blistering and cracking.

Details

In addition, the SPF manual contains details that depict 25 SPF roof system conditions regularly encountered on roofing projects; they are drawn in isometric and section views. All details depicting vertical termination of coatings and flashings show sheet-metal counterflashing, which helps promote long-term roof system performance.

Summing it up

The NRCA Sprayed Polyurethane Foam-Based Roofing Manual provides technical information tailored solely to roofing. SPF roof systems and their applications are highly technical—they should be applied by trained applicators and contractors knowledgeable about the specifics of SPF and associated protective surfacings. This manual should help to advance the art and science needed to produce quality SPF roof systems. **PR**

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