Designation: D 5469 – ~~93~~00

Standard Guide for Application of New Spray Applied Polyurethane Foam and Coated Roofing Systems[1]

This standard is issued under the fixed designation D 5469; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers the application of new roofing systems consisting of ~~sprayed~~ spray applied polyurethane foam insulation, elastomeric protective coatings, and optional mineral granules. This guide does not apply to retrofit or remedial applications.

1.2 Design criteria associated with the installation of ~~sprayed~~ spray in place polyurethane foam are beyond the scope of this specification.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety ~~problems~~, concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 1029 Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation[2]

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[1] This guide is under the jurisdiction of ASTM Committee ~~D-8~~ D08 on Roofing, Waterproofing, and Bituminous Materials and is the direct responsibility of Subcommittee D08.06 on Spray Polyurethane Foam Roof Systems.

Current edition approved ~~Oct. 15, 1993.~~ July 10, 2000. Published ~~D~~ September ~~1~~ 2000. Originally published as D 5469 – 93. Last previous edition D 5469 – 93.

D 451 Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products[3]
D 1079 Terminology Relating to Roofing, Waterproofing, and Bituminous Materials[3]
D 1621 Test Method of Compressive Properties of Rigid Cellular Plastics[4]
D 1622 Test Method for Apparent Density of Rigid Cellular Plastics[4]
D 2856 Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer[5]
D 4442 Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials[6]

2.2 *Other Standard:*

SSPC SP-6 Steel Structures Painting Council[7]

2.3 *Other Documents:*

Underwriters Laboratories, *Roofing Materials and Systems Directory*[8]
Factory Mutual Research Corporation, Loss Prevention Data Sheets 1–28[9]
Society of
Alliance for the Plastics Industry Polyurethane Division Bulletin Polyurethane Industry AX119 *Guide for the Safe Handling and Use of Polyurethane and Polyisocyanurate Foam Systems*
SPI/PFCD Bulletins: [10]
AY-102 Guide[10]
Spray Polyurethane Foam Alliance Documents:[10]
AY-102 Guide for Selection of Protective Coatings Over Sprayed Spray Polyurethane Foam Roofing Systems
AY-104 Sprayed Polyurethane Foam Roofing Systems for New and Remedial Roofing
AY-106 Introduction to
AY-118 Moisture Vapor Transmission
NRCA Roofing and Waterproofing Manual, Spray Polyurethane Foam-Based Roofing Systems
AY-108 Protective Coatings Manual
NRCA/SPFA Quality Control Guidelines for the Application of Spray Polyurethane Foam Roofing Systems
AY-118 Moisture Vapor Transmission
2.4 Roofing
NRCA/SPFA Manual for Inspection and Maintenance of Spray Polyurethane Foam-Based Roof Systems, A Guide for Building Owners

NOTE 1—*Details: Details*
—Numerous Numerous details are found in the referenced documents, in foam and coating manufacturers literature and from other sources. These details are to be considered general in nature. They should not be used without modification to allow for movement between the building, roofing, roof top equipment, and roof drainage systems.

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology D 1079.

[2] *Annual Book of ASTM Standards*, Vol 04.06.
[3] *Annual Book of ASTM Standards*, Vol 04.04.
[4] *Annual Book of ASTM Standards*, Vol 08.01.
[5] *Annual Book of ASTM Standards*, Vol 08.02.
[6] *Annual Book of ASTM Standards*, Vol 04.109.
[7] Available from Steel Structures Painting Council, 4400 5th Ave., Pittsburgh, PA 15213.
[8] Available from Underwriters Laboratories Inc., 333 Pfingsten Rd., Northbrook, IL 60062.
[9] Available from Factory Mutual Research Corporation, 1151 Boston-Providence Tpke., Norwood, MA 02062.
[10] Available from Spray Polyurethane Foam Contractors Division, The Society of the Plastics Industry, Inc., 1275 K St., NW, Alliance, 1300 Wilson Boulevard, Suite 400, Washington, DC 20005. 800, Arlington, VA 22209.

3.2 *Definitions of Terms Specific to This Standard:* Figs. 1-6 show the various types of polyurethane foam surfaces.

3.2.1 *coarse orange peel surface*—a surface of spray applied polyurethane foam that is slightly rough, having irregularities that form obtuse angles with the plane of the surface.

3.2.2 *core samples*—cylindrical sections of approximately ~~2~~ 50 to ~~3 in. (50 to~~ 75 mm (2 to 3 in.) diameter. They shall be cut using a round metal template or coring tool, and they shall extend from surface down to substrate.

3.2.3 *lift*—a single application of spray applied polyurethane foam.

3.2.4 *lightweight or insulating concrete fill*— concrete made with or without aggregate additions to portland cement, water, and air to form a hardened material which, when oven dried, will have a unit weight of 800 kg/m^3(50 lb/ft^3 ~~(800 kg/m^3~~) or less.

3.2.5 *orange peel surface*—a surface of spray applied polyurethane foam that is relatively smooth, but has a slightly rippled or dimpled appearance.

3.2.6 *popcorn surface*—a surface of spray applied polyurethane foam that is extremely rough, having irregularities that form angles which are perpendicular to the plane of the surface.

3.2.7 ~~*rippling verge*~~*verge of popcorn surface*—a surface of spray applied polyurethane foam that is moderately rough, but does not exhibit sharp angles perpendicular to the plane of the surface.

3.2.8 *slit samples*—crescent-shaped samples approximately ~~1 in. (25 mm)~~ 25 mm (1 in.) long and 12.5 mm (~~½ in. (12.5 mm)~~ in.) in depth. They are used to check coating surface quality and coating adhesion and thickness.

3.2.9 *smooth surface*—a surface of spray applied polyurethane foam that is relatively smooth.

3.2.10 *tree bark surface*—a surface of spray applied polyurethane foam that is extremely rough and irregular, having undercuts (upper surface of foam overhangs a lower surface) and usually accompanied by pinholes.

4. Significance and Use

4.1 This guide outlines general procedures and precautions necessary for correct and safe application of spray applied polyurethane foam roofing systems.

4.2 This guide is not all-inclusive; this guide is intended only to supplement detailed instructions from manufacturers and safety requirements established by law.

4.3 Refer to Polyurethane Foam Contractors ~~Division AY-104,~~ Alliance AY-104 and NRCA Spray Polyurethane Foam-Based Manual for industry guidelines.

5. Substrate Requirements

5.1 *General Requirements*:

5.1.1 Application shall conform to codes having jurisdiction.

5.1.2 All substrates shall be clean and free of moisture, dust, oil, grease, and release agents or other contaminants.

5.1.3 If a vapor retarder is specified, it should be installed in accordance with instructions of the vapor retarder manufacturer and be compatible with the spray applied polyurethane foam and substrate being covered. Refer to SPI/PFCD document AY-118.

5.1.4 If a primer is specified or required, it shall be installed to a clean surface in accordance with the primer manufacturer's instructions. The primer must be suitable for the substrate, be able to meet service temperature requirements, be compatible with the spray applied polyurethane foam, and acceptable to the foam manufacturer.

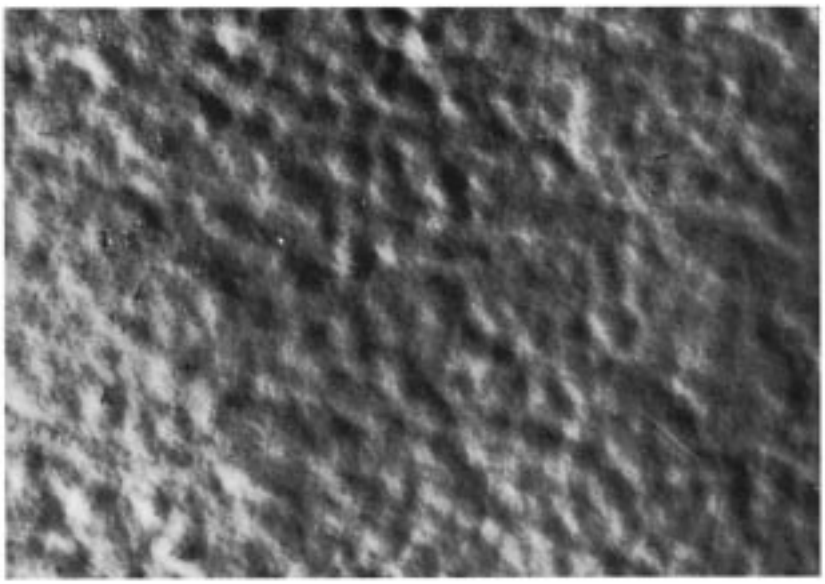

FIG. 1 Polyurethane Foam Texture—Smooth

FIG. 2 Polyurethane Foam Texture—Orange Peel

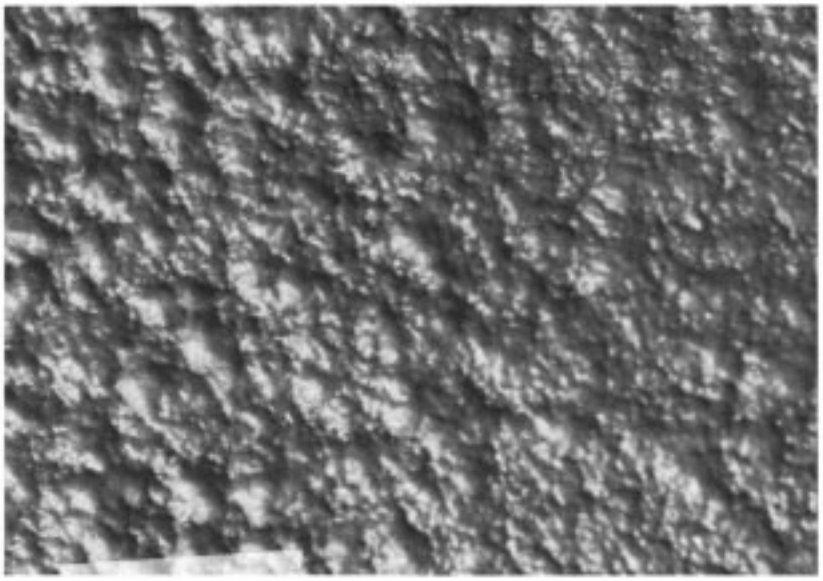

FIG. 3 Polyurethane Foam Texture—Coarse Orange Peel

5.2 *Metal*:

5.2.1 Metal decks shall conform to requirements of the Steel Deck Institute[11], American Iron and Steel Institute (AISI)[12], American Society of Civil Engineers (ASCE)[13], 7-88 and Factory Mutual Research Corporation (FMRC)[9].

5.2.2 *Surface Preparation*:

5.2.2.1 *Ferrous Metal*— Sandblast iron and steel surfaces which are not primed, shop painted, or otherwise protected in accordance with SSPC SP-6. Remove loose rust and unsound primer from shop-primed iron and steel surfaces. The sandblasted area shall be primed the same day.

5.2.2.2 *Non-Ferrous Metal*—Clean and prime all surfaces as recommended by primer and foam manufacturer.

[11] This guide is under the jurisdiction of ASTM Committee D08 on Roofing, Waterproofing, and Bituminous Materials and is the direct responsibility of Subcommittee D08.06 on Spray Polyurethane Foam Roof Systems.

Current edition approved July 10, 2000. Published September 2000. Originally published as D 5469 – 93. Last previous edition D 5469 – 93.

[12] Americal Iron and Steel Institute, 1133 15th ~~Street,~~ St., Suite 300, Washington, DC 20005-2701.

[13] American Society of Civil Engineers, 345 ~~East~~ E. 47th ~~Street,~~ St., New York, NY 10017.

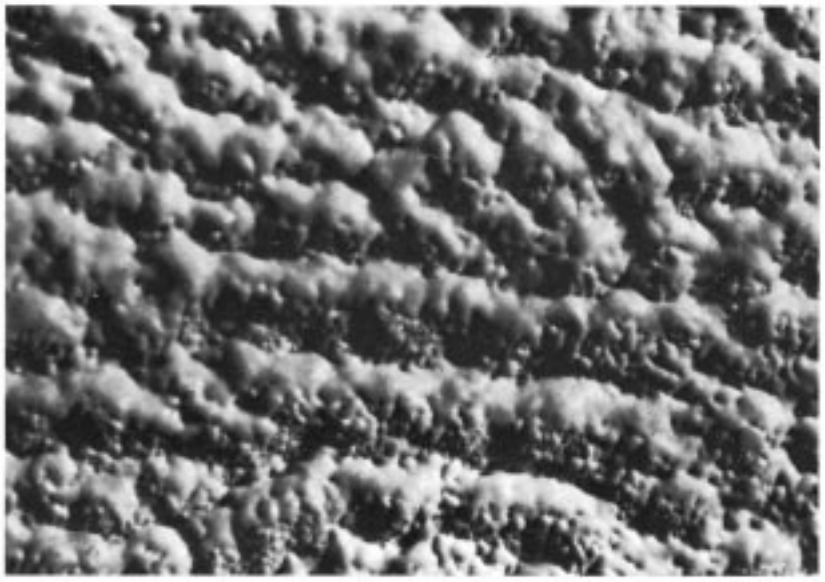

FIG. 4 Polyurethane Foam Texture—Rippling Verge of Popcorn

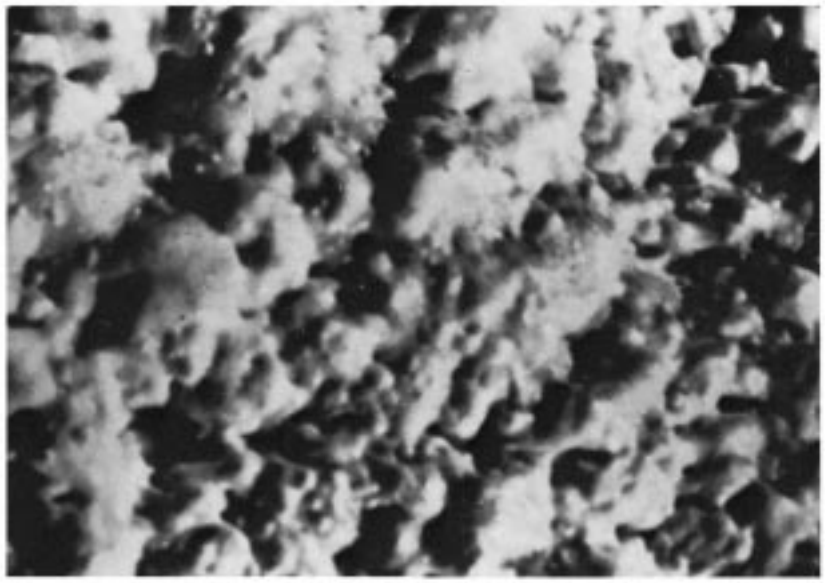

FIG. 5 Polyurethane Foam Texture—Popcorn

5.2.2.3 Fluted metal decks shall have flutes filled, covered, or taped with materials and procedures approved by the manufacturer of the polyurethane foam, prior to spray applied polyurethane foam application.

5.2.3 Lightweight corrugated roofs, which are secured to meet industry standards, shall meet the surface requirements in 5.2.1 and 5.2.2.

5.3 *Concrete*:

5.3.1 All joints and cracks that exceed 6 mm (¼ in.) shall be filled, covered, or taped with materials and procedures approved by the manufacturer of the polyurethane foam, prior to application of spray applied polyurethane foam.

5.3.2 Primer, if required, shall be as recommended by the primer or polyurethane foam manufacturer.

5.3.3 Sprayed polyurethane foam is not recommended directly over lightweight nonstructural concretes.

5.4 *Wood*:

5.4.1 Wood shall contain no more than 18 % moisture, as measured in accordance with Test Methods D 4442.

5.4.2 Wood surfaces shall be primed with exterior grade primer as recommended by the primer and polyurethane foam manufacturers.

5.4.3 Wood joints in excess of 6 mm (¼ in.) shall be taped or filled with materials and procedures approved by the manufacturer of the polyurethane foam.

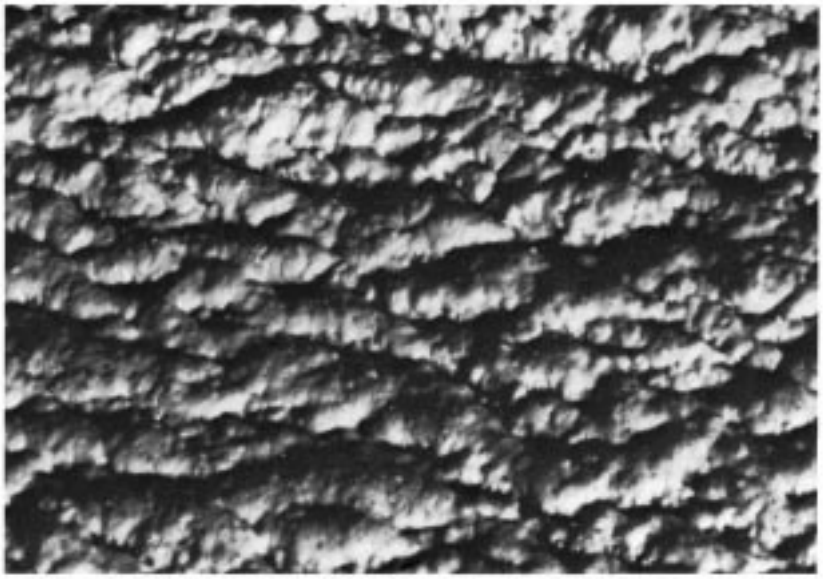

FIG. 6 Polyurethane Foam Texture—Tree Bark

5.4.4 Wood plank must be overlaid with a material, approved by the polyurethane foam manufacturer and secured by methods proven to meet the wind resistance requirements of FMRC, Underwriters Laboratory (UL), and local building codes.

5.5 *Gypsum Board*:

5.5.1 Boards shall be firmly butted together and mechanically fastened. Joints exceeding 6 mm (¼ in.) shall be filled or taped with materials and procedures approved by the manufacturer of the polyurethane foam.

5.5.2 Wet gypsum is not acceptable (see 9.10).

5.5.3 Cleaning by power brooming is not permitted.

6. Slope

6.1 The finished roofing system shall be sloped a minimum of 6 mm/m (¼ in./ft) to minimize ponding.

7. Equipment

7.1 The spray applied polyurethane foam shall be metered and mixed through equipment capable of providing a ratio of equal parts of "A" (isocyanate) component and "B" (polyol) component, by volume to within an accuracy of ±2 %.

7.2 Spray applied polyurethane foam ratio control shall be monitored by equipment pressure gages, which indicate constant pressure, and by uniform color of the spray applied polyurethane foam.

7.3 Spray applied polyurethane foam equipment shall provide temperature control of the "A" component and "B" component to within an accuracy of ~~±5°F (2.8°C).~~ 2.8°C (±5°F).

7.4 Spray equipment used to apply coating shall be in accordance with the coating manufacturer's recommendations.

8. Safety Requirements

8.1 All handling, storage, applications, and end use safety precautions shall be as outlined by the material manufacturers and SPI Polyurethane Division Technical Bulletin AX119.

8.2 Refer to appropriate Material Safety Data Sheets (MSDS) for additional safety information.

8.3 Conform to local codes and ordinances.

9. Polyurethane Foam Material and Application Requirements

9.1 The spray applied polyurethane foam shall meet the physical requirements of Specification C 1029 Type III.

9.2 The spray applied polyurethane foam lifts must be applied in a thickness of 12.5 mm (½ in.) or greater. The foam manufacturer must be consulted if the foam is to be applied in lifts greater than 37 mm (1½ in.).

9.3 The total spray applied polyurethane foam thickness shall be a minimum of one in. (or more if specified). The total thickness of the spray applied polyurethane foam shall be as specified ~~+-~~ 6 mm (¼ – 0 in.), except where variations are required to ensure drainage or to complete a tapered edge.

9.4 Areas to be built up in order to prevent ponding are to be filled in with spray applied polyurethane foam before the specified thickness is applied to the entire roof surface.

9.5 At parapet walls, building junctions, and penetrations, the spray applied polyurethane foam shall be terminated a minimum of 100 mm (4 in.) above the roof line. The coating system shall be carried an additional 100 mm (4 in.) above the foam. Foamed

in place cants shall be smooth and continuous to allow positive drainage.

9.6 The final configuration of the spray applied polyurethane foam surface shall not be excessively rough. “Verge of popcorn” spray polyurethane foam surfaces are acceptable if sufficient additional coats are applied to ensure a uniform coating at the dry film thickness specified.“ Popcorn” or “tree bark” surfaces are not acceptable. These areas shall be removed and refoamed to an acceptable surface.

9.7 Any damage or defects to the spray applied polyurethane foam surface shall be repaired prior to the protective coating application.

9.8 Spray applied polyurethane foam shall not be applied when the roof deck surface temperature is below ~~50°F (10°C),~~ 10°C (50°F), as measured by a surface pyrometer, unless low temperature sensitive materials are provided by the foam material supplier. Spray applied polyurethane foam shall not be applied under humid conditions exceeding manufacturer’s recommendations or when the roof deck surface temperature, as measured by a psychrometer is less than ~~5°F (15°C)~~ 15°C (5°F) above the dew point, as determined at the job site.

9.9 Spray applied polyurethane foam shall only be applied to a previously prepared roof deck surface that is free of loose dirt, dust, oil, grease, and other contaminants that will interfere with proper adhesion.

9.10 All accessory sheet metal shall be solvent cleaned and primed in accordance with the primer and polyurethane foam manufacturer’s recommendations.

9.11 Spray applied polyurethane foam shall not be applied in rain, snow, fog, or mist. The surface to which spray applied polyurethane foam is applied shall be dry. The presence of surface moisture can be determined by the use of moisture detection paper (MDP).[14]

9.12 Spray applied polyurethane foam shall not be applied when wind conditions exist that prevent application with acceptable surface texture (see 9.6) or that cause overspray on surfaces that are not intended for coverage by either spray applied polyurethane foam or the coating system.

9.13 The full thickness of spray applied polyurethane foam, in any area, shall be completed prior to the end of each day. Permissible exceptions shall be lead edges.

9.14 Care shall be taken not to block drainage from adjacent masonry, stone, or other building components. Use care when installing flashing so as not to close weep holes originally designed to allow escape of water.

10. Coating—Material and Application Requirements

10.1 Refer to Guide ~~AY-102 and Protective Coatings AY-108.~~ AY-102.

10.2 Consult manufacturer’s directions for all pertinent data specific to the type of coating being applied and approved application methods.

10.3 Install the coating in thickness and number of coats recommended by the manufacturer of the coating.

10.4 The spray applied polyurethane foam surface shall be free of moisture, frost, dust, debris, oils, tars, grease, or other materials that will impair adhesion of the protective coating.

10.5 Apply coating in two or more coats. Each coat shall be applied at right angles to the preceding coat. Preferably use successive coats of contrasting color to provide visual monitoring of the application.

10.6 The coating shall not be spray applied when the wind conditions exist that prevent uniform application of the coating or that cause overspray on surfaces that are not intended to be coated.

10.7 The coating shall be applied to at least ~~four in.~~ 100 mm (4 in.) beyond all terminal edges of spray applied polyurethane foam, where applicable, and the substrate shall be masked to provide a neat, finished appearance.

10.8 The base coat should be applied the same day as the spray applied polyurethane foam application. In no case shall less than two hours or more than 24 h elapse between application of the spray applied polyurethane foam and the base coat. If, due to weather conditions, or any other circumstances, the application of coating cannot be made within 24 h then the surfaces shall be evaluated as to the suitability for coating (see 10.4). The owner, or the coating manufacturer, or both, shall be informed and a course of action mutually agreed upon.

10.9 The base coat shall be smoothly applied at the specified thickness with the rate of application being governed by the spray applied polyurethane foam surface texture. “Verge of popcorn” spray applied polyurethane foam requires more coating to achieve given mil thickness and the applicator shall apply the necessary additional coating to any such areas. Coatings shall be applied at such rate as to given the minimum dry film thickness specified by the protective coating manufacturer.

10.10 The base coat shall be allowed to cure and be inspected for pinholes, thinly coated areas, uncured areas or other defects. Defects shall be repaired prior to subsequent coating applications (see 10.12). The base coat shall be free of dirt, dust, water, or other contaminants before application of the additional coats specified. Recoating time parameters must conform to the manufacturer’s recommendation.

10.11 Finish coats shall be applied in a manner to ensure adhesion between coats (see 10.10). Surface texture of spray applied polyurethane foam will affect dry film thickness. Additional material may be required in areas of coarse spray applied polyurethane foam profile.

[14] Kit (paper and presser) available from North Carolina Foam Industries, Inc., P.O. Box 1528, Mount Airy, NC 27030 has been found satisfactory for this purpose.

10.12 No exposed polyurethane foam shall be visible and all spray applied polyurethane foam shall be continuously coated without thin spots, holidays, blisters or pinholes. All defects must be recoated to minimum coating requirement and all pinholes shall be filled.

10.13 No foot traffic over finished areas of the roof surface shall be permitted until the coating is properly cured as specified by the coating manufacturer.

11. Granule—Material and Application Requirements

11.1 Granules, when specified, shall be continuously embedded in the topcoat.

11.2 Apply mineral granules continuously over the final layer of the coating while it is still wet. (Excess or loose granules shall be removed from the surface to avoid drain blockage.)

11.3 Mineral granules shall be applied at a rate based on the manufacturer's recommendations.

11.4 Mineral granules shall be number 11 screen size with 100 % mass passing a 2.36 mm (No. 8) sieve and 98 % mass retained on a 425 mm (No. 40) sieve as determined in accordance with Test Method D 451.

12. Walkway—Material and Application Requirements

12.1 Where specified, heavy traffic areas require additional protection in the form of porous, non-asphaltic walk pads, fabric reinforcements or embedded ~~granules. See PFCD publication AY-106.~~ granules.

13. Sampling

13.1 If specified, two core samples shall be made in the first 929 m^2(10 000 ft^2 ~~(929 m^2)~~) of roof area and one for each additional 929 m^2(10 000 ft^2 ~~(929 m^2)~~) or fraction thereof. Additionally, when specified, slit samples should be taken as required.

13.2 Core samples are used to determine spray applied polyurethane foam thickness, lift thickness, compressive strength (Test Method D 1621), density (Test Method D 1622), and cell structure (Test Method D 2856). They also indicate adhesion and coating thickness.

13.3 Slit samples are used to determine the number of coats applied and the dry film thickness of the coating system.

13.4 Holes left by removal of core samples shall be filled with spray applied polyurethane foam or foam plug set in compatible sealant and coated to match the fluid-applied coating as recommended by the coating manufacturer. Slits and other surface defects shall be repaired in accordance with the coating manufacturer's published technical guidelines.

13.5 Refer to NRCA/SPFA Quality Control Guidelines for the Application of Spray Polyurethane Foam Roofing, for corrective measures.

14. Inspection

14.1 Inspection procedures of the roofing system shall be determined by the purchaser and the seller and be included in the contract.

14.2 Refer to NRCA/SPFA Manual for Inspection and Maintenance of Spray Polyurethane Foam-Based Roof Systems, A Guide for Building Owners for industry guidelines.

15. Keywords

15.1 application; coatings; insulation (thermal); roofing; spray applied polyurethane foam