

SSPC: The Society for Protective Coatings

Coating Application Standard No. 14

Application of Thick Film Polyurea and Polyurethane Coatings to Concrete and Steel Using Plural-Component Equipment

1. Scope

This standard provides requirements for the field application of polyurea, polyurethane, or polyurea/polyurethane hybrid thick film coatings to concrete or steel surfaces using plural component spray equipment. In this standard, thick film coatings are defined as coatings specified to have greater than 500 micrometers [μm] (20 mils) dry film thickness. Surface preparation, pretreatments, machinery requirements and parameters are addressed in this standard.

2. Referenced Standards

2.1 The latest issue, revision, or amendment of the referenced documents in effect on the date of invitation to bid shall govern unless otherwise specified.

2.2 If there is a conflict between the requirements of any of the referenced documents and this standard, the requirements of this standard shall prevail.

2.3 SSPC STANDARDS AND JOINT STANDARDS:

PA 9 Measurement of Dry Coating Thickness on Cementitious Surfaces Using Ultrasonic Gages

2.4 ASTM INTERNATIONAL STANDARDS¹

C 805 Standard Test Method for Rebound Number of Hardened Concrete

D 4138 Standard Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means

D 4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

D 4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates

D 6132 Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage

D 7091 Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals

2.5 NACE INTERNATIONAL STANDARDS:²

SP0188 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Surfaces

2.6 INTERNATIONAL CONCRETE REPAIR INSTITUTE GUIDELINE³

Guideline 310.2 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

3. Definitions

Concrete: A composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate, usually a combination of fine aggregate and coarse aggregate; in Portland cement concrete, the binder is a mixture of Portland cement and water.

Outgassing: The spontaneous discharge of air or moisture vapor from concrete.

Pores: Small interconnected voids, such as in concrete, which allow fluids to penetrate an otherwise impervious material.

4. Qualifications of Craftworkers

The contractor shall provide documentation that the craftworker(s) applying the coating have received formal training on proper plural-component coating application techniques and that the operator(s) of the spray pump(s) have received formal training on material ratio, material viscosity, mixing, ambient conditions for application and curing, product data sheets, material safety data sheets, proper setup and monitoring of the plural-component pump(s) being used, and

¹ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

² NACE International, 1440 South Creek, Houston, TX 77084 phone: 281-228-6200. NACE standards may be obtained online from <http://www.nace.org>

³ ICRI International Concrete Repair Institute, 3166 S. River Road, Suite 132, Des Plaines, IL 60018, phone: 847-827-0830. ICRI standards may be obtained online from <http://www.icri.org>

troubleshooting basics (see Note 15.1). Formal training shall include a written exam and hands-on assessment.⁴

5. Surface Condition of Concrete Prior to Application of Coating

5.1 SURFACE SOUNDNESS: Before application of coating, the concrete substrate shall be sound and solid as determined by ASTM C 805 (see Note 15.2). Surface defects such as bugholes, voids, and cracks shall be repaired as specified prior to coating application.

5.2 SURFACE CLEANLINESS: When viewed without magnification, the concrete surface shall be free of visible dust, dirt, greases, and oils, contaminants, laitance, and loosely adhering concrete. See Note 15.3 for information regarding requirements for nonvisible contaminants.

5.3 PROFILE: Unless otherwise specified, the surface roughness shall be within CSP range 2-6 when evaluated in accordance with ICRI 310.2.

5.4 JOINTS: Unless otherwise specified, coatings and surfacings shall not be placed over functional joints (see Note 15.4).

6. Surface Condition of Steel Prior to Application of Coating

6.1 SURFACE CLEANLINESS

6.1.1 Visible Contaminants: Immediately prior to coating application, the steel surface shall meet specified requirements for visible surface cleanliness. The steel surface shall be prepared in accordance with project requirements for surface cleanliness. If these requirements are not provided in the project specification, the surface shall meet the requirements of the manufacturer's product data sheet for the coating to be applied.

6.1.2 Nonvisible Contaminants: Immediately prior to coating, the steel surface shall meet the specified requirements for maximum levels of nonvisible contaminants (see Note 15.3).

6.2 SURFACE PROFILE: Unless otherwise specified, a minimum profile of 76 μm (3 mils) measured in accordance with ASTM D 4417 Method B is required for thick film coatings⁵.

7. Coating Materials Handling

7.1 The proper PPE shall be utilized when handling the individual components of the system as well as during mixing and application. Polyurea and/or polyurethane coatings are formed from isocyanate and resin blend components. The

isocyanate components are known to be skin and respiratory irritants and sensitizers, and the aromatic amines are considered to be potential carcinogens. The resin blend component is frequently corrosive in nature, and capable of causing other adverse health effects. Refer to material manufacturer's Material Safety Data Sheets for information on proper PPE and additional safety information. SSPC-TU 8 also provides additional information.

7.2 All coating products shall be delivered to the work site in original, unopened containers with labels intact. Minor damage to containers is acceptable if the container has not been punctured or crimped or has had the lid seal broken. Each product shall have a readily accessible manufacturer's material safety data sheet.

7.3 Each container shall be clearly marked or labeled to show coating identification, date of manufacture, batch number, basic chemical composition, special instructions, and other information as needed to meet governmental requirements.

7.4 STORING: Coating materials shall be stored in accordance with applicable federal, state and local safety regulations. Storage temperatures shall be within the range specified in the material product data sheets. If product is exposed to temperature outside of specified range, the coating manufacturer shall be contacted. All containers of coating shall remain unopened until required for use. Containers shall be opened only as necessary to provide material to the painters. The data on the container label shall remain legible throughout the use of the contents.

7.5 MIXING

7.5.1 Each component of the coating shall be thoroughly mixed in accordance with the manufacturer's instructions and then applied by the plural component equipment in the ratio recommended by the manufacturer.

7.5.2 The mixing and application process shall comply with specified safety requirements for product use, including ventilation, dust control and protective personal equipment.

8. Pre-Application Checks

8.1 AMBIENT CONDITIONS: Coating shall not be applied in rain, wind, snow, fog, or mist. Coating shall not be applied to wet or damp surfaces unless the manufacturer has provided written documentation that permits application under these conditions. Coating shall not be applied on frosted or ice-coated surfaces.

8.2 TEMPERATURE: For both concrete and steel substrates, the surface temperature of the substrate, the temperature of the coating to be applied, and the ambient air temperature shall comply with the coating manufacturer's written requirements prior to and throughout the coating application and curing process. Coating shall not be applied when

⁴ Note that successful completion of SSPC's Marine Plural Component Program (MPCAC, C14) will satisfy this requirement. Other training courses covering the material listed in Section 4.1 may be available

⁵ SSPC-PA 17, Method for Determining Conformance to Steel Profile/Surface Roughness/Peak Count Requirements, references ASTM D 4417 and contains additional acceptance criteria.

the temperature of the substrate, coating, or surrounding air is outside the manufacturer's recommended range without the written approval of the manufacturer and the owner. Coating shall not be applied to a concrete substrate when the temperature of the concrete substrate exceeds the surrounding air temperature and is rising, unless the coating manufacturer has provided written documentation that permits application under these conditions (see Note 15.5).

8.3 HUMIDITY: Coating shall be applied within the specified relative humidity range. If no range is specified, the humidity shall remain within the range provided on the product data sheet throughout the application process. Coating shall not be applied in rain, fog, or mist or when the surface temperature is less than 3 °C (5 °F) above the dew point.

8.4 CONCRETE SUBSTRATE MOISTURE: Immediately prior to coating application, the moisture level of the concrete shall comply with the coating manufacturer's requirements as determined by the measurement method specified on the product data sheet. If the product data sheet does not state the measurement method and acceptable moisture level, the coating manufacturer shall be contacted to provide written instructions for determining an acceptable moisture level (see Note 15.6).

8.5 STEEL SUBSTRATE MOISTURE: Steel surfaces shall be dry and free of any water in seams, fastener areas, or joints.

8.6 MASKING: Required masking and protection shall be in place prior to startup of coating application.

9. Application Equipment Requirements

9.1 The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the coating to be applied, and shall be equipped with suitable pressure regulators and gauges. The equipment shall be maintained in proper working condition. Spray equipment shall meet the material transfer requirements of the local air pollution or air quality management district.

9.2 Spray equipment shall be kept sufficiently clean so that dirt, dried coating, and other foreign materials are not deposited in the coating film. Any solvents left in the equipment shall be removed before the equipment is used.

9.3 SPRAY EQUIPMENT MATERIAL PRESSURE: High- or low-pressure plural-component spray equipment is used for processing these coatings. For high-pressure spraying, equipment shall be capable of producing the required fluid pressures in order to get adequate mixing in the spray gun (see Note 15.7).

9.4 PROCESS TEMPERATURE CONTROL: The spray equipment shall be capable of heating the fluid materials consistently and continually to the processing temperatures

recommended by the coatings manufacturer. Machine and hose heaters shall be capable of preheating material stored in accordance with requirements of the product data sheet to its required application temperature.

9.5 SPRAY GUN PARAMETERS: The spray gun shall be able to mix and dispense the thick film coating in a desired pattern defined by the coating manufacturer. The gun, throughput, and tip sizes shall be chosen to make the designated dry film thickness attainable in one to three overlapping passes.

10. Project Test Area

10.1 Unless otherwise specified, a project test area shall be prepared, coated, and cured according to the requirements of the coating manufacturer's product data sheet and of this standard prior to full-scale production. The test area shall be on the structure itself or on a sample representative of the substrate to be coated, and shall be no smaller than 1 square meter [m²] (3 square feet [ft²] in size. Following application and cure of the coating, adhesion testing shall be performed on the test area according to Section 10.2 or 10.3 to confirm quality of the application and establish operating parameters for full-scale surface preparation and coating application.

10.2 STEEL SUBSTRATES: Following cure, adhesion testing shall be performed on the test specimen or test area in accordance with ASTM D 4541, Method D or E, using three pulls. The minimum adhesion value for each of the three pulls shall be at least 6.8 megaPascals [MPa] (1000 pounds per square inch gauge [psig]) unless otherwise specified.

10.3 CONCRETE SUBSTRATES: Following cure, adhesion testing shall be performed on the test specimen or test area in accordance with ASTM D 7234. The location of the disbondment for each of the three pulls shall be within the concrete substrate (i.e., cohesive failure of the concrete). Results of the tests shall be reported to the owner's representative.

11. Application Process Requirements

11.1 The contractor shall maintain a daily application log, including, but not limited to: processing pressure, material temperatures, mixing ratios throughout the application process, and other monitoring requirements as specified. These records shall be retained for a minimum of three years after project completion, unless a longer term is required by contract documents.

11.2 Cleaning and coating shall be so programmed that detrimental amounts of dust or other contaminants do not fall on wet, newly coated surfaces.

11.3 APPLICATION OF PRIMER: Unless otherwise specified, the primer shall be applied in accordance with instructions in the manufacturer's product data sheets. Coating shall be applied in a visually continuous film of with overlapping at the

edges of the spray pattern. Prior to application of topcoat, primer shall meet manufacturer's required DFT range unless otherwise specified. All thin spots or areas missed in the application shall be prepared, recoated, and permitted to dry before the next layer of coating is applied. During application, the gun shall be held perpendicular to the surface and at a distance that will ensure that a wet layer of coating is deposited on the surface.

11.4 APPLICATION OF TOPCOAT OR OVERCOAT:

Unless otherwise specified, no coating shall be applied until the preceding coat has dried/cured to the extent recommended by the manufacturer (see Notes 15.8 and 15.9). Unless otherwise specified, a coating shall not be applied to a dried coating that has exceeded the "maximum time to recoat" recommended by the manufacturer (see Note 15.9).

When the maximum recoat time is exceeded or when topcoating an existing fully cured coating, the existing coating shall be mildly abraded, solvent washed, or otherwise treated according to the manufacturer's recommendation before applying the next coat.

11.5 COATING THICKNESS ON STEEL SUBSTRATES:

When measured in accordance with requirements of SSPC-PA 2, the dry film thickness of each coat shall be as specified in the project specification. If not specified, the DFT shall be as required by the coating manufacturer's product data sheet (see Note 15.10). Dry film thicknesses of coatings shall be measured in accordance with ASTM D 6132 or ASTM D 7091 (nondestructive), or ASTM D 4138 (destructive). The latter test will require repair of the damaged dry coating.

11.6 COATING THICKNESS ON CONCRETE SUBSTRATES: When measured in accordance with requirements of SSPC-PA 9, the dry film thickness of each coat shall be as specified in the project specification. If not specified, the DFT shall be as required by the coating manufacturer's product data sheet. Dry film thicknesses of coatings shall be measured in accordance with ASTM D 6132 (nondestructive), or ASTM D 4138 (destructive). The latter test will require repair of the damaged dry coating.

11.7 CONTINUITY: Unless otherwise specified, all coatings shall be applied so that the cured film is continuous, i.e., pinhole-free.

Unless otherwise specified, the dried/cured film of coating shall be inspected for discontinuities in accordance with ASTM D 4787 or NACE SP0188. Any discontinuities found or areas damaged during this testing shall be repaired as specified.

12. Drying/Curing of Applied Coating

12.1 CURE: The adequacy of cure of coatings shall be determined as specified, or, if not specified, in accordance with method specified on the manufacturer's product data sheet. Inadequately cured coatings shall be replaced or treated as specified by the owner (see Note 15.8).

12.2 Coating shall not be force-dried in a manner that will cause checking, wrinkling, blistering, formation of pores, or otherwise adversely affect the appearance or the protective properties of the coating.

12.3 The applied coating shall be protected from all detrimental effects and materials, such as rain, condensation, contamination, snow, and freezing, until drying/curing has sufficiently occurred to the extent that no damage will occur to the protective film.

12.4 Unless otherwise specified, applied coating shall be not placed in service until it is thoroughly dried/cured in accordance with manufacturer's written instructions (see Note 15.10).

13. Repair of Coated Surfaces (Steel or Concrete)

13.1 Unless otherwise specified, all loose, cracked, brittle, or non-adherent coating or lining shall be removed.

13.2 Unless otherwise specified by the product data sheet or project specification, the surface of the intact coating shall be abraded for a minimum distance of 9 centimeters [cm] (3-1/2 inches) surrounding the area of damage. The cleaned surface shall be roughened as specified. If no requirements are provided in the project specification, the surface shall be roughened to the degree required by the product data sheet for the specified coating system. The edges of the repair area shall be feathered into the intact coating.

13.4 The abrasion shall be followed with a solvent wipe of the abraded area, using the coating manufacturer's recommended solvent. The area wiped shall extend a minimum of 2.5 cm (1 inch) beyond the feathered area onto intact coating to provide a smoother transition and better bonding.

13.5 If primer is required, compatible primer shall be applied to the area to be repaired and the abraded area, and allowed to cure according to requirements of the product data sheet.

13.6 The repair coating shall then be applied to the primed or abraded area in accordance with requirements of Sections 8 through 12. The repair coating shall extend 2.5 cm (1 inch) beyond the feathered area onto intact coating to provide a smoother transition and better bonding.

14. Disclaimer

14.1 While every precaution is taken to ensure that all information furnished in SSPC standards is as accurate, complete, and useful as possible, SSPC cannot assume responsibility nor incur any obligation resulting from the use of any materials, coatings, or methods specified herein, or of the standard itself.

14.2 This standard does not attempt to address problems concerning safety associated with its use. The user of

this standard, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for ensuring compliance with all governmental regulations.

15. Notes

Notes are not requirements of this standard.

15.1 QUALIFICATIONS OF CONTRACTOR: Contractors or shops that are certified to SSPC-QP 1 or SSPC-QP 3/AISC 420-10 (for application of coating to steel substrates) or SSPC-QP 8 (for application of coatings to concrete substrates) should employ craftworkers meeting the requirements of Section 4.

15.2 ICRI Guide 320 and NACE SP0390-2009 listed in the Additional Reading section are sources of additional information about repair techniques for damaged concrete. Specific requirements for treatment or repair of surface voids, bugholes, and other surface defects should be included in the project specification.

15.3 NONVISIBLE CONTAMINANTS: The contracting parties should be aware that other nonvisible contaminants may have an effect on coating performance. Coatings manufacturers should be consulted for recommendations of maximum surface contamination allowed. The project specification should establish what level of nonvisible contaminants may remain, and the test method or procedure to be used for determining the level of remaining nonvisible contaminants.

15.4 SSPC-TR 5 contains information about treatments of joints and cracks in concrete prior to application of coating.

15.5 The requirement for the concrete/substrate temperature to be greater than 3 °C (5 °F) above the dewpoint temperature and rising is a general caveat to prevent outgassing. The exact temperatures will vary among manufacturers for the various formulations, but this can be used as a general rule of thumb.

Outgassing can be minimized by avoiding application when the surface temperature is rising. The use of an appropriate primer/sealer will minimize outgassing in the thick film coating. An application technique frequently used to minimize outgassing/pinholes is to apply a thin discontinuous layer of coating prior to application of the full coat to gently warm the substrate.

15.6 The plastic sheet test (ASTM D 4263) is a simple qualitative test to indicate the presence of detrimental amounts of moisture in concrete. ASTM E 1907 and ASTM F 1869 are quantitative tests that provide actual moisture transmission rates. Moisture meters give only qualitative results but do so quickly. For some types of moisture meters, only the surface moisture is recorded unless nails are driven into the concrete. ASTM F 710 and ASTM F 2170 are additional test methods that may be useful in determining the suitability of a concrete surface for coating application.

15.7 Typically pressures range from 12-20 MPa (1800-3000 psi), or in accordance with manufacturer's recommendation for high pressure. Low-pressure spray equipment will have typical ranges in the 0.3 to 2 MPa (50 to 300 psi) range, since mixing occurs manually through an aftermixer element/chamber.

15.8 Application of coating before the preceding coat has dried/cured may result in such adverse effects as lifting, wrinkling, or loss of adhesion of undercoats.

15.9 Typical coating thicknesses range from 500 to 3000 µm (20 to 120 mils). Thickness requirements for polyureas and other coatings that dry immediately upon application are determined by use of dry film thickness readings alone.

15.10 If the maximum time for topcoating is exceeded, the undercoat will require complete removal or a special surface treatment, such as light sanding, as recommended by the coating manufacturer.

16. ADDITIONAL READING

The documents listed below may be consulted for additional information:

SSPC AND JOINT DOCUMENTS

- QP 1, Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors
- QP 3/AISC 420-10, Certification Standard for Shop Application of Complex Protective Coating Systems
- QP 8, Standard Procedure for Evaluating the Qualifications of Contracting Firms that Install Polymer Coatings and Surfacing on Concrete and Other Cementitious Substrates
- SP 13/NACE No. 6 Surface Preparation of Concrete
- SSPC-TR 5/ICRI 03741/NACE 02203, Design, Installation, and Maintenance of Protective Polymer Flooring Systems for Concrete
- SSPC-TU 2/NACE 6G197 Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment
- SSPC-TU 8, The Use of Isocyanate-Containing Paints as Industrial Maintenance Coatings
- SSPC-TU 10, Procedures For Applying Thick Film Coatings and Surfacing Over Concrete Floors

ACI INTERNATIONAL (ACI) DOCUMENTS⁶

- ACI 201.1R-08, Guide for Conducting a Visual Inspection of Concrete in Service
- ACI 224.1R, Causes, Evaluation, and Repair of Cracks in Concrete Structures
- Guideline 310.1R, Guide for Surface Preparation of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion

⁶ American Concrete Institute (ACI) 38800 Country Club Drive, Farmington Hills, MI 48331 USA. Standards available online from <http://www.concrete.org>

Guideline 320.1R, Guide for Selecting Application Methods for
the Repair of Concrete Surfaces
ACI 504R, Guide to Joint Sealants for Concrete Structures

ASTM STANDARDS

- D 4263, Standard Test Method for Indicating Moisture in
Concrete by the Plastic Sheet Method
- E 1907, Standard Practices for Determining Moisture-Related
Acceptability of Concrete Floors to Receive Moisture-
Sensitive Finishes
- F 710, Standard Practice for Preparing Concrete Floors to
Receive Resilient Flooring
- F 1869, Standard Test Method for Measuring Moisture Vapor
Emission Rate of Concrete Subfloor Using Anhydrous
Calcium Chloride
- F 2170, Standard Test Method for Determining Relative
Humidity in Concrete Floor Slabs Using in situ Probes

NACE INTERNATIONAL STANDARD

SP0390-2009, Maintenance and Rehabilitation Consider-
ations for Corrosion Control of Atmospherically Exposed
Existing Steel-Reinforced Concrete Structures

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