

SSPC: The Society for Protective Coatings

Coating Standard No. 45

Two-Component, Thick-Film Polyurea and Polyurea/Polyurethane Hybrid Coatings, Performance-Based

1. Scope

1.1 This standard contains minimum performance requirements for two types of two-component polyurea coatings and two types of polyurea/polyurethane hybrid coatings evaluated by laboratory testing.

2. Description

2.1 General Information: Coatings meeting the requirements of this standard are suitable for use on steel or concrete substrates. These coatings may be applied directly to the substrate or may require the use of a compatible primer, and may be applied in single or multiple coats. These coatings typically have a high film build (greater than 508 micrometers [μm] or greater than 20 mils) and are applied either by plural-component, high-pressure, high-temperature spray equipment, or by plural-component, low-pressure, static-mixer type equipment, depending upon the characteristics of each formulation.

2.2 Service Environments: These coatings are suitable for service in SSPC Environmental Zones 1A (interior, normally dry), 1B (exterior, normally dry), 2A (frequently wet by fresh water, excluding immersion), 2B (frequently wet by salt water, excluding immersion), 2C (fresh water immersion), and 2D (salt water immersion), or in the following environmental zones defined in ISO 12944-2: C1 (very low corrosivity), C2 (low corrosivity), C3 (medium corrosivity), C4 (high corrosivity), C5-I (very high corrosivity, industrial), C5-M (very high corrosivity, marine), Im1 (fresh water immersion), Im2 (seawater immersion), and Im3 (soil immersion). Resistance of these coatings to SSPC Environmental Zones 3B (chemical exposure, neutral), 3C (chemical exposure, alkaline), and 3A (chemical exposure, acidic) will vary based upon formulation.¹ Contact the coating manufacturer for specific chemical-resistance data if required.

2.3 Performance Levels: Two performance levels based on resistance to deterioration by artificial weathering are provided for coatings meeting the requirements of this standard. Coatings meeting Level 1 are suitable for interior exposure. Coatings meeting Level 2 have demonstrated superior resistance to deterioration by artificial weathering (ultraviolet light) and are more appropriate for exterior exposure.

2.4 Resin Types: Coatings meeting the requirements of this standard are typically comprised of polyisocyanate resins and polyamine and /or polyol resin components that react to form polyurea or polyurea/polyurethane hybrid coatings. 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 Safety Data Sheets for information on proper personal protective equipment (PPE) and additional safety information.²

2.4.1 Polyurea (Types 1a and 1b): A polyurea coating is based upon an isocyanate component and a resin blend component composed of amine terminated raw materials.

2.4.2 Polyurea/Polyurethane Hybrid (Types 2a and 2b): A polyurea/polyurethane hybrid coating is based upon an isocyanate component and a resin blend component composed of blends of amine terminated and hydroxyl terminated raw materials.

2.5 Drying Times: It is possible to formulate both Type 1 and Type 2 coatings as (a) non-hindered, fast-cure coatings with typical dry-hard times of less than 2 minutes or (b) hindered³ moderate-cure coatings with typical dry-hard times ranging from 2 minutes to less than 30 minutes.

2.5.1 Non-Hindered Coatings (Type 1a, and Type 2a, Fast Cure): The components of this type of coating react with each other rapidly, giving the coating a short pot life that requires plural-component equipment for spray application. Typical dry-hard times are less than 2 minutes.

2.5.2 Hindered Coatings (Type 1b and Type 2b, Moderate Cure): The components of this type of coating react with each other rapidly, giving the coating a short pot life that requires plural-component equipment for spray application. Typical dry-hard times range from 2 minutes to less than 30 minutes.

A summary of the types of coatings covered by this standard is shown on page 2.

¹ SSPC Environmental Zones are defined in "About SSPC Standards and Guides" available online from <<http://www.sspc.org>>.

² Additional information on regulations and material safety is available at <<https://www.osha.gov/SLTC/isocyanates/>> and from SSPC-TU 8, "The Use of Isocyanate-Containing Paints as Industrial Maintenance Coatings."

³ The term "hindered" refers to the use of sterically hindered amine components that retard the normally high curing rate of polyurea polymers.

Technology	Non-Hindered (Fast Cure)	Hindered (Moderate Cure)
Polyurea	Type 1a	Type 1b
Polyurea/Polyurethane Hybrid	Type 2a	Type 2b

3. Referenced Standards

3.1 The latest issue, revision, or amendment of the referenced documents in effect on the date of invitation to bid shall govern unless otherwise specified. Those documents marked with an asterisk (*) are referenced only in the Notes or Appendices, which are not requirements of this standard.

3.2. If there is a conflict between the requirements of any of the cited reference documents and this standard, the requirements of this standard shall prevail.

3.3 SSPC STANDARDS AND JOINT STANDARDS:

Guide 13	Guide for the Identification and Use of Industrial Coating Materials in Computerized Product Databases
* PA 2	Procedure for Determining Compliance to Dry Coating Thickness Requirements
PA 9	Measurement of Dry Organic Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
PA 15	Material and Preparation Requirements for Steel Panels Used to Evaluate the Performance of Industrial Coatings

3.4 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:⁴

D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension (Use Die C sample (similar to ASTM D638 with Type IV sample)
D471	Standard Test Method for Rubber Property – Effect of Liquids
* D523	Standard Test Method for Specular Gloss
D624	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers (use Die C tear)
D638	Standard Test Method for Tensile Properties of Plastics
D714	Standard Test Method for Evaluating Degree of Blistering of Paints
* D1296	Standard Test Method for Odor of Volatile Solvents and Diluents

⁴ ASTM International, 100 Barr Harbor Road, West Conshohocken PA, 19248. Standards are available online at <<http://www.astm.org>>

* D1475	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
* D1535	Standard Practice for Specifying Color by the Munsell System
D1640	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
D1734	Standard Practice for Making Cementitious Panels for Testing Coatings
D1849	Standard Test Method for Package Stability of Paint
D2240	Standard Test Method for Rubber Property – Durometer Hardness
* D2369	Standard Test Method for Volatile Content of Coatings
* D2371	Standard Test Method for Pigment Content of Solvent-Reducible Paints
* D2621	Standard Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
D4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser (use H 18 wheel)
D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
* D6132	Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage
D6289	Standard Test Method for Measuring Shrinkage from Mold Dimensions of Molded Thermosetting Plastics
D6943	Standard Practice for Immersion Testing of Industrial Protective Coatings
* D7091	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
D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
E96	Standard Test Method for Water Vapor Transmission of Materials
* G14	Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)
G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

3.5 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:⁵

Z129.1 Hazardous Industrial Chemicals –
Precautionary Labeling

3.6 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION STANDARD:⁶

ISO 12944 Paints and Varnishes – Corrosion
protection of steel structures by
protective paint systems Part 2:
Classification of environments.

4. Composition Requirements

4.1 RESIN REQUIREMENT: The resin system shall produce either polyurea-based or polyurea/polyurethane hybrid polymers (see Section 2.3 and Notes 12.1 and 12.2).

4.2 ANALYTICAL TEST DATA: If required, the coating manufacturer shall provide certificates of analysis for coating batches qualified by independent testing to meet this standard for use in verifying batch-to-batch consistency of material (see Note 12.2 and subsections).

5. Standard Testing Conditions

5.1 STEEL TEST PANELS: Triplicate panels shall be prepared for each test unless otherwise required by the standardized method for performance of the test. The hot-rolled steel panels shall conform to SSPC-PA 15. If priming is required by the coating manufacturer, all test panels shall be coated with primer in accordance with the manufacturer's written recommendations.

5.2 CONCRETE TEST PANELS: Triplicate panels shall be prepared for each test unless otherwise required by the standardized method for performance of the test. Concrete test panels shall meet requirements of ASTM D1734. Panel size shall be 76 x 152 x 14 millimeters [mm] (or 3 x 6 x 9/16 inches) or greater unless otherwise specified. If priming is required by the coating manufacturer, all test panels shall be coated with primer in accordance with the manufacturer's written recommendations.

5.3 APPLICATION: The coating shall be spray applied in a single coat or multiple coats, following the directions on the manufacturer's product data sheet.

5.4 DRY FILM THICKNESS: The dry film thickness (DFT) of the test panels shall meet the manufacturer's written recommended minimum thickness and shall not exceed the minimum by more than 381 μm (15 mils). If there is no recommended film thickness, then the DFT of each coat shall be 1270-1524 μm (50 to 60 mils). The DFT on steel test panels shall be measured in accordance the procedure in mandatory

Appendix A. Note that the DFT requirements of this section are intended for laboratory testing applications, and are not to be considered as requirements for field service (see Note 12.3) The DFT on concrete test panels shall be measured in accordance with SSPC-PA 9 (Restriction Level 3).

5.5 CURE: Before any testing, the coating shall be dried and cured in accordance with the manufacturer's written recommendations, or otherwise, shall be aged for a minimum of 5 days in an environment with a relative humidity of 50 ± 10 percent and an ambient temperature of 25 ± 2 degrees C (77 ± 5 degrees F).

6. Requirements of Liquid Components

6.1 APPLICATION PROPERTIES: All guidance provided by the manufacturer regarding mixing of multi-component products, and special application requirements shall be followed. The coating shall show no streaking, running, or sagging during application or while drying.

6.2 PACKAGE STABILITY: Package stability shall be tested in accordance with ASTM D1849. Storage conditions shall comply with the requirements of the manufacturer's product data sheets. Change in consistency greater than 15 percent or noncompliance with the application requirements shall be cause for rejection.

7. Physical Tests of Applied Films

7.1 DRY TIME: Spray the coating onto test panels of the specified substrate (see Section 5.1 or 5.2) at the maximum thickness recommended by the manufacturer. Test the coating for dry-hard time in accordance with ASTM D1640.

7.1.1 A Type 1a or Type 2a (non-hindered) coating must be dry in less than 2 minutes.

7.1.2 A Type 1b or Type 2b (hindered) coating must be dry in less than 30 minutes.

7.2 TENSILE STRENGTH: A test sample with a thickness of $1270 \pm 381 \mu\text{m}$ (50 ± 15 mils) or as specified shall have a minimum tensile strength of 10.3 megaPascals [MPa] (1200 pounds per square inch [psi]) when evaluated in accordance with ASTM D638, Type IV or ASTM D412, Die C.

7.2.1 Tear Strength (Die C tear): When tested in accordance with ASTM D624 a test sample of 1270 ± 381 micrometers (50 ± 15 mils) shall show a minimum Die C Tear equal to or greater than 35 kiloNewtons per meter [kN/m] (approximately 200 pounds per linear inch [pli]).

7.2.2 Elongation: When tested in accordance with ASTM D638 Type IV or D412 Die C, the minimum elongation shall be 100% for applications over cementitious substrates where substrate cracking could occur and over seam movement areas on steel substrates. The minimum elongation shall be 50 percent for applications over solid metallic substrates.

⁵ American National Standards Institute, 1819 L Street, NW, Washington, DC 20036. Standards are available online at <<http://www.ansi.org>>.

⁶ International Organization for Standardization, Case Postale 56, CH-1121 Geneva 20, Switzerland. Standards are available online at <<http://www.iso.org>>.