

SSPC: The Society for Protective Coatings

COATING STANDARD NO. 41

Moisture-Cured Polyurethane Primer or Intermediate Coat, Micaceous Iron Oxide Reinforced, Performance-Based

1. Scope

This standard contains requirements and acceptance criteria for laboratory evaluation of the performance of moisture-cured aromatic polyurethane coatings having thermoset binders and micaceous iron oxide pigment reinforcement. The coating may be applied either directly to a steel substrate, or over itself or a compatible primer such as SSPC-Paint 40 or other primers recommended by the coating manufacturer.

2. Description

2.1 Coatings meeting requirements of this standard are single-package moisture-cured polyurethane coatings characterized by the presence of free isocyanate groups capable of reacting with atmospheric moisture to form a solid film.

2.2 Coatings meeting the requirements of this standard are generally suitable for exposures 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), 3B (chemical exposure, neutral) and 3C (chemical exposure, alkaline). Primer/intermediate coat systems described in this standard meet the performance requirements of Section 7.4 of SSPC-Paint 40 (including Environmental Zone 2C Fresh Water Immersion).

2.3 Moisture-cured polyurethane coatings are typically applied by spray, but may be applied by brushing or rolling if recommended by the manufacturer.

2.4 UNITS OF MEASURE: This standard makes use of both the ASTM SI 10, "American National Standard for Metric Practice" International System Units (SI) and U.S. Customary units. The measurements are not exact equivalents; therefore, each system must be used independently of the other.

3. Referenced Standards

3.1 The date of the referenced standard in effect at the time of publication of this standard shall govern unless otherwise specified. Those documents marked with an

asterisk (*) are referenced only in the Notes or the Appendix, 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:

PA 2	Measurement of Dry Coating Thickness with Magnetic Gages
PA 15	Material and Preparation Requirements for Steel Test Panels Used to Evaluate the Performance of Industrial Coatings
PA 16	Method for Evaluating Scribe Undercutting on Coated Steel Test Panels Following Corrosion Testing
Paint 40	Zinc-Rich Moisture-Cured Polyurethane Primer, Performance-Based

3.4 AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) STANDARD:⁽¹⁾

- * T 339-10 Standard Method of Test for Analysis of Structural Steel Coatings for Isocyanate Content

3.5 ASTM INTERNATIONAL STANDARDS:⁽²⁾

- * D523 Standard Test Method for Specular Gloss
- * D562 Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
- D714 Standard Test Method for Evaluating Degree of Blistering of Paints
- * D1296 Standard Test Method for Odor of Volatile Solvents and Diluents
- * D1475 Standard Test Method for Density of Liquid Coatings, Inks, and Related Product

⁽¹⁾ American Association of State Highway and Transportation Officials (AASHTO), 444 North Capitol Street, NW Suite 249, Washington, DC 20001, phone 202-624-5800. Standards available online from <<https://bookstore.transportation.org/>>

⁽²⁾ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Standards available online from <http://www.astm.org>.

- * 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
- D1849 Standard Test Method for Package Stability of Paint
- D1654 Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
- * D2244 Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
- * 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
- D2794 Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- * D3359 Standard Test Methods for Rating Adhesion by Tape Test
- D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- D5894 Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
- * D6677 Standard Test Method for Evaluating Adhesion by Knife
- SI 10 American National Standard for Metric Practice

3.6 UNITED NATIONS STANDARD:⁽³⁾

GHS Globally Harmonized Standard of Classification and Labelling of Chemicals

4. Composition Requirements

4.1 VOC CONTENT: Coatings meeting requirements of this standard shall comply with all applicable federal, state, and local VOC regulations (see Note 12.1).

⁽³⁾ United Nations Economic Commission for Europe, Transport Division, Palais des Nations, CH - 1211 Geneva 10, Switzerland. Copies of this standard may be obtained from the United Nations Publications Customer Service, National Book Network, 15200, 15200 NBN Way, Ridge Summit PA 17124 <<https://unp.un.org/Details.aspx?pid=23481>>

4.2 PIGMENT REQUIREMENT

4.2.1 Micaceous iron oxide is a required pigment component in these coatings (see Note 12.2 for typical formulation percentage ranges). The manufacturer shall provide information on the micaceous iron oxide content if requested.

4.2.2 Optional pigment components include extenders, tinting colors and suspension control agents.

4.3 RESIN REQUIREMENT: The resin used in the coating shall be a polyisocyanate-based product that cures through a chemical reaction with atmospheric moisture. Use of other resins or modifiers shall be limited to products necessary for formula ingredient compatibility and to improve recoating properties. See Note 12.3 for information on modifying resins.

4.4 ANALYTICAL TEST DATA: If mutually agreed upon by purchaser and supplier, the coating manufacturer shall provide certificates of analysis for coating batches qualified by independent testing to meet this standard, including petrographic analysis of the percentage of lamellar particles present in the micaceous iron oxide pigment.

5. Test Panel Preparation

Triplicate test panels shall be prepared in accordance with SSPC-PA 15.

6. Requirements of Liquid Coating

6.1 PACKAGE STABILITY: Package stability shall be tested in accordance with ASTM D1849. Storage conditions shall be 30 days at 52 ± 1 °C (125 ± 2 °F). A change in consistency of greater than 10 Krebs Units or noncompliance with the viscosity requirements stated on the manufacturer's product sheet shall be cause for rejection.

6.2 APPLICATION PROPERTIES: All guidance provided by the manufacturer regarding mixing of multi-component products, thinning requirements, induction times, and special application requirements shall be followed. The coating shall be applied by single component-airless spray, electrostatic spray, conventional spray equipment such as HVLP, or brush and roller (depending upon its formulation and application characteristics) in accordance with the instructions on the applicable data sheet. The coating shall show no streaking, running, sagging or other defects during application or while drying.

7. Laboratory Tests of Applied Coatings

7.1 RECOATABILITY: If applicable, substrate and inter-coat adhesion properties of the applied coatings shall be

determined by measurements of adhesion values between

- a) primer and the substrate
- b) intermediate coat and the primer

Coating manufacturers shall provide acceptable window (time frame) ranges between applications of coats in a multi-coat system. Unless the purchaser specifically requests a variance, the maximum dry film thickness and the curing time (with reported conditions for temperature and humidity) as stated on the manufacturer's product data sheets shall be used for coating application prior to adhesion testing.

7.2 PRIMER ADHESION TO STEEL SUBSTRATE:

Apply the primer to steel panels and cure according to the manufacturer's recommendations. Adhesion shall be tested according to ASTM D4541, Method C, D, or E. Report the type of adhesion tester employed and the type of adhesive used for testing. Perform three pulls on each of three test panels. Unless a higher value is specified, the minimum adhesion value of the primer to the substrate for each pull shall be 4.1 MPa (600 psi). The instrument used to verify compliance to this standard (i.e., batch-to-batch consistency, see Section 4.4) shall be of the same type used to perform the initial testing (see Note 12.4).

7.3 INTERMEDIATE COAT ADHESION TO THE

PRIMER: Apply the intermediate coat to the primed panels and cure according to the coating manufacturer's recommendations. Adhesion shall be tested as described in Section 7.2. Intercoat adhesion is defined as the force required to separate the topcoat from the underlying coat.

Perform three pulls on each of the three test panels. Unless a higher value is specified, the minimum intercoat adhesion for each pull shall be 4.1 MPa (600 psi). The instrument used to verify compliance to this standard (i.e., batch-to-batch consistency, see Section 4.4) shall be of the same type used to perform the initial testing.

Tables 1 and 2 provide a summary of performance requirements for laboratory and accelerated testing.

8. Accelerated Laboratory Weathering Requirements

8.1 CYCLIC SALT SPRAY/UV/CONDENSATION

CABINET: Triplicate panels prepared in accordance with Section 5 shall be exposed in a cyclic test cabinet in accordance with ASTM D5894 for 1500 hours.

8.1.1 Rust Evaluation: After the specified exposure time, each replicate panel shall have no rusting of the coated portion (a rust rating of 10 per SSPC-VIS 2). Moderate rusting in the scribe mark is permissible and resulting staining shall be ignored. Strips 6 mm (1/4 inch) wide along the edges of the panel shall be ignored.

8.1.2 Blister Evaluation: After the specified exposure time, there shall be no blistering of the coated portion (a rating of 10 per ASTM D714).

TABLE 1
PERFORMANCE REQUIREMENTS
PHYSICAL TESTING

TEST	ASTM RATING METHOD	RESULTS (UNITS)	MINIMUM ACCEPTABLE VALUE
Adhesion (Section 7.2) Primer to Steel and Intermediate Coat to Primer	D4541 Method C, D, or E	MPa (PSI)	4.1 (600)
Direct Impact Resistance	D2794	N•m (lb-force per in ²)	6.8 (60)

TABLE 2
PERFORMANCE REQUIREMENTS
ACCELERATED LABORATORY CYCLIC EXPOSURE

TEST	RATING METHOD	EXPOSURE TIME (HRS)	ACCEPTABLE VALUE
Corrosion after exposure in cyclic accelerated test cabinet (ASTM D5894)			
Rust rating	SSPC-VIS 2	1500	minimum 10
Blister rating	ASTM D714	1500	minimum 10
Scribe undercutting rating	SSPC-PA 16	1500	no greater than 2 mm (1/16 inch) average

8.1.3 Scribe Evaluation: After the specified exposure time, the undercutting from the center of the scribe, evaluated in accordance with SSPC-PA 16, shall be no greater than 2 mm (1/16 in), a rating of 7 per Table 1 of ASTM D1654.

9. Material Quality Assurance

Optional tests used to determine the acceptability of a lot or batch of a qualified coating are listed in Note 12.5 and accompanying sub-sections.

10. Labeling

Labeling shall conform to the GHS labeling of industrial chemicals.

11. Disclaimer

11.1 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.

11.2 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.

12. Notes

Notes are not requirements of this standard.

12.1 VOC CONTENT: U.S. Federal limits for VOCs in industrial maintenance coatings were published in 1998 and may be found at 40 CFR 59, subpart D, National Volatile Organic Compound Emission Standards for Architectural Coatings <http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=4b8291a47d7dbfffc78b40bef17cc383&mc=true&n=sp40.6.59.d&r=SUBPART&ty=HTML#ap40.6.59_1413.1> The Federal limits apply to the coating at the time of manufacture.

Local regulations regarding VOC content, VOC emissions, and container labeling may vary depending on project location. Many state and local governments and/or air quality management areas have more stringent VOC regulations than those in the federal rule. Local regulations frequently apply at the time of application, after thinning according to the manufacturer's recommendations. The coating manufacturer's product data sheet usually provides information on the total VOC content.

12.2 PIGMENT: The typical micaceous iron oxide content for these coatings ranges from 15 to 35% by weight of nonvolatile components.

12.2.1 Micaceous iron oxide pigment is incorporated into coatings for the purposes of improved barrier protection, film hardness, decreased film porosity, and viscosity control. It may also provide improved adhesion to steel substrates, and superior intercoat adhesion properties. Micaceous iron oxide can impart a measure of film reinforcement while relieving stresses that can be developed in the binder

12.2.2 Blends of micaceous iron oxide and aluminum pigments are used in various coating formulations to improve ultraviolet light and water resistance where extended periods of exterior exposure are anticipated prior to application of topcoats.

12.3 MODIFYING RESINS: Other resins or modifiers are typically less than 15% of total resin content.

12.4 TOPCOAT ADHESION: If desired, an adhesion test may be performed to determine adhesion between primer coatings meeting requirements of this standard and compatible topcoats. To test for adhesion, prepare three panels in accordance with Section 5. Apply a compatible topcoat and cure as recommended by the topcoat manufacturer. The thickness of the topcoat shall conform to the manufacturer's recommendations. Test adhesion using an adhesion tester with a self-aligning pulling mechanism as described in ASTM D4541. Report the type of adhesion tester employed. Perform three pulls per panel. The minimum adhesion value of each pull shall be 4.1 MPa (600 psi). In the case of adhesive failure below 4.1 MPa (600 psi), repeat the pull test. The instrument used to verify compliance to this standard shall be of the same type used to perform the initial testing.

In addition to using ASTM D4541, ASTM D3359 (Method A or B, depending on coating thickness) and ASTM D6677 may be specified to assess adhesion.

12.5 QUALITY ASSURANCE TESTS: The quality assurance tests are used to determine whether the supplied products are of the same type and quality as those originally qualified to this standard and accepted for use by the purchaser. The selected tests should accurately and rapidly measure the physical and chemical characteristics of the coating necessary to verify that the supplied material is substantially the same as the previously accepted material. All quality assurance tests must be performed on the originally submitted qualification sample. The results of these tests are used to establish pass/fail criteria for quality assurance testing of supplied products.

12.5.1 Establishing Quality Assurance Acceptance Criteria: Many ASTM test methods contain precision and bias statements. Specification developers should be cognizant of the fact that these statements exist. Quality assurance test criteria should not be more stringent than the inter-laboratory precision of the test methods used. The specifier may require additional technical data to satisfy quality assurance or local regulatory requirements.

Where precision and bias data are not available for a given test method, determine the standard deviation of a minimum of five measurements taken on the originally tested and certified material. The pass/fail criterion is that the measurement of the test sample shall fall within two standard deviations of the target value. The contracting parties should agree on a target value.

12.5.2 Optional Quality Assurance Tests: Quality assurance tests include but are not limited to, infrared analysis (ASTM D2621), viscosity (ASTM D562), weight per gallon (ASTM D1475), total solids (ASTM D2369), dry time (ASTM D1640), percent pigment (ASTM D2371) gloss (ASTM D523), color (ASTM D1535, ASTM D2244), odor (ASTM D1296), and isocyanate content (AASHTO T339-10-UL).

Summary of 2017 Revisions to SSPC-Paint 41

Scope: Addition to scope allows the primer to be used direct-to-steel or as an intermediate coat over a compatible primer.

Section 2.4: This new section clarifies that S.I. and U.S. Custom units listed in the standard are not exact equivalents, and each system must be used independently of the other.

Section 3: Referenced Standards: Standards that are not cited in the 2017 revision have been removed, newly referenced standards (all in the Notes) have been added.

Section 5: Standard Testing Conditions: Requirements for preparation of steel panels for testing have been revised to reference SSPC-PA 15 requirements.

Section 6: Requirements of Liquid Coating: Requirements for mixing, storage life, and working properties have been removed, as they were intended for field application of the coating. They have been replaced by requirements for package stability determined in accordance with ASTM D1849, and requirements to follow the manufacturer's guidance for proper application of the coating prior to field exposure or accelerated performance testing.

Section 7: Laboratory Testing of Applied Coatings: The requirements for adhesion testing have been clarified, but the minimum values required have not changed.

Section 8.1.3 Scribe Evaluation: Now requires evaluation of scribe undercutting data using SSPC-PA 16 (which requires averaging multiple data points) rather than reporting a single maximum reading. Instead of a single maximum point reading of no more than 4 mm (1/8 inch), the average of 18 data points (9 measurements on each side of the scribe) shall be no more than 2 mm (1/16 inch).

Non-Mandatory Notes:

12.1 Volatile Organic Compound language has been revised for clarification.

12.4 A sentence has been added noting that ASTM 3359 and ASTM D6677 may be specified as additional test methods for assessing coating adhesion.

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