

SSPC: The Society for Protective Coatings

PAINT SPECIFICATION NO. 36

Two-Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based

1. Scope

1.1 This specification covers the requirements for a high performance two-component UV-stable polyurethane topcoat (ASTM D 16, Type V polyurethane). It is intended for a topcoat that provides excellent color and gloss retention, not for thick section elastomeric coatings.

1.2 Coatings meeting the requirements of this specification are generally suitable for exposures in 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).

1.3 The specified coating is intended for application by brush, spray, or roller. It is generally applied over a primer or intermediate coating.

2. Description

2.1 This coating is typically based on a hydroxyl functional polyol resin and an aliphatic polyisocyanate co-reactant.

2.2 WEATHERING LEVELS: This specification contains three levels of accelerated and South Florida weathering performance. Table 1 specifies the amount of time the coating must perform before noticeable change in order to achieve the defined performance level. Polyurethane topcoats are available in a wide range of color and gloss. Procurement documents shall state the desired level of performance, exposure method (in accordance with Table 1), color and gloss. For example, a specifier may require

Level 2 Florida exposure, initial gloss greater than 80, matched to a specific color. A certain level of accelerated weathering does not necessarily correspond to a particular level of atmospheric weathering and they need to be specified independently. These are two independent complementary tests for measuring coating performance. If no level is specified, Level 3 will be assumed.

3. Reference Standards

3.1 The standards referenced in this specification are listed in Sections 3.4 through 3.6, and form a part of this specification. A standard marked with an asterisk (*) is referenced only in the Notes, which are not requirements of this specification.

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

3.3 If there is a conflict between the requirements of any of the cited reference standards and this specification, the requirements of this specification shall prevail.

3.4 SSPC STANDARD:

Guide 13 Guide for the Identification and Use of Industrial Coating Materials in Computerized Product Databases

3.5 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:

D 16 Terminology Relating to Paint, Varnish, Lacquer, and Related Products

Table 1
Time Corresponding to Each Performance Level

	Accelerated UV-A Hours to noticeable change*	Florida Exposure Months to noticeable change*
Level 1	500 to 999	12 to 23
Level 2	1000 to 1999	24 to 48
Level 3	2000 or more	48 or more

* Noticeable change is defined as a gloss loss of 30 units measured at a 60° angle (washed with a 0.1 percent solution of mild detergent) or a color change of greater than 2.0 ΔE^* (C.I.E. 1976 $L^*a^*b^*$)

- D 523** Test Method for Specular Gloss
- * **D 562** Test Method for Consistency of Paints Using the Stormer Viscometer
- * **D 968** Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
- D 1014** Practice for Conducting Exterior Exposure Tests of Paints on Steel
- D 1259** Test Methods for Nonvolatile Content of Resin Solutions
- * **D 1296** Test Method for Odor of Volatile Solvents and Diluents
- * **D 1308** Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- D 1475** Test Method for Density of Paint, Varnish, Lacquer, and Related Products
- * **D 1535** Practice for Specifying Color by the Munsell System
- * **D 1640** Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
- D 1849** Standard Method for Package Stability of Paint
- D 2244** Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinate
- D 2369** Test Method for Volatile Content of Coating
- * **D 2371** Test Method for Pigment Content of Solvent-Reducible Paints
- * **D 2621** Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
- D 2698** Test Method for the Determination of Pigment Content of Solvent-Reducible Paints by High Speed Centrifuging
- D 2794** Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- * **D 3359** Test Methods for Measuring Adhesion by Tape Test
- * **D 3719** Test Method for Quantifying Dirt Collection on Coated Exterior Panels
- * **D 4214** Test Methods for Evaluating Degree of Chalking of Exterior Paint Films
- D 4587** Practice for Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus
- * **D 5402** Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs
- * **D 5590** Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

3.5 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD:

Z129.1 Hazardous Industrial Chemicals - Precautionary Labeling

3.6 FEDERAL SPECIFICATIONS AND STANDARDS:

FED-STD-141 Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing

- * **Method 3011** Condition in Container
- Method 4321** Brushing Properties
- Method 4331** Spraying Properties
- Method 4541** Working Properties and Appearance of Dried Film

4. Composition Requirements

4.1 The manufacturer is given wide latitude in the selection of raw materials and manufacturing processes. (See Note 11.1.)

4.2 RESIN REQUIREMENT: The curing agent shall be an aliphatic polyisocyanate. The total coating binder solids shall be made up of at least 17% polyisocyanate by weight. See Annex 1 for the theoretical calculation and the method for actual determination.

5. Requirements of Liquid Coating

5.1 PACKAGE STABILITY: Package stability shall be tested in accordance with ASTM D 1849. Storage conditions shall be 30 days at $52 \pm 1^\circ\text{C}$ ($125 \pm 2^\circ\text{F}$). A change in consistency of greater than 10 Krebs units or noncompliance with the application requirements shall be cause for rejection.

5.2 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 easily applied by brush, roller, or spray when tested in accordance with Fed. Std. 141, Methods 4321, 4331, and 4541. The paint shall show no streaking, running, or sagging during application or while drying.

6. Weathering Requirements

6.1 WEATHERING RESISTANCE: Two weathering test procedures are specified below. Test data may not be available for the desired color and gloss specified. Performance levels are established using whites and light colors. It is left to the discretion of the specifier whether to accept

Florida data from a similar color or to use UV-A data in lieu of Florida weathering data.

6.1.1 Accelerated Weathering: Accelerated weathering shall be performed in accordance with ASTM D 4587, Procedure B. Test panels shall have a primer/intermediate coat as recommended by the manufacturer.

6.1.2 South Florida Weathering: South Florida weathering shall be performed in accordance with ASTM D 1014 (45 degrees south exposure, washed with mild detergent.) Test panels shall have a primer/intermediate coat as recommended by the manufacturer.

6.1.3 Application shall be according to manufacturer's written recommendations. A minimum of three panels shall be exposed. Clear coatings must be tested over the intended basecoat. 60 degree gloss shall be measured according to ASTM D 523 and tristimulus color measured according to ASTM D 2244 both initially and at the end of each level period. A change from initial gloss of less than 30 units or a change from initial color of less than 2.0 ΔE^* (C.I.E. 1976 $L^*a^*b^*$) shall be required to meet the Level as indicated in Table 2 below. Table 2 summarizes the tests of Section 6 as well as the minimum acceptance criteria.

7. Material Quality Assurance

7.1 If the user chooses, tests may be used to determine the acceptability of a lot or batch of a qualified coating. (See Note 11.2.)

8. Labeling

8.1 Labeling shall conform to ANSI Z129.1

8.2 Technical data shall be provided for at least all data elements categorized as "essential" in SSPC-Guide 13.

9. Inspection

9.1 All material supplied under this specification is subject to timely inspection by the purchaser or his authorized representative. The contractor shall replace such material as is found defective under this specification. (See Note 11.3.) In case of dispute, unless otherwise specified, the arbitration or settlement procedure established in the procurement documents shall be followed. If no arbitration procedure is established, the procedure specified by the American Arbitration Association shall be used.

9.2 Samples of paints may be requested by the purchaser and shall be supplied upon request along with the manufacturer's name and identification for the materials. Samples may be requested at the time the purchase order is placed or may be taken from unopened containers at the job site.

9.3 Unless otherwise specified, the sampling shall be in accordance with ASTM D 3925.

10. Disclaimer

10.1 While every precaution is taken to ensure that all information furnished in SSPC standards and specifications 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 specification or standard itself.

10.2 This specification does not attempt to address problems concerning safety associated with its use. The user of this specification, as well as the user of all products or practices described herein, is responsible for instituting appropriate health and safety practices and for insuring compliance with all governmental regulations.

Table 2
Summary of Performance Testing Results to be Reported

Exposure Test	Performance Level	Exposure Time	Measurement Test /Minimum Criteria	
			Color Change ASTM D 2244	Gloss Loss ASTM D 523
Accelerated Weathering ASTM D 4587	Level 1	500 h	Color Change less than 2.0 ΔE^*	Gloss Loss less than 30
	Level 2	1000 h		
	Level 3	2000 h		
South Florida Weathering ASTM D 1014	Level 1	12 mo	Color Change less than 2.0 ΔE^*	Gloss Loss less than 30
	Level 2	24 mo		
	Level 3	48 mo		

11. Notes

Notes are not requirements of this specification.

11.1 VOC CONTENT: Each coating, after recommended thinning, must conform to published government regulations regarding volatile organic compound (VOC) content. VOC information should be supplied on the label or the technical data sheet. Various governmental agencies may have different VOC limits or use different methods of testing. The owner may modify this specification as necessary to specify a particular VOC content limit consistent with local regulations. Coatings meeting the composition and performance requirements of this specification usually have a VOC level between 0 and 450 g/L (0 and 3.75 lb/gal).

11.2 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 tested and certified for acceptance. 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 of the 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.

11.2.1 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 interlaboratory precision of the test methods used.

Example: A common quality assurance test is density (weight per gallon) as measured by ASTM D 1475. The interlaboratory reproducibility at the 95% confidence level tells us that any two measurements that differ by more than 1.8% should be considered suspect. This only represents the precision of the measurement technique and does not account for normal variances in the manufactured product.

The acceptable range for paint density must be stated. For example, a composition specification may state this requirement as 10.0 ± 0.2 lb/gal, 10.0 lb/gal $\pm 2\%$, or as a range from 9.8 to 10.2 lb/gal. The manufacturer of proprietary products should provide this information. Using these values, if the manufacturer's lab measures the density to be 9.8 lb/gal, the product meets the specification and the paint is shipped to the job. Because of the lab to lab variation of 1.8%, the user's lab may measure the density of this sample to be as low as 9.8 less 1.8% of 9.8 (= 9.6 lb/gal). Similarly for the high end, the manufacturer may measure density of 10.2 lb/gal while the user measures $10.2 + 1.8\%$ (= 10.4 lb/gal). The pass/fail criteria for the user to accept a batch of paint should therefore be 9.6 to 10.4 lb/gal.

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 must agree on a target value.

11.2.2 Quality Assurance Tests: Quality assurance tests include but are not limited to: infrared analysis (ASTM D 2621), viscosity (ASTM D 562), weight per gallon (ASTM D 1475), total solids (ASTM D 2369), dry time (ASTM D 1640), percent pigment (ASTM D 2371), gloss (ASTM D 523), color (ASTM D 1535), condition in container (Fed. Std. 141, Method 3011), and odor (ASTM D 1296).

11.3 The procurement documents should establish the responsibility for samples, testing, and any required affidavit certifying full compliance with the specification.

ANNEX

1. Theoretical Calculation for Percent Polyisocyanate by Weight in the Total Vehicle

This example is for the formulator who knows the composition of the coating. Consider just the resin component for this calculation.

	Weight	Weight Solids
Polyol A	100.00	70.00
Aliphatic Polyisocyanate B	<u>30.00</u>	<u>27.00</u>
	130.00	97.00

Fraction (Percent) of polyisocyanate in total vehicle = $27 \div 97 = 0.278$ or 27.8% by weight.

2. Method for Determination of Percent Polyisocyanate in the Total Vehicle

Part 1

Determine the percent non-volatile content by weight, N, of the polyol component only (Component 1) by ASTM 2369.

Determine the percent pigment content by weight, P, of Component 1 by ASTM 2698 (part of ASTM 2369).

Subtract the pigment content from the non-volatile content of Component 1 to obtain the percent non-volatile by weight polyol content, R.

$$R = N - P$$

Part 2

Determine the percent vehicle content by weight of the polyisocyanate curing agent, I, in accordance with ASTM 1259.

Part 3

Obtain the volume mix ratio of Component 1 : Component 2 as supplied from the manufacturer's data sheet e.g.,
 $vol_1 : vol_2$

Measure the specific gravity of each component by ASTM D 1475.

Convert volume mix ratio to weight mix ratio by multiplying by the specific gravity of each component; e.g.,

$$vol_1 \times s.g._1 = wt_1 \quad \text{and} \quad vol_2 \times s.g._2 = wt_2$$

Part 4

Multiply the weight of each component in the weight ratio by their respective percent vehicle solids content by weight, R and I, to obtain the weight vehicle of each component; e.g.,

$$wt_1 \times R = vehicle_1 \quad \text{and} \quad wt_2 \times I = vehicle_2$$

Calculate % polyisocyanate in the binder by dividing the weight of Component 2 vehicle by the sum of the two vehicle solids; e.g.,

$$\% \text{ polyisocyanate} = \frac{vehicle_1}{vehicle_1 + vehicle_2} \times 100$$

Appendix 1: Optional Laboratory Physical Tests of Applied Films

Typical properties that might be expected of a quality polyurethane topcoat are described in Table 3 with corresponding ASTM test methods and suggested test requirements.

Table 3
Typical Properties

Test	ASTM	Result (Units)	Typical Values
Adhesion	D 3359	—	4B or better
Direct impact resistance	D 2794	inch-lbs	30 inch-lbs or better
Abrasion resistance (falling sand)	D 968	liters/mil	15 liters/mil or greater
Solvent (MEK) resistance	D 5402	number of double rubs	50 to 150 DR for MEK
Accelerated fungal resistance	D 5590	disfigurement rating	5 to 10 where 10 is no disfigurement
Quantifying dirt collection on coated exterior panels	D 3719	photographic standard	$\Delta E^* < 2.0$
Evaluating degree of chalking of exterior paints	D 4214	photographic standard rating method	6 to 8 where 10 is no chalking
Effect of household chemicals on clear and pigmented organic finishes	D 1308	—	No visual effects