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Standard Guide for Testing Water-Borne Architectural Coatings¹

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1. Scope

1.1 This guide covers the selection and use of procedures for testing water-borne coatings to be used on exterior, interior or both types of surfaces (Note 1). The properties that can be examined or, in some cases, the relevant test procedures are listed in Table 1 and Table 2.

NOTE 1—The term “architectural coating” as used here combines the definition in Terminology D 16 with that in the *FSCT Paint/Coatings Dictionary*², as follows: “Organic coatings intended for on-site application to interior or exterior surfaces of residential, commercial, institutional, or industrial buildings, in contrast to industrial coatings. They are protective and decorative finishes applied at ambient temperatures. Often called Trade Sales Coatings” (see 2.3).

NOTE 2—Architectural coatings that are designed to give better performance than most conventional coatings because they are tougher and more stain and abrasion resistant are covered by Guide D 3730.

1.2 The types of organic coatings covered by this guide are as follows:

- (1) Type 1 Interior Latex Flat Wall Paints,
- (2) Type 2 Exterior Latex House Paints,
- (3) Type 3 Water-Borne Floor Paints, and
- (4) Type 4 Interior Latex Semigloss and Gloss Paints.

1.2.1 Each is intended for application by brushing, rolling, spraying or other means to the material appropriate for its type, which may include plaster, masonry, wallboard, wood, steel, previously painted surfaces, and other architectural substrates.

1.3 *This standard does not purport to address all of the safety 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:

D 16 Terminology for Paint and Related Coatings, Materials and Applications³

D 185 Test Methods for Coarse Particles in Pigments, Pastes, and Paints⁴
D 215 Practice for the Chemical Analysis of White Linseed Oil Paints³
D 344 Test Methods for Relative Hiding Power of Paints by the Visual Evaluation of Brushouts³
D 358 Specification for Wood to be Used as Panels in Weathering Tests of Coatings⁵
D 522 Test Methods for Mandrel Bend Test of Attached Organic Coatings³
D 523 Test Method for Specular Gloss³
D 562 Test Method for Consistency of Paints Using the Stormer Viscometer³
D 658 Test Method for Abrasion Resistance of Organic Coatings by Air Blast Abrasive³
D 660 Test Method for Evaluating Degree of Checking of Exterior Paints³
D 661 Test Method for Evaluating Degree of Cracking of Exterior Paints³
D 662 Test Method for Evaluating Degree of Erosion of Exterior Paints³
D 772 Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints³
D 869 Test Method for Evaluating Degree of Settling of Paint⁵
D 968 Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive³
D 1006 Practice for Conducting Exterior Exposure Tests of Paints on Wood³
D 1014 Test Method for Conducting Exterior Exposure Tests of Paints on Steel³
D 1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage³
D 1296 Test Method for Odor of Volatile Solvents and Diluents⁶
D 1308 Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes⁵
D 1475 Test Method for Density of Liquid Coatings, Inks, and Related Products³
D 1554 Terminology Relating to Wood-Base Fiber and

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² Available from the Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422.

³ *Annual Book of ASTM Standards*, Vol 06.01.

⁴ *Annual Book of ASTM Standards*, Vol 06.03.

⁵ *Annual Book of ASTM Standards*, Vol 06.02.

⁶ *Annual Book of ASTM Standards*, Vol 06.04.



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Particle Panel Materials⁷
D 1640 Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature³
D 1729 Practice for Visual Evaluation of Color Differences of Opaque Materials³
D 1736 Test Method for Efflorescence of Interior Wall Paints⁵
D 1849 Test Method for Package Stability of Paint⁵
D 2064 Test Method for Print Resistance of Architectural Paints⁵
D 2196 Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Viscometer³
D 2197 Test Method for Adhesion of Organic Coatings by Scrape Adhesion³
D 2243 Test Method for Freeze-Thaw Resistance of Water-Borne Coatings⁵
D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates³
D 2369 Test Method for Volatile Content of Coatings³
D 2370 Test Method for Tensile Properties of Organic Coatings³
D 2486 Test Method for Scrub Resistance of Interior Latex Flat Wall Paints⁵
D 2574 Test Method for Resistance of Emulsion Paints in the Container to Attack by Microorganisms³
D 2805 Test Method for Hiding Power of Paints by Reflectometry³
D 3168 Practice for Qualitative Identification of Polymers in Emulsion Paints³
D 3258 Test Method for Porosity of Paint Films⁵
D 3359 Test Methods for Measuring Adhesion by Tape Test³
D 3450 Test Method for Washability Properties of Interior Architectural Coatings⁵
D 3456 Practice for Determining by Exterior Exposure Tests Susceptibility of Paint Films to Microbiological Attack³
D 3719 Test Method for Quantifying Dirt Collection on Coated Exterior Panels⁵
D 3723 Test Method for Pigment Content of Water Emulsion Paints by Low-Temperature Ashing³
D 3730 Guide for Testing High-Performance Interior Architectural Wall Coatings⁵
D 3792 Test Method for Water Content of Water-Reducible Paints by Direct Injection into a Gas Chromatograph³
D 3793 Test Method for Low-Temperature Coalescence of Latex Paint Films⁵
D 3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings³
D 3928 Method for Evaluation of Gloss or Sheen Uniformity⁵
D 3960 Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings³
D 4017 Test Method for Water in Paints and Paint Materials by Karl Fischer Method³

D 4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser³
D 4062 Test Method for Levelling of Paints by Draw-Down Method⁵
D 4213 Test Method for Scrub Resistance of Paints by Abrasion Weight Loss⁵
D 4214 Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films³
D 4287 Test Method for High-Shear Viscosity Using the ICI Cone/Plate Viscometer³
D 4400 Test Methods for Sag Resistance of Paints Using a Multinotch Applicator⁵
D 4585 Practice for Testing Water Resistance of Coatings Using Controlled Condensation³
D 4707 Test Method for Measuring of Paint Spatter Resistance During Roller Application⁵
D 4828 Test Method for Practical Washability of Organic Coatings⁵
D 4946 Test Method for Blocking Resistance of Architectural Paints⁵
D 4958 Test Method for Comparison of the Brush Drag of Latex Paints⁵
E 70 Test Method for pH of Aqueous Solutions with the Glass Electrode⁸
E 105 Practice for Probability Sampling of Materials⁹
E 1347 Test Method for Color and Color Difference Measurement of Object-Color Specimens by Tristimulus (Filter) Colorimetry³
2.2 *U.S. Federal Test Method Standard No. 141*:¹⁰
2112 Application by Roller
2131 Application of Sprayed Films
2141 Application of Brushed Films
3011 Condition in Container
4541 Working Properties and Appearance of Dried Film
6301 Wet Adhesion (Tape Test)

3. Terminology

3.1 For definitions of terms in this guide refer to Terminology D 16 and D 1554.

4. Conditions Affecting Water-Reducible Coatings

4.1 Interior and Exterior Coatings:

4.1.1 *Substrate Type*—The substrate to be painted can affect not only the application properties of a coating, such as gloss and uniformity, but is also a factor in determining the type of coating to use. For instance, a primer-sealer may be required for porous substrates, such as new drywall, bare plaster, new wood or porous masonry. Other factors are the type and quality of metal, wood or wood composite (plywood, particle board or hardboard), the type, quality and alkalinity of concrete, plaster and joint cement systems, and the type and condition of any previous coatings.

4.1.2 *Substrate Conditions*—Conditions such as porosity and hardness determine the kind of coating that can be applied.

⁸ Annual Book of ASTM Standards, Vol 15.05.

⁹ Annual Book of ASTM Standards, Vol 14.02.

¹⁰ Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robins Ave., Philadelphia, PA 19111-5094, Attn: NPODS

⁷ Annual Book of ASTM Standards, Vol 04.10.



Documents

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The condition of previously painted substrates, such as degree of chalk, presence of grease, dirt, mold, and water-soluble or oily contaminants, film adhesion and porosity, all influence the performance of coatings. Smoothness of the substrate affects the spreading rate, final appearance, and texture.

4.1.3 Preparation of previously painted substrates including cleaning, solvent cleaning, and sanding.

4.1.4 Type and quality of primer or undercoat and time of drying before topcoating.

4.1.5 The application properties, even of interior water-reducible coatings, are affected by temperature and humidity at the time of application and during drying. As these materials contain water, surfaces do not have to be completely dry before application. However, low temperature during drying may cause poor film formation.

4.2 Exterior Finishes:

4.2.1 *Substrate Weathering*—Weathering of wood before painting will probably adversely affect the performance of exterior coatings. Some weathering of masonry surfaces may have beneficial effects on the performance.

4.2.2 *Substrate Aspects of the Building*— If construction defects or defects due to age are such that excessive moisture from the inside or the outside makes its way through the substrate or if the substrate is in direct contact with damp ground, blistering, flaking or peeling may result.

4.2.3 Environmental conditions after application, both general for the area and specific, such as under eaves, behind shrubbery, northside and southside exposure.

TABLE 1 List of Standards in Sectional Order

Property (or related test)	Section	ASTM Standard	Federal Test Method Standard 141
Sampling	6.2	D 3925	1022
Liquid Coating Properties			
Condition in container	7.1		3011
Coarse particles and foreign matter	7.2	D 185	
Density or weight per gallon	7.3	D 1475	
Fineness of dispersion	7.4	D 1210	
Odor	7.5	D 1296	4401
Colorant acceptance	7.6		
pH	7.7	E 70	
Package stability	7.8		
Heat stability	7.8.1	D 1849	
Freeze-thaw stability	7.8.2	D 2243	
Settling	7.8.3	D 869	
Microorganism resistance	7.8.4	D 2574	
Coating Application and Film Formation			
Application properties	8.1		4541
Brush application	8.1.1		2141
Brush drag	8.1.1.1	D 4958	
Roller application	8.1.2		2112
Roller spatter	8.1.2.1	D 4707	
Spray application	8.1.3		2131
Touch-up uniformity	8.2	D 3928	
Low-temperature coalescence	8.3	D 3793	
Rheological properties	8.4		
Consistency (Low-shear viscosity)	8.4.1	D 562	
Rheological properties of non-Newtonian materials	8.4.2	D 2196, D4287	
Sag resistance	8.4.3	D 4400	4494
Levelling properties	8.4.4	D 4062	
Drying properties	8.5	D 1640	4061
Appearance of Dry Film			
Color difference	9.1	...	
Color appearance	9.1.1		
Color differences by visual comparison	9.1.2	D 1729	
Color differences using instrumental measurements	9.1.3	D 2244	
Directional reflectance	9.2	E 1347	
Gloss	9.3	...	
Gloss, 60°	9.3.1	D 523	
Sheen (85° gloss)	9.3.2	D 523	
Hiding power	9.4	D 344, D 2805	
Properties of Dry Film			
Interior and Exterior Coatings	10.1		
Abrasion resistance	10.1.1	D 658, D 968, D 4060	6192
Adhesion	10.1.2	D 2197, D 3359	
Wet adhesion	10.1.3		6301
Flexibility	10.1.4	D 522, D 2370	6221 ^A
Resistance to household chemicals	10.1.5	D 1308	
Efflorescence from the film	10.1.6	D 1736	
Efflorescence from the substrate	10.1.7		
Interior Finishes	10.2		
Block resistance	10.2.1	D 4946	
Print resistance	10.2.2	D 2064	



TABLE 1 *Continued*

Property (or related test)	Section	ASTM Standard	Federal Test Method Standard 141
Film porosity	10.2.3	D 3258	
Washability and cleansability	10.2.4		
Washability	10.2.4.1	D 2486, D 4213	
Cleansability	10.2.4.2	D 3450, D 4828	6141 ^B
Exterior Coatings	10.3		
Adhesion to chalky surfaces	10.3.1		6301
Dirt pick-up	10.3.2	D 3719	
Fume resistance	10.3.3	...	
Fume resistance test	10.3.3.1		
Blister resistance	10.3.4	D 4585	
Exposure resistance	10.3.5	D 1006, D 1014	
Chalking	10.3.5.2	D 4214	
Checking	10.3.5.3	D 660	
Cracking	10.3.5.4	D 661	
Erosion	10.3.5.5	D 662	
Flaking	10.3.5.6	D 772	
Fade resistance	10.3.5.7	D 2244	
Stain resistance	10.3.6		
Coating Analysis			
Chemical analysis	11.1	D 215	
Volatile content	11.2	D 2369	
Volatile organic content	11.3	D 3960	
Water content	11.4	D 3792, D 4017	
Pigment content	11.5	D 3723	
Pigment analysis	11.6	D 215	7261
Nonvolatile vehicle identification	11.7	D 3168	

^A Equivalent only to Method B of Test Method D 522.

^B Except for scrub medium.

5. Selection of Tests

5.1 Because the conditions to which a coating is subjected vary with (a) the surface type: wall, floor, ceiling, and (b) the service environment: exterior or interior, specialized types of water-borne coatings have been developed for the different locations. The recommended test methods presented in Table 1 and Table 2 cover practically all of the properties of water-reducible coatings but all of them are not required with each type. Coatings intended for exterior use only or both exterior and interior use require certain properties not relevant to those for interior use only. Selection of the methods to be followed must be governed by experience and the requirements in each individual case, together with agreement between the purchaser and the seller.

5.2 The purchaser should first determine the properties a coating should have and then select only those test methods that measure or evaluate those properties. After selecting the desired tests, the purchaser should then decide which properties are the most important and establish the requirements or specifications accordingly. Since coating properties frequently tend to oppose each other, such as low sheen versus good cleansability, some properties may need to be less emphasized if others are to be accentuated. This balance of properties must be considered when selecting the tests and establishing the requirements. The significance of the tests and the normal range of values are presented in the different sections, in most cases.

5.3 This guide does not indicate relative importance of the various tests nor does it recommend specific test values because properties very important to one purchaser may be less so to another.

6. Sampling

6.1 Prior to sampling, the condition of the container should be established since damage to it may cause evaporation, skinning, or other undesirable effects on the coating.

6.2 Sample in accordance with Practice D 3925. Determine the density in pounds per gallon (kilograms/litre) in accordance with Test Method D 1475. Continue sampling and determining density until successive results agree within 0.1 lb (45 g) or as agreed upon between the purchaser and seller. Then take samples for testing.

6.3 Specify the amount required for a representative sample, the package sizes, and an identification code. A1-U.S. gal (or 4-L) sample is usually sufficient for the recommended tests, but for guidance in selecting a sampling plan consult Practice E 105.

7. Liquid Coating Properties

7.1 *Condition in Container*—Thickening, pigment settling, and liquid separation are undesirable and objectionable if material that has been stored cannot be readily reconditioned and made suitable for application with a reasonable amount of stirring. The referenced method covers procedures for determining changes in properties after storage and lists characteristics that are undesirable and objectionable in a stored paint. Determine condition in the container in accordance with Method 3011 of Federal Test Method Standard No. 141. (See also 7.10 Package Stability.)

7.2 *Coarse Particles and Foreign Matter*—Liquid coatings must be free of coarse particles and foreign matter to be able to form uniform films of good appearance, a typical maximum being 0.5 weight % of the total material. The referenced method with a 325-mesh (45-µm) screen gives the percentage of