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Standard Guide for Testing Exterior Wood Stains and Clear Water Repellents¹

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1. Scope

1.1 This guide covers the selection and use of procedures for testing exterior wood stains and clear water repellents. This includes both water borne and solvent borne semitransparent and opaque stains and clear water repellents. The properties that can be examined or, in some cases, the relevant test procedures are listed in 2.1 and 2.2.

NOTE 1—The term “opaque stain” is defined as a pigmented composition intended for use on wooden surfaces to produce a uniform finish that obscures the grain and color of the wood, but not its surface texture; also called solid color or solid hide.

NOTE 2—The term “semitransparent” is defined as a pigmented composition intended for use on wooden surfaces to produce a uniform finish that does not fully obscure the grain or the texture of the wood.

NOTE 3—The term “clear” is defined as a transparent composition intended for use on wooden surfaces to produce a uniform finish that does not obscure the grain or texture of the wood.

1.1.1 *Discussion*—When applied to woods that differ in color, there is a color difference between stained substrates.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This guide is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.42 on Architectural Coatings.

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2. Referenced Documents

2.1 *ASTM Standards*:²

- D16 Terminology for Paint, Related Coatings, Materials, and Applications
- D56 Test Method for Flash Point by Tag Closed Cup Tester
- D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- D154 Guide for Testing of Varnishes (Withdrawn 2018)³
- D185 Test Methods for Coarse Particles in Pigments
- D215 Practice for the Chemical Analysis of White Linseed Oil Paints (Withdrawn 2005)³
- D344 Test Method for Relative Hiding Power of Paints by the Visual Evaluation of Brushouts (Withdrawn 2018)³
- D358 Specification for Wood to Be Used as Panels in Weathering Tests of Coatings (Withdrawn 2014)³
- D522 Test Methods for Mandrel Bend Test of Attached Organic Coatings
- D523 Test Method for Specular Gloss
- D562 Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
- D660 Test Method for Evaluating Degree of Checking of Exterior Paints
- D661 Test Method for Evaluating Degree of Cracking of Exterior Paints
- D662 Test Method for Evaluating Degree of Erosion of Exterior Paints
- D714 Test Method for Evaluating Degree of Blistering of Paints
- D772 Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints
- D869 Test Method for Evaluating Degree of Settling of Paint
- D968 Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
- D1006 Practice for Conducting Exterior Exposure Tests of Hand and Factory Applied Paints on Wood and Wood Composite Materials

² 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.

³ The last approved version of this historical standard is referenced on www.astm.org.

- D1038 Terminology Relating to Veneer, Plywood, and Wood Structural Panels
- D1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
- D1296 Test Method for Odor of Volatile Solvents and Diluents (Withdrawn 2021)³
- D1475 Test Method for Density of Liquid Coatings, Inks, and Related Products
- D1554 Terminology Relating to Wood-Base Fiber and Particle Panel Materials
- D1640 Test Methods for Drying, Curing, or Film Formation of Organic Coatings
- D1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials
- D1849 Test Method for Package Stability of Paint
- D2196 Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational Viscometer
- D2197 Test Method for Adhesion of Organic Coatings by Scrape Adhesion
- D2243 Test Method for Freeze-Thaw Resistance of Water-Borne Coatings
- D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
- D2245 Test Method for Identification of Oils and Oil Acids in Solvent-Reducible Paints (Withdrawn 2016)³
- D2369 Test Method for Volatile Content of Coatings
- D2370 Test Method for Tensile Properties of Organic Coatings
- D2371 Test Method for Pigment Content of Solvent-Reducible Paints
- D2372 Practice for Separation of Vehicle From Solvent-Reducible Paints
- D2486 Test Methods for Scrub Resistance of Wall Paints
- D2574 Test Method for Resistance of Emulsion Paints in the Container to Attack by Microorganisms
- D2621 Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints
- D2697 Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
- D2805 Test Method for Hiding Power of Paints by Reflectometry
- D3168 Practice for Qualitative Identification of Polymers in Emulsion Paints
- D3273 Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- D3274 Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation
- D3278 Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
- D3359 Test Methods for Rating Adhesion by Tape Test
- D3456 Practice for Determining by Exterior Exposure Tests the Susceptibility of Paint Films to Microbiological Attack
- D3719 Test Method for Quantifying Dirt Collection on Coated Exterior Panels (Withdrawn 2009)³
- D3723 Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
- D3793 Test Method for Low-Temperature Coalescence of Latex Paint Films by Porosity Measurement (Withdrawn 2012)³
- D3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings
- D3928 Test Method for Evaluation of Gloss or Sheen Uniformity
- D3960 Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- D4017 Test Method for Water in Paints and Paint Materials by Karl Fischer Method
- D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
- D4062 Test Method for Leveling of Paints by Draw-Down Method
- D4141 Practice for Conducting Black Box and Solar Concentrating Exposures of Coatings
- D4212 Test Method for Viscosity by Dip-Type Viscosity Cups
- D4214 Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
- D4287 Test Method for High-Shear Viscosity Using a Cone/Plate Viscometer
- D4400 Test Method for Sag Resistance of Paints Using a Multinotch Applicator
- D4446 Test Method for Anti-Swelling Effectiveness of Water-Repellent Formulations and Differential Swelling of Untreated Wood When Exposed to Liquid Water Environments
- D4585 Practice for Testing Water Resistance of Coatings Using Controlled Condensation
- D4587 Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
- D4958 Test Method for Comparison of the Brush Drag of Latex Paints
- D5326 Test Method for Color Development in Tinted Latex Paints
- D5401 Test Method for Evaluating Clear Water Repellent Coatings on Wood
- D6686 Test Method for Evaluation of Tannin Stain Resistance of Coatings
- D6695 Practice for Xenon-Arc Exposures of Paint and Related Coatings
- E70 Test Method for pH of Aqueous Solutions With the Glass Electrode
- E105 Guide for Probability Sampling of Materials
- E313 Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates
- E1347 Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry
- G90 Practice for Performing Accelerated Outdoor Weathering of Materials Using Concentrated Natural Sunlight

2.2 *U.S. Federal Standards*.⁴

U. S. Federal Test Method Standard No. 141 C

2131 Application of Sprayed Films

2141 Application of Brushed Films

3011 Condition in Container

4203 Reducibility and Dilution Stability

4421 Absorption Test

4541 Working Properties and Appearance of Dried Film

6301 Wet Adhesion (Tape Test)

2.3 *Other Documents*:

Paints/Coatings Dictionary of the Federation of Societies for Coatings Technology⁵

Paint and Coatings Testing Manual

3. Terminology

3.1 For definitions of terms in this guide refer to Terminology **D16**, **D1038**, and **D1554** and to the FSCT Stain/Coatings Dictionary.

4. Conditions Affecting Coatings

4.1 *Moisture*—Wood is porous and will absorb moisture, causing it to swell. As it dries, it will shrink. It is this cycle of shrinking and swelling that causes warping and cracking in the wood substrate. This dimensional instability stresses a coating, affecting its durability. Many semitransparent, opaque, or solid color exterior stains are formulated to repel water to protect wood from ingress of moisture, thereby reducing the tendency of the wood to warp and crack.

4.2 *Substrate Type*—The substrate to be coated 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 may be required for previously coated wood that will receive opaque stain; or a primer-sealer on previously uncoated wood. Other factors include the type and quality of wood or wood composite (plywood, particle board or hardboard) or pressure treated wood.

4.3 *Substrate Conditions*—Conditions such as species of wood, porosity, degree of weathering, and previous coatings determine the kind of coating that can be applied. The performance of coatings on uncoated new wood can be influenced by the presence of mill glaze and wood grain orientation. The condition of previously stained substrates such as degree of chalk, presence of dirt, mold, and water-soluble or oily contaminants, extractives, film adhesion, and porosity also influence the performance of coatings. Smoothness of the substrate affects the spreading rate, final appearance, and texture.

4.4 Preparation of previously coated or weathered substrates including cleaning, sanitizing, and sanding.

4.5 The application properties are affected by temperature and humidity at the time of application and during drying.

⁴ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

⁵ Available from Federation of Societies for Coatings Technology (FSCT), 492 Norristown Rd., Blue Bell, PA 19422-2350, <http://www.coatingstech.org>.

4.5.1 *For Water Reducible*—As these materials contain water, surfaces do not have to be completely dry before application. However, application and surface temperatures lower than 50 °F may cause poor film formation.

4.5.2 *For Solvent Reducible*—Surface dampness may adversely effect film uniformity, wetting, and adhesion. Humidity and low temperature have relatively little effect except for slowing the drying.

4.6 *Substrate Weathering*—Weathering of wood before staining will adversely affect the performance of exterior coatings.

4.6.1 *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.

4.6.2 Environmental conditions after application, both general for the area and specific, such as under eaves, behind shrubbery, north side and south side exposure are significant weathering factors.

5. Selection of Tests

5.1 Because the conditions to which a coating is subjected vary with (1) the surface type: deck, siding, species of wood and (2) the service environment; sheltered, exposed, and horizontal, specialized types of solvent-borne and water-borne coatings have been developed for the different locations. Selection of the referenced 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 which properties are the most important. After establishing the requirements or specifications, select the test methods that measure or evaluate those properties. The balance of properties must be considered when establishing the requirements and selecting the tests. The significance of the tests and the normal range of values are presented in the different sections, in most cases.

6. Sampling

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

6.2 Sample in accordance with Practice **D3925**. Determine the density in pounds per gallon (kilograms/litre) in accordance with Test Method **D1475**. 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. A 1-US gal (or 4-L) sample is usually sufficient for the recommended tests, but for guidance in selecting a sampling plan consult Practice **E105**.

7. Liquid Coating Properties

7.1 *Skimming*—Coatings that contain a binder that dries by oxidation may be subject to skin formation in a partially-filled