Designation: D3794 – 22

Standard Guide for Testing Coil Coatings[1]

This standard is issued under the fixed designation D3794; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers procedures for testing coil coatings. The test methods included are listed in Table 1. Where more than one test method is listed for the same characteristic, no attempt is made to indicate superiority of one method over another. Selection of test methods to be followed must be governed by the requirements in each individual case, together with agreement between the producer and user.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B117 Practice for Operating Salt Spray (Fog) Apparatus
B368 Test Method for Copper-Accelerated Acetic Acid-Salt Spray (Fog) Testing (CASS Test)
C1371 Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
C1549 Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
D522 Test Methods for Mandrel Bend Test of Attached Organic Coatings
D523 Test Method for Specular Gloss
D610 Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
D660 Test Method for Evaluating Degree of Checking of Exterior Paints
D661 Test Method for Evaluating Degree of Cracking of Exterior Paints
D714 Test Method for Evaluating Degree of Blistering of Paints
D822 Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
D823 Practices for Producing Films of Uniform Thickness of Paint, Coatings and Related Products on Test Panels
D870 Practice for Testing Water Resistance of Coatings Using Water Immersion
D968 Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
D1005 Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers
D1014 Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates
D1193 Specification for Reagent Water
D1200 Test Method for Viscosity by Ford Viscosity Cup
D1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
D1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings
D1308 Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems
D1474 Test Methods for Indentation Hardness of Organic Coatings
D1475 Test Method for Density of Liquid Coatings, Inks, and Related Products
D1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
D1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials
D1735 Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
D1823 Test Method for Apparent Viscosity of Plastisols and Organosols at High Shear Rates by Extrusion Viscometer

[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 D01.53 on Coil Coated Metal.

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[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.

D1824 Test Method for Apparent Viscosity of Plastisols and Organosols at Low Shear Rates
D2092 Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting (Withdrawn 2008)[3]
D2196 Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational Viscometer
D2197 Test Method for Adhesion of Organic Coatings by Scrape Adhesion
D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D2247 Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
D2248 Practice for Detergent Resistance of Organic Finishes
D2369 Test Method for Volatile Content of Coatings
D2454 Practice for Determining the Effect of Overbaking on Organic Coatings
D2697 Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
D2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
D2803 Guide for Testing Filiform Corrosion Resistance of Organic Coatings on Metal
D3003 Test Method for Pressure Mottling and Blocking Resistance of Organic Coatings on Metal Substrates
D3134 Practice for Establishing Color and Gloss Tolerances
D3170 Test Method for Chipping Resistance of Coatings
D3278 Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
D3359 Test Methods for Rating Adhesion by Tape Test
D3361 Practice for Unfiltered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
D3363 Test Method for Film Hardness by Pencil Test
D3960 Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
D4138 Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means
D4141 Practice for Conducting Black Box and Solar Concentrating Exposures of Coatings
D4145 Test Method for Coating Flexibility of Prepainted Sheet
D4146 Test Method for Formability of Zinc-Rich Primer/Chromate Complex Coatings on Steel
D4147 Practice for Applying Coil Coatings Using Wire-Wound Drawdown Bars
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
D4518 Test Methods for Measuring Static Friction of Coating Surfaces (Withdrawn 2000)[3]
D4585 Practice for Testing Water Resistance of Coatings Using Controlled Condensation
D4587 Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
D5031 Practice for Enclosed Carbon-Arc Exposure Tests of Paint and Related Coatings
D5178 Test Method for Mar Resistance of Organic Coatings
D5402 Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs
D5531 Guide for Preparation, Maintenance, and Distribution of Physical Product Standards for Color and Geometric Appearance of Coatings
D5723 Practice for Determination of Chromium Treatment Weight on Metal Substrates by X-Ray Fluorescence
D5796 Test Method for Measurement of Dry Film Thickness of Thin-Film Coil-Coated Systems by Destructive Means Using a Boring Device
D5894 Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
D6093 Test Method for Percent Volume Nonvolatile Matter in Clear or Pigmented Coatings Using a Helium Gas Pycnometer
D6491 Practice for Evaluation of Aging Resistance of Pre-stressed Prepainted Metal In a Dry Heat Test
D6492 Practice for Detection of Hexavalent Chromium On Zinc and Zinc/Aluminum Alloy Coated Steel
D6578 Practice for Determination of Graffiti Resistance
D6665 Practice for Evaluation of Aging Resistance of Pre-stressed Prepainted Metal in a Boiling Water Test
D6695 Practice for Xenon-Arc Exposures of Paint and Related Coatings
D6906 Test Method for Determination of Titanium Treatment Weight on Metal Substrates by Wavelength Dispersive X-Ray Fluorescence
D6944 Practice for Determining the Resistance of Cured Coatings to Thermal Cycling
D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals
D7093 Test Method for Formability of Thin Film Organic Coatings on Steel Over a Biaxially Stretched Dome
D7376 Practice for Outdoor Evaluation of Wet Stack Storage Conditions on Coil-Coated Metals
D7639 Test Method for Determination of Zirconium Treatment Weight or Thickness on Metal Substrates by X-Ray Fluorescence
D7835 Test Method for Determining the Solvent Resistance of an Organic Coating Using a Mechanical Rubbing Machine
D7893 Guide for Corrosion Test Panel Preparation, Testing, and Rating of Coil-Coated Building Products
D7869 Practice for Xenon Arc Exposure Test with Enhanced Light and Water Exposure for Transportation Coatings

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

D7897 Practice for Laboratory Soiling and Weathering of Roofing Materials to Simulate Effects of Natural Exposure on Solar Reflectance and Thermal Emittance
D8331 Test Method for Measurement of Film Thickness of Thin-Film Coatings by Non-Destructive Means Using Ruggedized Optical Interference
E70 Test Method for pH of Aqueous Solutions With the Glass Electrode
E84 Test Method for Surface Burning Characteristics of Building Materials
E284 Terminology of Appearance
E308 Practice for Computing the Colors of Objects by Using the CIE System
E376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods
E408 Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
E643 Test Method for Ball Punch Deformation of Metallic Sheet Material
E903 Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
E1164 Practice for Obtaining Spectrometric Data for Object-Color Evaluation
E1356 Test Method for Assignment of the Glass Transition Temperatures by Differential Scanning Calorimetry
E1541 Practice for Specifying and Matching Color Using the Colorcurve System (Withdrawn 2007)[3]
E1545 Test Method for Assignment of the Glass Transition Temperature by Thermomechanical Analysis
E1640 Test Method for Assignment of the Glass Transition Temperature By Dynamic Mechanical Analysis
E1808 Guide for Designing and Conducting Visual Experiments
E1918 Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
E1980 Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
G7 Practice for Natural Weathering of Materials
G60 Practice for Conducting Cyclic Humidity Exposures
G85 Practice for Modified Salt Spray (Fog) Testing
G87 Practice for Conducting Moist SO_2 Tests
G90 Practice for Performing Accelerated Outdoor Weathering of Materials Using Concentrated Natural Sunlight
G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials
G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
G152 Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
G153 Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
G155 Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials

3. Terminology

3.1 *Definitions:*

3.1.1 *coil coating, n*—application of coatings or films to continuous metal coil stock.

3.1.2 *direct roller coat, n*—coating with the applicator or coating roll revolving in the same direction as the strip.

3.1.3 *metal pretreatment, n*—chemical treatment normally applied to the metal substrate prior to prime or finish coating.

3.1.3.1 *Discussion*—The treatment is designed to react with and modify the metal substrate to produce a surface suitable for coating or adhesive bonding.

3.1.4 *reverse roller coat, n*—coating with the applicator or coating roll revolving in a direction opposite to that of the strip.

3.2 The definitions given in Terminology G113 are applicable to this guide.

4. Significance and Use

4.1 This guide represents a collection of pertinent ASTM test methods used within the coil coatings industry. In the past coil coaters world wide depended on industry standards written by the National Coil Coating Association. That association, working cooperatively with ASTM, will no longer issue new, nor update old, standards.

5. General Requirements

5.1 All standard tests shall be made at 25 ± 3 °C (77 ± 25 °F) and 50 ± 5 % relative humidity, immediately after baking unless otherwise specified.

6. Sampling

6.1 The number of samples per unit of production shall be agreed upon between the producer and user.

7. Liquid Coating Properties

7.1 *Viscosity:*

7.1.1 It is common to measure the viscosity of coil coatings using an efflux technique (Ford or Zahn cup). This provides a simple, rapid technique for controlling the viscosity of a product, either in a paint production facility, or on-line at a coil coating facility. Coatings in the coil industry, however, cover a wide range of generic qualities, with many of them having non-Newtonian rheological characteristics. It is important, therefore, to consider the behavior of these coatings under different shear conditions, as well as measuring efflux viscosity. Some of the test methods require little expertise, where other test methods involve costly equipment and a high level of experience to run and interpret the rheological data.

7.1.2 *Efflux Viscosity*—Determine efflux viscosity in accordance with Test Method D4212 (Zahn cup) or D1200 (Ford cup).

7.1.3 *High-Shear Extrusion Viscosity*—Determine the high-shear extrusion viscosity for plastisols and organosols in accordance with Test Method D1823.

7.1.4 *Low-Shear Viscosity for Plastisols and Organosols*—Test in accordance with Test Method D1824.

7.1.5 *Rotational Viscosity*—Determine the viscosity with a rotational viscometer in accordance with Test Method D2196.