



Designation: D6577 – 15 (Reapproved 2019)

## Standard Guide for Testing Industrial Protective Coatings<sup>1</sup>

This standard is issued under the fixed designation D6577; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This guide covers the selection and use of test methods and procedures for testing industrial protective coatings. Selection of the standards to be followed must be governed by experience and the requirements in each individual case, together with agreement between the supplier and the user.

1.2 This guide covers the testing of liquid coatings as applied on substrate by brushing, rolling, spraying, or other means appropriate to the coating and circumstance.

NOTE 1—The term “industrial protective coating” as used in this guide is described in the scope of Subcommittee D01.46<sup>1</sup> as “paints applied to substrates on-site of structures and buildings, especially where subject to corrosive environments, as industrial, urban, and marine environments.”

NOTE 2—Guides for testing other coating types, such as Guides D4712, D5146, D5324 or for surface preparation, coating application, such as Guide D3276, are available and should be used when it is applicable.

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:*<sup>2</sup>

**B117** Practice for Operating Salt Spray (Fog) Apparatus

**C868** Test Method for Chemical Resistance of Protective Linings (Withdrawn 2015)<sup>3</sup>

**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

**D185** Test Methods for Coarse Particles in Pigments

**D344** Test Method for Relative Hiding Power of Paints by the Visual Evaluation of Brushouts (Withdrawn 2018)<sup>3</sup>

**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

**D609** Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products

**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

**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

**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

**D869** Test Method for Evaluating Degree of Settling of Paint

**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

**D1200** Test Method for Viscosity by Ford Viscosity Cup

<sup>1</sup> 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 D01.46 on Industrial Protective Coatings.

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<sup>2</sup> 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.

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

- 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
- D1296** Test Method for Odor of Volatile Solvents and Diluents
- D1308** Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- D1474** Test Methods for Indentation Hardness of Organic Coatings
- D1475** Test Method for Density of Liquid Coatings, Inks, and Related Products
- D1535** Practice for Specifying Color by the Munsell System
- D1640** Test Methods for Drying, Curing, or Film Formation of Organic Coatings
- D1653** Test Methods for Water Vapor Transmission of Organic Coating Films
- 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
- D1730** Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
- D1731** Practices for Preparation of Hot-Dip Aluminum Surfaces for Painting
- D1732** Practices for Preparation of Magnesium Alloy Surfaces for Painting
- D1735** Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
- 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
- D2200** Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces
- D2201** Practice for Preparation of Zinc-Coated and Zinc-Alloy-Coated Steel Panels for Testing Paint and Related Coating Products
- 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
- D2247** Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
- D2354** Test Method for Minimum Film Formation Temperature (MFFT) of Emulsion Vehicles
- D2369** Test Method for Volatile Content of Coatings
- D2371** Test Method for Pigment Content of Solvent-Reducible Paints (Withdrawn 2019)<sup>3</sup>
- D2574** Test Method for Resistance of Emulsion Paints in the Container to Attack by Microorganisms
- D2616** Test Method for Evaluation of Visual Color Difference With a Gray Scale
- 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
- 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
- D2805** Test Method for Hiding Power of Paints by Reflectometry
- D2832** Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings
- D3134** Practice for Establishing Color and Gloss Tolerances
- D3168** Practice for Qualitative Identification of Polymers in Emulsion Paints
- D3170** Test Method for Chipping Resistance of Coatings
- D3276** Guide for Painting Inspectors (Metal Substrates)
- D3278** Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
- D3359** Test Methods for Rating Adhesion by Tape Test
- D3363** Test Method for Film Hardness by Pencil Test
- D3792** Test Method for Water Content of Coatings by Direct Injection Into a Gas Chromatograph
- D3793** Test Method for Low-Temperature Coalescence of Latex Paint Films by Porosity Measurement (Withdrawn 2012)<sup>3</sup>
- D3912** Test Method for Chemical Resistance of Coatings and Linings for Use in Nuclear Power Plants
- D3924** Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials (Withdrawn 2016)<sup>3</sup>
- 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
- 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
- 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
- D4457** Test Method for Determination of Dichloromethane and 1,1,1-Trichloroethane in Paints and Coatings by Direct Injection into a Gas Chromatograph

- D4541** Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- D4585** Practice for Testing Water Resistance of Coatings Using Controlled Condensation
- D4587** Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
- D4712** Guide for Testing Industrial Water-Reducible Coatings (Withdrawn 2014)<sup>3</sup>
- D4752** Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
- D4958** Test Method for Comparison of the Brush Drag of Latex Paints
- D5009** Test Method for Evaluating and Comparing Transfer Efficiency of Spray Applied Coatings Under Laboratory Conditions
- D5031** Practice for Enclosed Carbon-Arc Exposure Tests of Paint and Related Coatings
- D5064** Practice for Conducting a Patch Test to Assess Coating Compatibility
- D5065** Guide for Assessing the Condition of Aged Coatings on Steel Surfaces
- D5146** Guide to Testing Solvent-Borne Architectural Coatings
- D5162** Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
- D5178** Test Method for Mar Resistance of Organic Coatings
- D5201** Practice for Calculating Formulation Physical Constants of Paints and Coatings
- D5286** Test Methods for Determination of Transfer Efficiency Under General Production Conditions for Spray Application of Paints
- D5324** Guide for Testing Water-Borne Architectural Coatings
- D5327** Practice for Evaluating and Comparing Transfer Efficiency of Spray Applied Coatings Under General Laboratory Conditions
- D5402** Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs
- D5894** Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
- D5895** Test Methods for Evaluating Drying or Curing During Film Formation of Organic Coatings Using Mechanical Recorders
- D6093** Test Method for Percent Volume Nonvolatile Matter in Clear or Pigmented Coatings Using a Helium Gas Pycnometer
- D6132** Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Coating Thickness Gage
- D6578** Practice for Determination of Graffiti Resistance
- D6677** Test Method for Evaluating Adhesion by Knife
- D6695** Practice for Xenon-Arc Exposures of Paint and Related Coatings
- D6905** Test Method for Impact Flexibility of Organic Coatings
- D6943** Practice for Immersion Testing of Industrial Protective Coatings and Linings
- D6944** Practice for Determining the Resistance of Cured Coatings to Thermal Cycling
- D7055** Practice for Preparation (by Abrasive Blast Cleaning) of Hot-Rolled Carbon Steel Panels for Testing of Coatings
- 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
- D7187** Test Method for Measuring Mechanistic Aspects of Scratch/Mar Behavior of Paint Coatings by Nanoscratching
- D7868** Practice for Determining the Dry Fall (Fog) Properties of Protective Coatings
- E84** Test Method for Surface Burning Characteristics of Building Materials
- F1249** Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
- G7** Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials
- G8** Test Methods for Cathodic Disbonding of Pipeline Coatings
- G14** Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)
- G20** Test Method for Chemical Resistance of Pipeline Coatings
- G42** Test Method for Cathodic Disbonding of Pipeline Coatings Subjected to Elevated Temperatures
- G50** Practice for Conducting Atmospheric Corrosion Tests on Metals
- G62** Test Methods for Holiday Detection in Pipeline Coatings
- G80** Test Method for Specific Cathodic Disbonding of Pipeline Coatings (Withdrawn 2013)<sup>3</sup>
- G85** Practice for Modified Salt Spray (Fog) Testing
- G90** Practice for Performing Accelerated Outdoor Weathering of Materials Using Concentrated Natural Sunlight
- G95** Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method)
- G106** Practice for Verification of Algorithm and Equipment for Electrochemical Impedance Measurements
- G113** Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials
- G141** Guide for Addressing Variability in Exposure Testing of Nonmetallic Materials
- G147** Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests
- 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 Light Apparatus for Exposure of Non-Metallic Materials

## 2.2 Federal Standards:<sup>4</sup>

- U.S. Federal Test Method Standard No. 141C:
  - 1022 Sampling for Inspection and Testing
  - 2112 Application by Roller
  - 2131 Application of Sprayed Films
  - 2141 Application of Brushed Films
  - 2161 Application of Film with Film Applicator (Magnetic Chuck)
  - 2162 Application of Film with Film Applicator Using Suction Panel Holder
- 3011 Condition in Container
- 4061 Drying Time
- 4321 Brushing Properties
- 4331 Spraying Properties
- 4335 Roller Coating Properties
- 4401 Odor Test

## 2.3 U.S. Environmental Protection Agency Standard:<sup>5</sup>

- EPA Federal Reference Method 24 Determination of Volatile Matter Content, Density, Volume Solids, and Weight Solids of Surface Coatings

## 2.4 NACE Standard:<sup>6</sup>

- NACE TM0174 Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials in Immersion Service

## 2.5 ANSI Standard:<sup>7</sup>

- N512 Protective Coatings (Paints) for the Nuclear Industry

## 3. Terminology

### 3.1 Definitions:

3.1.1 For definitions of terms used in this guide, refer to Terminology **D16**.

3.1.2 The definitions given in Terminology **G113** relating to natural and artificial weathering tests are applicable to this guide.

## 4. Significance and Use

4.1 This guide is intended to provide assistance in selecting appropriate tests for evaluating the general performance level to be expected of a coating or coating system on a given substrate exposed to a given type of environment. **Table 1** represents a listing of all the tests.

4.2 Surface preparation or cleanliness prior to application of the coating can be critical to the proper performance of the coating.

4.3 Results obtained in the tests cited in this guide may not be adequate for predicting coating service life of a specific coating system in a specific environmental exposure. A suitable control coating system of known performance in the service environment should be included in the testing for comparison.

<sup>4</sup> Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

<sup>5</sup> 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>.

<sup>6</sup> Available from NACE International (NACE), 1440 South Creek Dr., Houston, TX 77084-4906, <http://www.nace.org>.

<sup>7</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

## 5. Conditions Affecting Performance

5.1 Practical requirements and performance of industrial coatings may vary with the following:

5.1.1 *Substrate Type*—Ferrous, nonferrous, previously coated surfaces, masonry, and other materials.

5.1.2 *Substrate Conditions and Surface Profile*—Cleanliness, porosity, smoothness, and weathering of the substrates.

5.1.3 *Substrate Aspects of Structure*—Construction defects or defects due to age such that excessive moisture makes its way through a porous substrate or is trapped in components; design defects that cause galvanic corrosion; environmental exposure to deteriorating materials such as deicing salts, improperly prepared welds, or other site-specific detrimental conditions.

5.1.4 Type, quality, and suitability of the surface treatment or primer used and time of drying before coating application.

5.1.5 Application methods and techniques.

5.1.6 *Application and Cure Conditions*—Environmental conditions, such as temperature and relative humidity, during application and drying.

5.1.7 *Service Conditions*—Environmental conditions such as solar radiation, temperature, humidity, and chemical and mechanical stress.

## 6. Sampling and Test Conditions

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 coating.

6.2 Sample in accordance with Practice **D3925** or Method 1022 of Federal Test Method Standard No. 141C. Prepare coating films of uniform thickness on test panels in accordance with Practices **D823**.

6.3 Tests and observations shall be at standard laboratory conditions in accordance with Specification **D3924** unless otherwise specified or agreed upon between the supplier and the user.

## 7. Liquid Coatings Properties

7.1 *Condition in Container*—Thickening, settling, and separation are undesirable and objectionable if a liquid coating cannot be reconditioned and made suitable for application with a reasonable amount of stirring. The referenced test method, Method 3011.1 covers procedures for determining changes in properties after storage. Determine the condition in the container in accordance with Method 3011.1 of U.S. Federal Test Method Standard No. 141C.

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 value is 0.5 weight % of the total material. Determine the content of coarse particles and foreign matter in accordance with Test Methods **D185**. This referenced method uses material retained in a 325-mesh (45- $\mu$ m) screen as a measure of coarse particle and foreign matter.

7.3 *Density or Weight per Gallon*—The density as measured by weight per gallon is used to help ensure product uniformity

**TABLE 1 List of Test Methods by Properties**

Property or Related Test	Section	ASTM Standard	Federal Test Method Standard No. 141C
Scope:			
Guides	1.2	D3276, D4712, D5146, D5324	...
Terminology	3.1.1	D16	...
	3.1.2	G113	...
Sampling and Test Conditions:			
Sampling	6.2	D823, D3925	1022
Test conditions	6.3	D3924	...
Liquid Coatings Properties:			
Condition in container	7.1	...	3011
Coarse particles and foreign matter	7.2	D185	...
Density or weight per gallon	7.3	D1475	...
Fineness of dispersion	7.4	D1210	...
Settling	7.5	D869	...
Viscosity:	7.6		
Newtonian fluids	7.6.1	D1200, D2196, D4212	...
Consistency	7.6.2	D562	...
High-shear viscosity	7.6.3	D4287, D4958	...
Flash point	7.7	D56, D93, D3278	...
Freeze-thaw stability	7.8	D2243	...
Odor	7.9	D1296	4401
Microorganism resistance	7.10	D2574	...
Package stability	7.11	D1849	...
Volatile content of coatings	7.12	D2369, D2832	...
Volume solids	7.13	D2697, D5201, D6093	...
Volatile organic content	7.14	D1475, D2369, D3792, D3960 D4017, D4457	...
Chemical analysis	7.15	D2371, D2621, D3168	...
Transfer efficiency	7.16	D5009, D5286, D5327	...
Application and Film Formation:	8		
Panel preparation	8.1	D609, D1730, D1731, D2200, D7055	...
Application properties	8.2	D7868	2112, 2131, 2141, 2161, 2162, 4321, 4331, 4335
Drying properties	8.3	D1640, D5895	4061
Leveling properties	8.4	D4062	...
Wet film thickness	8.5	D1212	...
Low temperature coalescence of paints	8.6	D2354, D3793	...
Touch-up	8.7	D3359, D3928	...
Sag resistance	8.8	D4400	...
Pot life	8.9	...	...
Appearance of Dry Film:	9		
Color:	9.1		
Color difference by visual evaluation	9.1.1	D1729, D2616	...
Color difference by instrumental evaluation	9.1.2	D2244, D3134	...
Color description by visual evaluation	9.1.3	D1535	...
Color description by instrumental evaluation	9.1.4	D2244	...
Gloss	9.2	D523, D3134	...
Hiding power	9.3	D344, D2805	...
Properties of Dry Film:	10		
Abrasion resistance	10.1	D968, D4060	...
Adhesion	10.2	D2197, D3359, D4541	...
Dry film thickness	10.3	D1005, D4138, D6132, D7091	...
Elongation	10.4	D522	...
Internal stresses	10.5	...	...
Hardness	10.6	D1474, D3363, D5178, D7187	...
Discontinuity (Holiday)	10.7	D5162, G62	...
Impact resistance	10.8	D2794, D3170, D6905, G14	...
Burning characteristics	10.9	E84	...
Slip coefficient and creep resistance	10.10	...	...
Performance of Dry Film	11		
Moisture vapor transmission rate	11.1	D1653, F1249	...
Cathodic disbonding	11.2	G8, G42, G80, G85	...
Chemical resistance	11.3	C868, D1308, D3912, D4752, D5402, G20, G106	...
Moisture resistance	11.4	D870, D1735, D2247, D4585	...
Exterior exposure:	11.5		
Conducting	11.5.1	D1014, G50	...
Atmospheric exposure	11.5.2	G7	...
Accelerated outdoor weathering	11.5.3	D4141, G90	...
Patch test	11.5.4	D5064	...
Laboratory exposure:	11.6		
Accelerated weathering	11.6.1	G141, G147, G151	...
Enclosed carbon arc	11.6.1.1	D5031, G153	...
Open flame carbon arc	11.6.1.2	D822, G152	...

**TABLE 1** *Continued*

Property or Related Test	Section	ASTM Standard	Federal Test Method Standard No. 141C
Xenon arc	11.6.1.3	D6695, G155	...
Fluorescent UV	11.6.1.4	D4587, G154	...
Corrosion resistance:	11.6.2	B117, D5894, G85	...
Cyclic wet/dry test (Prohesion)	11.6.2.1	G85	...
Cyclic corrosion/UV	11.6.2.2	D5894	...
Salt for (spray)	11.6.2.3	B117, G85	...
Filiform corrosion	11.6.2.4	D2803	...
Report results	11.7	D610, D660, D661, D662, D714, D772, D1654, D4214, D5065	...

from batch to batch. Test Method **D1475** gives a procedure for measuring the density of the coating at specified temperature. A calibrated weight-per-gallon cup is used. Determine the density in accordance with Test Method **D1475**.

**7.4 Fineness of Dispersion**—Pigmented paints involve the dispersion of colored pigments and filler pigments into the liquid vehicle. Generally, the more finely a pigment is dispersed, the more efficiently it is being utilized. The fineness of dispersion (or fineness of “grind”) provides a means to measure and report the degree to which pigment agglomerates have been broken down in the dispersion process. The degree of dispersion can affect paint properties such as color, gloss, and pigment settling. Determine fineness of dispersion in accordance with Test Method **D1210**.

**7.5 Settling**—The amount and type of settling is an indication of how well the pigments remain in suspension and how easily settled pigment can be remixed. Pigments and fillers dispersed in paints are subject to settling as generally described in Stokes Law. Determine the degree of settling in accordance with Test Method **D869**.

**7.6 Viscosity**—Viscosity refers to the flow resistance of a fluid. Viscosity values are often related to application properties such as flow, leveling, and sag resistance and should fall within an agreed-upon range.

**7.6.1 Viscosity of Newtonian or Near Newtonian Fluids**—(constant viscosity regardless of shear rate), may be measured in accordance with Test Methods **D1200** and **D4212**. This viscosity measurement is used to determine package viscosity and application viscosity. Viscosity of non-Newtonian materials should be measured in accordance with Test Methods **D2196** since it measures resistance to flow at different shear rates. The ratio of viscosity values at different shear rates is also a way of measuring thixotropy often related to film build or sag resistance. Determine viscosity in accordance with Test Methods **D1200** or **D2196**.

**7.6.2 Consistency (Low-Shear Viscosity)**—Consistency is used mainly to ensure product uniformity. Consistency is defined in Test Method **D562** as the load in grams required to produce a specific rate of rotation in a specimen using the Stormer viscometer. This is a one-speed test method. Two paints of the same consistency may have quite different rheological properties during application. Determine consistency in accordance with Test Method **D562**.

**7.6.3 High-Shear Viscosity**—The viscosity of a paint under high shear is related to its behavior when brushed, rolled, or sprayed. In Test Methods **D4287** and **D4958**, the shear rate is

similar to that occurring during brush application so that the measured viscosity is related to brush drag, spreading rate, and film build. High-shear viscosity is more likely used in the development and quality control of paints than a requirement in a paint specification. Determine high-shear viscosity in accordance with Test Method **D4287**.

**7.7 Flash Point**—Flash point refers to the lowest temperature at which a vapor will ignite if presented with an ignition source such as a flame or spark. The flash point for a paint is needed to conform with many government regulations concerning transportation, labeling, packaging, and storage procedures. Determine flash point in accordance with Test Methods **D56**, **D93**, or **D3278**.

**7.8 Freeze-Thaw Stability**—Waterborne coatings may be subjected to freezing conditions during shipping and storage. Suitably stabilized products can resist several cycles of freezing and thawing without showing deleterious changes such as coagulation, graininess (seeding), or excessive viscosity increase. Test Method **D2243** covers the determination of the extent to which waterborne coatings retain their original consistency and freedom from lumps when subjected to freezing and subsequent thawing. Determine freeze-thaw resistance in accordance with Test Method **D2243**.

**7.9 Odor**—Odor is often associated with the volatile components: organic solvents or ammonia in waterborne coatings. No specific ASTM test method is available for evaluating odor. Method 4401 of Federal Test Method Standard No. 141C does address “characteristic” or expected odor. Test Method **D1296** may also be suitable as the basis for a test even though it is not specifically designed for liquid coatings.

**7.10 Microorganism Resistance**—Microorganisms in waterborne paints can cause gassing, putrefaction, or fermentation and their corresponding odors, and loss in viscosity and film build capability. Determine if the liquid coating contains living bacteria and if it is resistant to attack by bacteria in accordance with Test Method **D2574**.

**7.11 Package Stability**—Since liquid coatings cannot normally be used immediately after manufacture, they must remain stable in the package for some time. Test Method **D1849** covers the change in consistency and in certain related properties that may take place in packaged coatings when stored at a temperature above room temperature. Determine package stability in accordance with Test Method **D1849**.

**7.12 Volatile Content of Coatings**—Test Method **D2369** is used to determine the weight percent volatile content of