



Designation: D333 – 01 (Reapproved2007)

## Standard Guide for Clear and Pigmented Lacquers<sup>1</sup>

This standard is issued under the fixed designation D333; 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 These test methods cover procedures for testing lacquers and lacquer coatings. The test methods included are listed in [Table 1](#).

NOTE 1—In accordance with Terminology [D16](#), a lacquer is defined as a coating composition that is based on synthetic thermoplastic filmforming material dissolved in organic solvent(s) and that dries primarily by solvent evaporation. Typical lacquers include those based on nitrocellulose, other cellulose derivatives, vinyl resins, acrylic resins, etc.

NOTE 2—Lacquers may be applied under such diverse conditions, to so many different surfaces, and their dried films may be subjected to so many kinds of wear and exposure that it is not possible to assure desired performance from a single selection of test methods and numerical results therefrom. Those skilled in lacquer technology may find partial assurance of obtaining desired qualities in various types of lacquers through careful selection of the methods covered herein and intelligent interpretation of results therefrom.

NOTE 3—It is intended ultimately to remove all experimental procedures from Test Methods D333 and to establish them as a guide to the selection of test methods for lacquer and perhaps to interpretation of results therefrom. Temporarily there remain in Test Methods D333 a few tests that are too short or otherwise presently unsuitable for establishment under separate ASTM designations.

1.2 The values stated in SI units are to be regarded as the 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 and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

- [B117 Practice for Operating Salt Spray \(Fog\) Apparatus](#)
- [D16 Terminology for Paint, Related Coatings, Materials, and Applications](#)

<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 [D01.55](#) on Factory Applied Coatings on Preformed Products.

Current edition approved June 1, 2007. Published July 2007. Originally approved in 1931. Last previous edition approved in 2001 as D333 – 01. DOI: 10.1520/D0333-01R07.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- [D56 Test Method for Flash Point by Tag Closed Cup Tester](#)
- [D88 Test Method for Saybolt Viscosity](#)
- [D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester](#)
- [D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids \(and Calculation of Dynamic Viscosity\)](#)
- [D522 Test Methods for Mandrel Bend Test of Attached Organic Coatings](#)
- [D523 Test Method for Specular Gloss](#)
- [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](#)
- [D658 Test Method for Abrasion Resistance of Organic Coatings by Air Blast Abrasive \(Withdrawn 1996\)<sup>3</sup>](#)
- [D659 Method for Evaluating Degree of Chalking of Exterior Paints \(Withdrawn 1990\)<sup>3</sup>](#)
- [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](#)
- [D823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, 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](#)
- [D1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to](#)

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

**TABLE 1 List of Test Methods**

Test Method	Section	ASTM Method
General Requirements	4	...
Liquid Materials:		
Color of Clear Lacquers:		
Gardner Color Scale	9	D1544
Platinum-Cobalt Scale	9	D1209
Flash Point:		
Tag Closed Cup	11	D56, D93, D3278
Homogeneity:		
Clarity and Cleanness	8	D2090
Fineness of Pigment Grind	8	D1210
Nonvolatile Matter	7	D1644
Sample Preparation	5	...
Viscosity:		
Ford Cup (Efflux)	10	D1200
Kinematic High Precision	10	D445
Weight per Gallon (Density)	6	D1475
Dried Films:		
Abrasion Resistance:		
Air Blast Abrasion Tester	19	D658
Falling Sand Method	19	D968
Chip Resistance:	30	D3170
Color-Pigmented Coatings:		
Spectrophotometric Method	15	E308
Munsell Color System	15	D1535
Color Difference-Pigmented Coatings:		
Visual Method	16	D1729
Instrumental Evaluation of Color Differences of Opaque Materials	16	D2244
Elongation:		
Conical Mandrel	17	D522
Cylindrical Mandrel	17	D1737
Film Thickness:		
Nondestructive Magnetic Base	13	D1186
Nondestructive Nonmagnetic Metallic Base	13	D1400
Penetration Thickness Gage	13	D1400
Dial Comparator	13	D1005
Gloss:		
Specular Gloss	14	D523
Hardness Indentation Method	18	D1474
Hiding Power	27	D2805
Household Chemical Resistance	21	D1308
Light Stability	31	D2620
Outdoor Exposure:		
Preparation of Coated Panels:		
Aluminum Alloy Panels	22	D1733
Steel Panels	22	D609
Test Procedures:		
Exposure Tests Using Steel Panels	22	D1014
Evaluating Blistering	22	D714
Evaluating Chalking	22	D659
Evaluating Checking	22	D660
Evaluating Cracking	22	D661
Evaluating Rusting	22	D610
Evaluating Erosion	22	D662
Evaluating Flaking	22	D772
Panel Preparation:		
Manual Spraying Method	12	...
Automatic Application	12	D823
Perspiration Resistance	28	D2204
Plasticizer Migration	29	D2199
Print Test	20	D2091
Salt Fog	24	B117
Temperature-Change Resistance	23	D1211
Water Fog Testing	25	D1735
Water Immersion Test	26	D870

- a Ferrous Base (Withdrawn 2006)<sup>3</sup>
- D1200 Test Method for Viscosity by Ford Viscosity Cup
- D1209 Test Method for Color of Clear Liquids (Platinum-Cobalt Scale)
- D1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
- D1211 Test Method for Temperature-Change Resistance of Clear Nitrocellulose Lacquer Films Applied to Wood (Withdrawn 2006)<sup>3</sup>
- D1308 Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- D1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base (Withdrawn 2006)<sup>3</sup>
- 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
- D1544 Test Method for Color of Transparent Liquids (Gardner Color Scale)
- D1644 Test Methods for Nonvolatile Content of Varnishes
- D1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials
- D1733 Method for Preparation of Aluminum Alloy Panels for Testing Paint, Varnish, Lacquer, and Related Products (Withdrawn 1979)<sup>3</sup>
- D1735 Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
- D1737 Method of Test for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus (Withdrawn 1988)<sup>3</sup>
- D2090 Test Method for Clarity and Cleanness of Paint and Ink Liquids (Withdrawn 2007)<sup>3</sup>
- D2091 Test Method for Print Resistance of Lacquers
- D2199 Test Method for Measurement of Plasticizer Migration From Vinyl Fabrics to Lacquers
- D2204 Method of Test for Perspiration Resistance of Organic Coatings (Withdrawn 1976)<sup>3</sup>
- D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
- D2620 Test Method for Light Stability of Clear Coatings (Withdrawn 2001)<sup>3</sup>
- D2805 Test Method for Hiding Power of Paints by Reflectometry
- D3170 Test Method for Chipping Resistance of Coatings
- D3278 Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
- E308 Practice for Computing the Colors of Objects by Using the CIE System

### 3. Significance and Use

3.1 These test methods are intended to compile as well as provide screening tests in evaluating clear and pigmented lacquers as used in different coating operations.

3.2 Each coating system may contain from a simple one coat operation to a multicoat finishing system.

3.3 The substrates may be varied, ferrous and non ferrous, plastic or wood which can affect the performance of a given coating system.

3.4 Substrate cleaning, chemically or physically, is an essential and critical aspect to the performance of the coating system.

3.5 Results from the various tests are not necessarily all useful in evaluating the performance of the different types of coating systems used on the many varied substrates.

#### 4. General Requirements

4.1 All tests shall be made in diffused light (not in direct sunlight), and at  $23 \pm 2^\circ\text{C}$  ( $73.5 \pm 3.5^\circ\text{F}$ ) and  $50 \pm 5\%$  relative humidity, unless otherwise specified.

#### 5. Preparation of Sample

5.1 Many clear lacquers and all pigmented lacquers contain suspended solids that have a tendency to settle to the bottom of the container. Stir any settled portion with a paddle or spatula and then shake vigorously for 10 min on a mechanical agitator. Since many lacquer solvents are extremely volatile, care should be taken during sampling and testing to avoid loss of significant amounts of volatile matter.

#### 6. Weight Per Gallon

6.1 Determine the density as described in Test Method **D1475**. This method is particularly adaptable for high-viscosity fluids or where a component is too volatile for a specific gravity balance determination. If a weight per gallon cup of 83.2-mL capacity is used, calculation of weight per gallon is simplified.

#### 7. Nonvolatile Matter

7.1 Nonvolatile matter determination is an indication of the amount of permanent film-forming material contained in a lacquer. At ambient temperatures, drying of a lacquer film may involve gradual loss of slowly volatile solvents, hence solids determinations may differ from those resulting from a nonvolatile determination accelerated by a higher temperature.

7.2 Determine the nonvolatile content of lacquers as described in Test Methods **D1644**. As an additional requirement, the specimen shall be reheated and reweighed until the weight is constant to within 1 mg. Test Method A of Test Methods **D1644** is preferred since Method B is potentially dangerous when used with lacquers.

#### 8. Homogeneity

8.1 Good quality lacquers and their ingredients should be uniformly constituted and free from particles of foreign matter.

8.2 Determine the presence or absence of foreign matter in nonpigmented liquids for use in paints and lacquers or lacquers themselves as described in Test Method **D2090**.

8.3 Determine the degree of dispersion (commonly referred to as “fineness of grind”) of pigment, semiquantitatively, in pigmented coating systems in accordance with Test Method **D1210**.

#### 9. Color

9.1 The color of a clear lacquer is only a preliminary indication of the color of a dried film of lacquer. The initial

color may bleach and another color may appear under certain conditions of exposure.

9.2 Determine the color of clear lacquers as described in Test Method **D1544**. This method gives a comparison of the color of the sample with that of a color reference standard.

9.3 Determine the color of essentially water-white lacquers in accordance with Test Method **D1209**. This method shall be used where the color-producing bodies in the lacquer have very nearly the same light-absorption characteristics as those of the platinum-cobalt standards.

#### 10. Viscosity

10.1 The viscosity of a lacquer is a property that can be used as a guide in determining the ease with which a given lacquer may be applied. For example, lacquers designed for spray application may be low in viscosity whereas they are high for doctor blade or roller application.

10.2 Determine the viscosity of clear and pigmented finishes designed for spray application as described in Test Method **D1200**. This method is not recommended for lacquers with viscosities requiring more than 100 s efflux time.

10.3 For precise viscosity determinations in the range from 0.4 to 16 000 cSt proceed in accordance with Test Method **D445**.

NOTE 4—Caution should be observed in that it is recognized that changes in viscosity may occur in lacquers upon aging.

#### 11. Flash Point

11.1 The organic solvents used in lacquers have characteristic flash points. The flash point of a liquid is defined as the lowest temperature, corrected to 760 mmHg (101.3 kPa ) of pressure, of the sample at which application of an ignition source causes the vapor of the sample to ignite under specified conditions of test.

11.2 Determine the flash point by Test Method **D56** or Test Methods **D93** for liquid storage regulations of Occupational Safety and Health Administration (OSHA) of U. S. Department of Labor and for classification of hazardous liquids for shipments under the regulations of U. S. Department of Transportation and bulk shipments by water.

11.2.1 Determine the flash point of lacquer or lacquer materials having a viscosity less than 9.5 cSt at  $25^\circ\text{C}$  ( $77^\circ\text{F}$ ) or 45 SUS at  $37.8^\circ\text{C}$  ( $100^\circ\text{F}$ ) (Test Method **D88**) by Test Method **D56** and of lacquers having a viscosity of more than 9.5 cSt at  $25^\circ\text{C}$  ( $77^\circ\text{F}$ ) or 45 SUS at  $37.8^\circ\text{C}$  ( $100^\circ\text{F}$ ) by Method A of Test Methods **D93**. Use Method B of Test Methods **D93** whenever there is a question that the heat transfer within a viscous lacquer is not sufficient to assure an accurate flash point. In addition, use Method B when testing pigmented lacquers or suspensions of solids and liquids which tend to skin under test conditions.

11.3 Test Methods **D3278**, which give comparable results to Test Method **D56** and Test Methods **D93** while requiring a smaller specimen and less time to run, may be used as an alternative method.