



Designation: D 154 – 85 (Reapproved 1996)

## Standard Guide for Testing Varnishes<sup>1</sup>

This standard is issued under the fixed designation D 154; 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 procedures for testing varnishes. Some test methods are included, but most sections refer to specific ASTM test methods.

1.2 Varnishes 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. Those skilled in varnish technology may find partial assurance of obtaining desired qualities in various types of varnishes through careful selection of the methods covered and intelligent interpretation of results.

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 56 Test Method for Flash Point by Tag Closed Tester<sup>2</sup>
- D 93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester<sup>2</sup>
- D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)<sup>2</sup>
- D 479 Test Method for Reactivity of Paint Liquids<sup>3</sup>
- D 523 Test Method for Specular Gloss<sup>4</sup>
- D 658 Test Method for Abrasion Resistance of Organic Coatings by Air Blast Abrasive<sup>4</sup>
- D 968 Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive<sup>4</sup>
- D 1200 Test Method for Viscosity by Ford Viscosity Cup<sup>4</sup>
- D 1209 Test Method for Color of Clear Liquids (Platinum-Cobalt Scale)<sup>5</sup>

- D 1310 Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus<sup>4</sup>
- D 1469 Test Method for Total Rosin Acids Content of Coating Vehicles<sup>6</sup>
- D 1475 Test Method for Density of Paint, Varnish, Lacquer, and Related Products<sup>4</sup>
- D 1542 Test Method for Qualitative Detection of Rosin in Varnishes<sup>6</sup>
- D 1544 Test Method for Color of Transparent Liquids (Gardner Color Scale)<sup>4</sup>
- D 1545 Test Method for Viscosity of Transparent Liquids by Bubble Time Method<sup>6</sup>
- D 1546 Test Method for Performance Tests of Clear Floor Sealers<sup>7</sup>
- D 1639 Test Method for Acid Value of Organic Coating Materials<sup>6</sup>
- D 1640 Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature<sup>4</sup>
- D 1641 Test Method for Exterior Durability of Varnishes<sup>7</sup>
- D 1644 Test Methods for Nonvolatile Content of Varnishes<sup>4</sup>
- D 1647 Test Method for Resistance of Dried Films of Varnishes to Water and Alkali<sup>6</sup>
- D 1729 Practice for Visual Evaluation of Color Differences of Opaque Materials<sup>4</sup>
- D 2090 Test Method for Clarity and Cleanliness of Paint and Ink Liquids<sup>6</sup>
- D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates<sup>4</sup>
- D 2369 Test Method for Volatile Content of Coatings<sup>4</sup>
- D 2805 Test Method for Hiding Power of Paints by Reflectometry<sup>4</sup>
- D 3278 Test Method for Flash Point of Liquids by Small Scale Closed Cup Apparatus<sup>4</sup>
- D 3964 Practice for Selection of Coating Specimens for Appearance Measurements<sup>4</sup>
- D 4039 Test Method for Reflection Haze of High-Gloss Surfaces<sup>4</sup>
- D 4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser<sup>4</sup>

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.33 on Polymers and Resins.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 05.01.

<sup>3</sup> Discontinued; see 1983 *Annual Book of ASTM Standards*, Vol 06.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol 06.01.

<sup>5</sup> Annual Book of ASTM Standards, Vol 06.04.

<sup>6</sup> Annual Book of ASTM Standards, Vol 06.03.

<sup>7</sup> Annual Book of ASTM Standards, Vol 06.02.

**LIQUID VARNISH PROPERTIES**
**3. Appearance**

3.1 Appearance of the liquid varnish is important both for aesthetic reasons and because it indicates whether the dried film is likely to have a satisfactory appearance. Examine the liquid varnish for foreign matter, sediment or skins in accordance with Test Method D 2090.

**4. Color**

4.1 Most varnishes are predominantly yellow, but the color of the liquid varnish is only a preliminary indication of the color of the dried varnish film. The initial color may bleach or may darken depending upon the conditions of exposure. Determine approximately and quickly the liquid color of small specimens in Gardner-Holdt tubes by comparison with the Gardner Color Standards in accordance with Test Method D 1544.

4.2 Measure the color of extremely pale varnishes by using larger specimens in 100-mL cylinders, 300 mm deep, in accordance with Test Method D 1209.

4.3 A more precise measure of color, in terms of tristimulus values, may be made on small specimens in 10-mm cells with parallel walls in accordance with Practice E 308.

**5. Viscosity**

5.1 The viscosity of a varnish or clear vehicle is a property important in ease of application; varnishes for brush application are typically 1 to 2 St whereas varnishes with viscosities as high as 100 St may sometimes be added to lithography coatings or used as mixing vehicles for producing enamels. Viscosity is commonly measured at 77°F (25°C).

5.2 For the rapid, approximate measurement of the viscosity of transparent varnishes, determine the bubble time by Test Method D 1545. Report the viscosity either in stokes or in Gardner-Holdt letter designations as described in Table 1 of Test Method D 1545.

5.3 For a rapid, approximate measurement of the viscosity of translucent varnishes, determine the Ford cup efflux time in accordance with Test Method D 1200.

5.4 For the precise measurement of viscosity, use capillary viscometers as described in Test Method D 445.

**6. Specific Gravity**

6.1 Specific gravity of a varnish is the ratio of the weight of a given volume of the varnish at a given temperature to the weight of an equal volume of distilled water at the same temperature. Determine specific gravity or density at 77°F (25°C) or other agreed temperature in accordance with Test Method D 1475 which allows use of either a pycnometer or a weight per gallon cup.

**7. Volatile Content**

7.1 Volatile matter determination is an indication of the amount of material in the coating that will be given off to the atmosphere in the area where the coating is applied. Depending

**TABLE 1 List of Test Methods**

Test Method	Section	ASTM Designation
<i>Liquid Varnish Properties:</i>		
Appearance	3	D 2090
Color (Gardner)	4.1	D 1544
Color, Platinum-Cobalt Scale	4.2	D 1209
Color, tristimulus	4.3	E 308
Viscosity:	5	
Bubble time (Gardner-Holdt)	5.2	D 1545
Ford cup efflux	5.3	D 1200
Kinematic, high precision	5.4	D 445
Specific gravity	6	D 1475
Volatile content	7	D 2369
Nonvolatile matter	8	D 1644
Flash point:	9	
Tag closed-cup		D 56
Pensky Martens		D 93
Tag open-cup		D 1310
Setaflash closed tester		D 3278
Skimming	10	
Acid value	11	D 1639
Reactivity of paint liquids	12	D 479
Rosin content, quantitative	13	D 1469
Rosin content, qualitative (Lieberman-Storch and Halphen-Hicks)	13	D 1542
<i>Drying and Curing Properties:</i>		
Drying time	14	D 1640
Print free time	15	D 1640
<i>Dry Varnish Properties:</i>		
Gloss:	16	
Specular gloss		D 523
Reflective haze		D 4039
Resistance of dried films to water and alkali	17	D 1647
Abrasion resistance:		
Carborundum air blast	18	
Falling abrasive		D 658
Taber abramer		D 968
Exterior durability		D 4060
Color of dried film	19	D 1641
	20.1	D 2244
	20.2	D 1729
Clear floor sealers	21	D 1546

upon the method of application, the time required to vaporize the volatile, and the conditions of the atmosphere surrounding the application, it is recommended that Test Method D 2369 be used to determine the volatile content of a varnish.

**8. Nonvolatile Matter**

8.1 Nonvolatile content is an indication of the amount of permanent film-forming material contained in a varnish. The normal drying of a varnish film may involve varying amounts of absorption of oxygen from the air, loss of volatile solvents, and continuing decomposition of the dried film. The net result of this process may differ somewhat from a nonvolatile determination at a temperature higher than the normal drying conditions.

8.2 With due regard to the composition of the varnish, determine the nonvolatile matter in accordance with either Method A (3 h at 220°F (105°C)) or Method B (10 min at 300°F (149°C)) of Test Methods D 1644.

8.3 As noted in Test Method D 2369, nonvolatile matter can also be calculated by subtracting the volatile content from 100.