Designation: D 3322 – 82 (Reapproved 2001)

Standard Practice for Testing Primers and Primer Surfacers Over Preformed Metal[1]

This standard is issued under the fixed designation D 3322; 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 practice covers the selection and use of procedures for testing primers and primer surfacers. The test methods included are listed in Table 1.

1.2 *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:*

B 117 Practice for Operating Salt Spray (Fog) Apparatus[2]

C 540 Test Method for Image Gloss of Porcelain Enamel Surfaces[3]

D 16 Terminology Relating to Paint, Varnish, Lacquer, and Related Products[4]

D 522 Test Methods for Mandrel Bend Test of Attached Organic Coatings[4]

D 523 Test Method for Specular Gloss[4]

D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coating, and Related Coating Products[4]

D 610 Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces[5]

D 658 Test Method for Abrasion Resistance of Organic Coatings by Air Blast Abrasive[6]

D 660 Test Method for Evaluating Degree of Checking of Exterior Paints[4]

D 661 Test Method for Evaluating Degree of Cracking of Exterior Paints[4]

D 714 Test Method for Evaluating Degree of Blistering of Paints[4]

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels[4]

TABLE 1 Test Methods

Property	Section	ASTM Method	Federal Test Method Specification No. 141B
Abrasion resistance:			
Air blast abrasion tester	6.2	D 658	...
Falling sand method	6.2	D 968	6191
Adhesion:			
Scrape adhesion	6.3	D 2197	6303.1
Parallel-groove adhesion	6.3	D 2197	6302.1
Tape adhesion	6.3	D 3359	...
Chemical resistance:			
Household chemical resistance	6.4.2	D 1308	...
Detergent resistance	6.4.3	D 2248	
Hydrocarbon resistance	6.4.4	...	6011
Chip resistance	6.5	D 3170	...
Color difference:			
Visual evaluation	6.6	D 1729	4249.1
Instrumental evaluation	6.6	D 2244	6123
Cracking resistance	6.7	D 2246	...
Elongation:			
Conical mandrel	6.8	D 522	...
Cylindrical mandrel	6.8	D 1737	...
Filiform corrosion	6.9	D 2803	...
Gloss	6.10	D 523	6101
Hardness	6.11	D 1474	...
Holdout	6.12	C 540	...
Mildew resistance	6.13	...	6271.1
Outdoor exposure:			
Blistering	6.14.2	D 714	6461
Cracking	6.14.2	D 661	6471
Rusting	6.14.2	D 610	6451
Checking	6.14.2	D 660	6421
Print resistance	6.15	D 2091	...
Salt spray resistance	6.16	B 117	6061
Sanding properties	6.17	...	6321
Water resistance:			
High humidity	6.18.2	D 1735	...
Water immersion	6.18.3	D 870	...
Weldability	6.19	...	[A]

[A] U.S. Military Specification MIL-P-46105 (MR).

D 870 Practice for Testing Water Resistance of Coatings Using Water Immersion[4]

D 968 Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive[4]

D 1005 Test Methods for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers[4]

D 1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base[4]

D 1308 Test Method for Effect of Household Chemicals on

[1] This practice 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 Nov. 26, 1982. Published January 1983. Originally published as D3322 – 74. Last previous edition D3322 – 74a.

[2] *Annual Book of ASTM Standards*, Vol 03.02.

[3] Discontinued; see *1990 Annual Book of ASTM Standards*, Vol 15.02.

[4] *Annual Book of ASTM Standards*, Vol 06.01.

[5] *Annual Book of ASTM Standards*, Vol 06.02.

[6] Discontinued; see *1995 Annual Book of ASTM Standards*, Vol 06.01.

Clear and Pigmented Organic Finishes[5]
D 1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base[4]
D 1474 Test Methods for Indentation Hardness of Organic Coatings[4]
D 1640 Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature[4]
D 1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely Illuminated Opaque Materials[4]
D 1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting[7]
D 1731 Practices for Preparation of Hot-Dip Aluminum Surfaces for Painting[7]
D 1732 Practices for Preparation of Magnesium Alloy Surfaces for Painting[7]
D 1733 Method of Preparation of Aluminum Alloy Panels for Testing Paint, Varnish, Lacquer, and Related Products[8]
D 1735 Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus[4]
D 1737 Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus[9]
D 2091 Test Method for Print Resistance of Lacquers[5]
D 2092 Guide for Treatment of Zinc-Coated (Galvanized) Steel Surfaces for Painting[5]
D 2197 Test Methods for Adhesion of Organic Coatings by Scrape Adhesion[4]
D 2201 Practice for Preparation of Zinc–Coated and Zinc–Alloy–Coated Steel Panels for Testing Paint and Related Coating Products[4]
D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates[4]
D 2246 Test Method for Finishes on Primed Metallic Substrates for Humidity-Thermal Cycle Cracking[10]
D 2248 Practice for Detergent Resistance of Organic Finishes[4]
D 2454 Practice for Determining the Effect of Overbaking on Organic Coatings[4]
D 2803 Guide for Filiform Corrosion Resistance of Organic Coatings on Metal[4]
D 3170 Test Method for Chipping Resistance of Coatings[5]
D 3359 Test Methods for Measuring Adhesion by Tape Test[4]
D 3456 Practice for Determining by Exterior Exposure Tests the Susceptibility of Paint Films to Microbiological Attack[4]

2.2 *Federal Test Methods:*[11]

141B/6011 Immersion Resistance
141B/6271.1 Mildew Resistance
141B/6321 Sanding Characteristics

2.3 *U.S. Military Specification:*

MIL-P-46105[11]

3. Terminology

3.1 *Definitions:*

3.1.1 *primer*—the first of two or more coats of paint, varnish, or lacquer system (same as in Terminology D 16).

3.1.2 *primer surfacer*—a pigmented coating for filling minor irregularities which is sanded to obtain a smooth uniform surface preparatory to applying finish coats. A primer surfacer is not usually applied over a primer.

4. Significance and Use

4.1 Primers and primer surfacers may be used over many different surfaces top coated with one or more of a variety of coatings and subjected to many kinds of wear and exposure.

4.2 The selection of the tests to be used for any given product or system must be governed by experience and by the requirement agreed upon between the producer and the user.

5. Panel Preparation

5.1 *Treatment of Substrate*—Preparation of test panels should include any cleaning treatment agreed upon between the purchaser and the seller or one of the following ASTM Practices: D609, D1730, D1731, D1732, D2201; Guide D 2092; and Method D 1733.

5.2 *Substrate, Film Thickness, and Application Means*—Conduct performance tests on the specified substrate on coatings having a film thickness agreed upon between the purchaser and the seller. Primers are generally applied to a dry film thickness of 0.3 to 1.5 mil (8 to 38 µm) and primer surfacers to film thickness of 0.7 to 2.0 mil (17 to 50 µm). Unless otherwise agreed upon, apply primers and primer surfacers in accordance with Practices D 823.

5.3 *Measurement of Film Thickness*—Since the properties of the primer or primer surfacer can vary considerably with the thickness of the coating, it is important to know the film thickness. Measure the film thickness in accordance with Test Methods D 1400, D 1005, or D 1186.

5.4 *Drying of Primer or Primer Surfacer*:

5.4.1 Before tests are run, air dry or bake the primer or primer surfacer according to the schedule and temperature and age as agreed upon between the purchaser and the seller.

5.4.2 Overbake the primer or primer surfacer to determine the time/temperature effect on the physical and chemical properties. Do this in accordance with Practice D 2454.

5.4.3 It may be desirable for some reason (handling, stacking, etc.) to determine the various stages and rates of film formation in the drying or curing of primers and primer surfacers at room temperatures. Do this as described in Test Method D 1640.

6. Physical Properties of The Dry Film

6.1 Primers and primer surfacers are usually (but not always) topcoated. Therefore, many of the following tests should be run on the complete system (substrate/primer or primer surfacer/topcoat). Some of the tests however are for the untopcoated primer or primer surfacer. The properties required of a primer or primer surfacer depend on the intended end use and the tests to be used should be selected on the basis of experience and agreed upon between the purchaser and the seller.

[7] *Annual Book of ASTM Standards*, Vol 02.05.
[8] Discontinued; see *1980 Annual Book of ASTM Standards*, Part 27.
[9] Discontinued; see *1988 Annual Book of ASTM Standards*, Vol 06.01.
[10] Discontinued; see *1991 Annual Book of ASTM Standards*, Vol 06.01.
[11] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094.

6.2 *Abrasion Resistance*—Determine the abrasion resistance as described in either Test Method D 658 or D 968.

6.3 *Adhesion*:

6.3.1 The primer or primer surfacer of a specified substrate as agreed upon between the purchaser and the seller is subjected to an adhesion test to determine the degree of attachment the coating has to the substrate.

6.3.2 Determine the adhesion of the primer or primer surfacer as described either in Test Methods D 2197 or D 3359.

6.3.3 The above methods, in addition to measuring the adhesion of the coating to the substrate, can also be used to determine the intercoat adhesion between the topcoat and the primer or primer surfacer.

6.4 *Chemical Resistance*:

6.4.1 Coating systems frequently come into contact with various chemicals that may have an effect on the properties of the system. Failure when it occurs is usually in the form of discoloration, change in gloss, blistering, softening, swelling, dissolving, or loss of adhesion. Unless a primer is to be left untopcoated in actual service, primers and primer surfacers should be topcoated with the appropriate product before undergoing chemical resistance tests.

6.4.2 *Household Chemical Resistance*—Determine the effect of chemicals in accordance with Test Method D 1308.

6.4.3 *Detergent Resistance*—Determine the resistance to failure under conditions of immersion in a detergent solution in accordance with Practice D 2248.

6.4.4 *Hydrocarbon Resistance*—Test hydrocarbon resistance in accordance with Method 6011 of U.S. Federal Test Method Standard No. 141B.

6.5 *Chip Resistance*—The chip resistance of a primer or primer surfacer is the ability of a film to withstand sudden impact from stones, gravel, etc., without being loosened from the substrate. Determine chip resistance by Test Method D 3170.

6.6 *Color Difference-Pigmented Dry Film*—The color differences between two similarly homogeneously colored, opaque film such as those formed by primers or primer surfacers may be determined using visual evaluating techniques or by instrumental means. Determine color differences visually using Practice D 1729. Determine color differences instrumentally using Test Method D 2244.

6.7 *Cracking Resistance*—A test for resistance to temperature and humidity changes, or a cold cracking test as it is sometimes called, is designed to give an indication of the resistance of a coating system to cracking or checking caused by temperature and humidity changes and also by aging. The degree of correlation between accelerated crack results and long-term room-temperature aging varies with the types of coating. The industry uses the test widely and it is felt that a system showing good cold crack resistance will perform satisfactorily in service. Some factors that can affect results are type of substrate, substrate thickness, primer, primer surfacer, topcoat, and film thickness of the different coatings. Determine cracking resistance in accordance with Test Method D 2246.

6.8 *Elongation*—An elongation test may be used as an indication of the flexibility of an attached primer or primer surfacer. It can also show whether there is any change during aging. Determine elongation by Test Methods D 522 or D 1737.

6.9 *Filiform Corrosion Resistance*—Filiform corrosion is a type of corrosion that occurs under coatings on metal substrates and is characterized by a definite thread-like structure and directional growth. Determine the susceptibility of organic films over metal substrates to this type of corrosion by Guide D 2803.

6.10 *Gloss*—Determine the gloss of primers and primer surfacers in accordance with Test Method D 523.

6.11 *Hardness*—Determine the film hardness of primers and primer surfacers in accordance with Test Methods D 1474, using either Test Method A (Knoop indentation hardness) or Test Method B (Pfund indentation hardness) as agreed upon between the purchaser and the seller. Other methods of determining hardness may be used as agreed upon between the purchaser and the seller.

6.12 *Holdout*—Holdout is the ability of a primer or primer surfacer to give a smooth (nonporous), uniform appearance when topcoated. This property can be evaluated visually or by instrumental means. One method of measuring for holdout is described in Test Method C 540.

6.13 *Mildew Resistance*—Test mildew resistance in accordance with Method 6271 of U.S. Federal Test Method Standard No. 141B or Practice D 3456.

6.14 *Outdoor Exposure*:

6.14.1 Primers and primer surfacers can have an important effect on the durability of any paint system destined for exterior use. While the accelerated tests given in other sections of this practice are intended to enable one to predict performance, actual outdoor exposure should be made. Usage of paint systems is so varied that no one set of conditions (length of exposure or place of exposure) can be given in this practice to cover all situations. These conditions as well as the type of substrate, substrate preparation, etc., should be agreed upon between the purchaser and the seller. However, it is suggested that, unless otherwise agreed upon, prepare panels for outdoor exposure in accordance with 4 of this practice.

6.14.2 Many properties of organic coating systems should be evaluated periodically throughout the outdoor exposure period. Where failures occur on a topcoated system, experience is required to determine whether or not the primer or primer surfacer is involved. Properties most likely to involve the primer or primer surfacer may be evaluated as follows: blistering, Test Method D 714; cracking, Test Method D 661; rusting, Test Method D 610; checking, Test Method D 660.

6.15 *Print Resistance*—A print test can be used to determine the degree of thermoplasticity or solvent retention of a film and hence whether the product can be safely stacked or packaged and, in the case of a thermoplastic film, at what temperature the film prints or mars. A print test can also be used to determine the degree of marring due to pressure. Determine the imprinting and thermoplasticity of primer or primer surfacer films as described in Test Method D 2091.

6.16 *Salt Spray Resistance*—Salt spray testing of coatings is helpful in determining their resistance to failure in service under conditions of high humidity and salt concentrations.

Under accelerated conditions of laboratory testing, the temperature, the pH, the concentration of the salt solution, and other physical properties can be controlled. The selection of the substrate, the application technique, the choice of the topcoat, the manner in which the coating is scribed, the location or position of the panels within the cabinet, the length of the test, the inspection of panels, and the method of reporting results must be agreed upon between the purchaser and the seller. Test for salt spray resistance in accordance with Practice B 117.

6.17 *Sanding Properties*:

6.17.1 Sanding properties are normally expected of primer surfacers only. Method 6321 of U.S. Federal Test Method Standard No. 141B covers this property.

6.17.2 Prepare and dry a film of the material to be tested as specified in the product specification. Scuff the surface of the dried film manually with 400 softback sandpaper. Examine the film for gouging and deep scratches, and determine whether there has been any clogging of the sandpaper. Depending on the end use of the primer surfacer involved, other methods of sanding may be used as agreed upon between the purchaser and the seller.

6.18 *Water Resistance*:

6.18.1 Testing of coating systems with water is helpful in determining their resistance to failure under conditions of high humidity or water immersion. Failure in water tests is usually evidenced by blistering, dulling, softening, or loss of adhesion which does not disappear or recover upon evapora-tion of the absorbed water.

6.18.2 Determine the resistance to failure under conditions of high humidity in accordance with Practice D 1735.

6.18.3 Determine the resistance to failure under conditions of water immersion in accordance with Practice D 870. This test is best suited for coating systems that will actually be soaked in water during service.

6.19 *Weldability*—In some instances it is necessary to weld metal that has been primed. The welding characteristics of a primer or primer surfacer may be tested in accordance with U.S. Military Specification MIL-P-46105 (MR), Section 4.4.11.

7. Keywords

7.1 corrosion resistance; filiform corrosion; holdout; primers; primer surfacers; sanding properties