Designation: D4213 – 08 (Reapproved 2012)

Standard Test Method for Scrub Resistance of Paints by Abrasion Weight Loss[1]

This standard is issued under the fixed designation D4213; 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 test method covers an accelerated procedure for determining the resistance of paints to erosion caused by scrubbing. (Note: The term *wet abrasion* is sometimes used for *scrubbing*, and *wet abrasion resistance* or *scrubbability* for *scrub resistance*.) Although scrub resistance tests are intended primarily for interior coatings, they are sometimes used with exterior coatings as an additional measure of film performance.

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:*[2]

D562 Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer

D1193 Specification for Reagent Water

D1475 Test Method For Density of Liquid Coatings, Inks, and Related Products

D2486 Test Methods for Scrub Resistance of Wall Paints

D3450 Test Method for Washability Properties of Interior Architectural Coatings

D3980 Practice for Interlaboratory Testing of Paint and Related Materials (Withdrawn 1998)[3]

D4828 Test Methods for Practical Washability of Organic Coatings

E70 Test Method for pH of Aqueous Solutions With the Glass Electrode

E180 Practice for Determining the Precision of ASTM Methods for Analysis and Testing of Industrial and Specialty Chemicals (Withdrawn 2009)[3]

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Summary of Test Method

3.1 The material under test is applied to a black plastic scrub test panel, and after drying one week, a section of the test panel is placed in a straight-line abrasion tester, adjacent to a similar section of a standard calibration panel. The two sections are scrubbed simultaneously to produce essentially identical abrasion experiences and the amount of erosion loss in each section determined from the panel weights before and after scrubbing.

3.2 The scrub resistance on a dry-film basis is calculated as the percent ratio of the weight loss of the calibration panel to that of the test panel. From that value, scrub resistance is calculated on the basis of both dry- and wet-film volume.

4. Significance and Use

4.1 Interior paint films often become soiled, especially near doorways, windows, and play areas, and frequently need to be cleaned by scrubbing. This test method covers the determination of the relative resistance of paints to erosion when scrubbed.

4.2 The precision of scrub resistance measurements in absolute physical values, such as Test Methods D2486 cycles-to-failure or this test method, microlitres per 100 cycles, is poor due to the relatively large effect of subtle and difficult-to-control variables in test conditions. The test method described herein minimizes this problem by using a standard calibration panel as an integral part of each scrubbing operation and relating its weight loss to that of the paint film under test to establish the latter's scrub resistance.

NOTE 1—The numerical scrub resistance values obtained by this test method are of significance only in relation to the specific calibration panel types with which the value is obtained. Thus, for example, a scrub resistance value of 83 with a Type X calibration panel would be reported as 83X.

4.3 Results obtained by this test method do not necessarily represent the scrub resistance that might be determined if the

[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.42 on Architectural Coatings.

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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.

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

test film is allowed to dry before testing appreciably longer than the seven-day period specified herein.

4.4 Results obtained by this test method do not necessarily relate to ease of soil or stain removal (also referred to as "cleanability" or "cleansability"). To test for those characteristics use Test Methods D3450 and D4828.

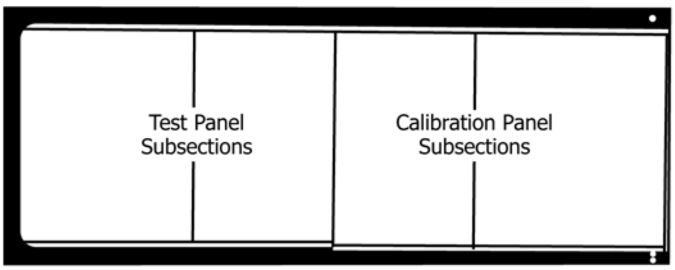

FIG. 1 Alignment of Panels for Scrubbing

5. Apparatus and Materials

5.1 *Straight-line Scrub Tester,* set for 37 ± 1 cycles per minute, having a minimum intrinsic stroke length of 255 mm (10 in.), counter for recording the number of scrub cycles, base pan, glass support plate, "Lilly" frame, and C-clamps to hold down the entire test assembly.

5.2 *Sponge Holder,* stainless steel construction, weight: 450 ± 10 g, approximate inside dimensions: 22 by 75 by 95 mm (7⁄8 by 3 by 3¾ in.).

5.3 *Polyurethane Sponges,*[4] skin free, open-cell formation, density 0.032 to 0.040 g/cm^3 (2 to 2.5 lb/ft^3), compression (25 % deflection) 4.8 kPa (0.7 psi), width and length 0.08 in. (2 mm) larger than the sponge holder with which it is to be used, thickness such that when inserted into the sponge holder it protrudes about 5 to 6 mm (0.25 in.) beyond the skirt (see Fig. 1).

5.4 *Abrasive Pad,*[5] 6-mm (¼-in.) thick, cut to same size as the sponge with which it is to be used.

5.5 *Film Caster,* with horseshoe frame, clearance 175 µm (7 mils), film width approximately 135 mm (5¼ in.).

5.6 *Black Plastic Panels,*[6] dimensions: 0.25 ± 10 % by 165 by 430 mm (0.01 ± 10 % by 6.5 by 17 in.). Level and uniform dull black surface, impervious to and unaffected by water or aliphatic solvents, plasticizer-free, density 1.33 ± 0.05 g/cm^3.

NOTE 2—With dark colored paints use white panels. These should be the same as the black except for color, and density: 1.41 ± 0.05 g/cm^3.

5.7 *Drawdown Plate,* 6-mm (¼-in.) thick, clear float glass, size adequate to be used as a base for drawdowns on the specified scrub test panels.

5.8 *Non-Abrasive Scrub Medium,*[7] standard wetting liquid. Formula and preparation instructions are as follows:[8-10]

Formula—Parts by Weight	
Water, reagent, Specification D1193, Type IV	89.6[A]
Hydroxyethyl cellulose[8]	2.0
Detergent [9]	4.0
Trisodium phosphate, anhydrous	4.0
Acetic acid glacial	0.3[B]
Preservative [10]	0.1
	100.0

[A] Vary to achieve a final consistency of 165 to 220 g (75 to 85 Krebs Units) with a Stormer viscometer in accordance with Test Method D562.
[B] Vary to achieve a final pH from 9.5 to 10.0 in accordance with Test Method E70.

5.8.1 Slowly add the hydroxyethyl cellulose to the water while stirring mechanically. Stir until uniform and then slowly add 2 to 3 drops of 28 % ammonium hydroxide solution while mixing, and continue mixing until the solution turns clear. In the order shown, add the other ingredients separately, stirring continuously. Be sure each item is uniformly dispersed before adding the next one. Finally, add the preservative and adjust the pH with glacial acetic acid.

NOTE 3—When a referee test is made the medium should be freshly prepared, or from a previously unopened container that is no more than 1-year old.

5.9 *Analytical Balance With Windshield Enclosure,* reading to 0.1 mg and accurate to 1 mg.

5.10 *Static Shield,* a thin gage metal plate, size 110 by 165 mm (4¼ by 6½ in.), to be placed on the balance pan when weighing. A satisfactory shield can be made from 0.175 to 0.300 mm (7 to 12 mil) thick aluminum or tinplate.

5.11 *Oven,* adjusted to 50 to 55°C (120 to 130°F).

5.12 *Calibration Panels,*[11] prepared in advance using paints of suitable scrub resistance.

NOTE 4—The procedure for preparing calibration panels is the same as described in 6.1 and 6.2 for regular test panels, except that the panels shall be aged sufficiently before use to ensure that the effect of additional ageing on their scrub resistance is negligible. A period of 6 months has been found adequate. Earlier use requires that in a given test series all calibration panels be the same age.

5.13 *Pycnometer,* for example, "weight-per-gallon" cup.

[4] Sponges, available from suppliers of scrub testers, cut to precise size for their respective holders.

[5] Abrasive pad—Scotch-Brite #7448 manufactured by 3M Company, 3M Center Bldg., St. Paul, MN 55144-1000 has been found satisfactory. Pads cut to the correct size are available from suppliers of scrub testers.

[6] Scrub Test Panels—Black: Form P121-10N and White: Form P122-10N, available from The Leneta Co., 15 Whitney Rd., Mahwah, NJ 07430, were used in the round-robin for this method. Other charts that are in compliance with requirements stated in 5.6 may be used also.

[7] Non-Abrasive Scrub Medium—Catalog Item SC-1 available from The Leneta Company is made in accordance with these requirements.

[8] Hydroxyethyl cellulose having a molar substitution (MS) value from 1.8 to 2.5 and a 2 % solution viscosity in the range of 4400 to 6500 cps.

[9] Iso-octylphenoxy polyethoxyethanol detergent, such as Triton X-100 has been found satisfactory for this purpose.

[10] 1,3,5-triethyl hexahydro-sym-triazine (Vancide TH), obtainable from R. T. Vanderbilt Co., 30 Winfield St., Norwalk, CT 06855, has been found satisfactory.

[11] Calibration panels may be prepared by individual laboratories for internal use and for relating their results to those of associated laboratories. Suitably aged and standardized calibration panels, having "poor," "good," and "very good" scrub resistance are available commercially from the Leneta Company. These are identified as Type A, C, and D respectively. The scrub resistance of Type A has been found to be approximately 35 % of Type C, and Type C approximately 50 % of Type D.