Designation: D3450 – 15

Standard Test Method for Washability Properties of Interior Architectural Coatings[1]

This standard is issued under the fixed designation D3450; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of the relative ease of removing soilant discolorations from the dried film of an interior coating by washing with either an abrasive or nonabrasive cleaner.

1.2 This test method is limited to coatings having a CIE-Y reflectance of 60 % or more, as measured in accordance with Test Method E1347.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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

D1210 Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage

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

E1347 Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *soilant, n*—a discoloring substance that clings to the surface of a coating, whose dispersed color component is not in solution and therefore does not penetrate into the film.

3.1.1.1 *Discussion*—soilant differs from stain in that the colorant of a stain is in solution and, therefore, can penetrate into the film.

4. Summary of Test Method

4.1 The test material is applied to a black plastic panel and allowed to dry for 7 days. The reflectance of the film is measured (R_1) and then a soilant consisting of carbon black dispersed in mineral oil is applied on the film. The panel is placed on a glass plate in a washability machine and the film is washed with either an abrasive or nonabrasive scrub medium for 100 cycles. The panel is rinsed and dried and the reflectance in the stained area is read (R_2). The ratio of the reflectance, R_2/R_1, is a measure of the degree to which the soilant has been removed.

5. Significance and Use

5.1 Interior architectural paints are often discolored by dirt and other soilant materials. This test method covers the relative ease and completeness of removal of a specific soilant from such a surface by scrubbing. The greater the ease of soil removal with a minimum of film erosion, the greater the useful service life is expected to be.

5.2 Results obtained by this test method do not necessarily correlate with all types of soilants.

5.3 Semigloss finishes generally require only the nonabrasive type cleaner for good soilant removal, whereas flat paints may require the abrasive type.

6. Apparatus

6.1 *Washability Tester,*[3] also referred to as a straight line washability machine.

6.1.1 *Accessory Apparatus:*

[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] Model AG 8100 (replaced by BYK-Gardner model 5060) from BYK-Gardner, Inc., Gardner Laboratory, 9104 Guilford Road, Columbia, MD 21046 and Model "D" from Paul N. Gardner Co., Inc., 316 N. E. First St., Pompano Beach, FL 33060 were used originally in this test method. See RR:D01-1065. Straight-line washability testers may be adapted to meet the requirements of this method.

6.1.1.1 *Glass Plate,* measured to fit, 454 by 165 by 6.3 mm (17⅞ by 6½ by ¼ in.).

6.1.1.2 *Stainless Steel Pan.*

6.1.1.3 *"C" Clamps.*

6.1.1.4 *Scale,* standard.

6.1.1.5 *White Blotter.*

6.1.1.6 *Holder,* brass, measuring 95 by 76 by 25.4 mm (3¾ by 3 by 1 in.).

6.2 *U-Shaped Film Caster,*[4] having both a 0.18-mm (7-mil) clearance by 132 mm width and a 0.25-mm (10-mil) clearance by 138 mm width.

6.3 *Film Applicator,* 76 mm (3 in.) width with 76-µm (3-mil) clearance.

6.4 *Suction Plate* for drawdowns (large size).

6.5 *45°, 0° Reflectometer,* with green filter, as specified in Test Method E1347.

6.6 *Balance,* with 0.1-g scale graduation.

6.7 *Fineness of Dispersion Gage,* as specified in Test Method D1210.

7. Reagents and Materials

7.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[5] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 *Purity of Water*—Unless otherwise indicated, reference to water shall be understood to mean reagent water conforming to Type IV of Specification D1193.

7.3 *Black Plastic Panels.*[6]

7.4 *Sponge.*[7,8]

7.5 *Masking Tape.*

7.6 *Soilant Medium,*[9,8] consisting of the following:

	grams
Mineral oil, USP heavy	60
Odorless mineral spirits	32
Carbon black[10,8]	8
	100

7.6.1 Mix components and disperse to a Hegman fineness of 7 (0.5 mils or 13 µm) or when measured in accordance with Test Method D1210.

7.7 *Scrub Media* (Note 1).

7.7.1 *Nonabrasive Medium*[9,8] consisting of the following:

	grams
Water	89.7[A]
Hydroxyethyl cellulose[11]	2.0
Detergent[12,8]	4.0
Trisodium phosphate, anhydrous	4.0
Acetic acid glacial	0.3[B]
Preservative[13,8]	0.03
	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.

7.7.2 *Abrasive Medium,*[9,8] consisting of the following:

	grams
Water	49.5[A]
Hydroxyethyl cellulose[11]	0.8
Ammonium hydroxide 28 %	---
Detergent[12,8]	2.0
Trisodium phosphate, anhydrous	2.0
Silica[14,8]	45.0
Acetic acid, glacial	0.7[B]
Preservative[13,8]	0.03
	100.0

[A] Vary to achieve a final consistency of 475 to 600 g (110 to 120 Krebs Units) with the Stormer Viscometer in accordance with Test Method D562.
[B] Vary to achieve a final pH of 9.5 to 10.0 in accordance with Test Method E70.

7.8 Slowly add the hydroxethyl 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. Add the silica slowly to ensure uniform dispersion. Finally, add the preservative and adjust the pH with glacial acetic acid.

NOTE 1—When a referee test is made, prepare fresh medium or use standardized scrub medium[7] from a previously unopened container that is no more than 1 year old.

8. Preparation of Apparatus

8.1 *Washability Machine*—The washability machine should be leveled before use and operated at 37 ± 1 cpm; each cycle

[4] The Dow film caster from BYK-Gardner, was used originally in this test method.

[5] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

[6] Dull black plastic panels, P–121–1ON, 432 by 165 by 0.25 mm (6½ by 17 in. by 10 mils) in size, manufactured by the Leneta Co., 15 Whitney Rd., Mahwah, NJ 07430 were used in the original development of this standard in order to get the results in this test method.

[7] The sole source of supply of a sponge, cellulosic type, coarse pore grade, 95 by 76 by 38 mm (3¾ by 3 by 1½ in.) meeting Federal Spec. L-S-626, Type II, known to the committee at this time is the O'Cel-O Div., General Mills, Inc., 305 Sawyer Ave., Tonawanda, NY 14150.

[8] If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, [1] which you may attend.

[9] The sole source of supply of laboratory standardized stain and scrub media, known to the committee at this time is the Leneta Co.

[10] The sole source of supply of Carbon Black, known to the committee at this time is Printex U Beads, The DeGussa Corp., 65 Challenger Road, Ridgefield Park, NJ 07660.

[11] Known sources of hydroxyethyl cellulose include: Cellosize QP-4400H, The Dow Chemical Company, Midland, MI, and Natrosol 250 MR, Ashland Aqualon, Wilmington, DE.

[12] The sole source of supply of octyl phenoxy polyethoxyethanol, Triton X-100, known to the committee at this time is The Dow Chemical Company, Midland, MI.

[13] The preservative package recommended is BIT, 1,2–Benzisothiazol-3(2H)-one (20 % w/w). There are several suppliers who offer BIT-based agents.

[14] The sole source of supply of Tamsil 45, known to the committee at this time is Unimin Specialty Minerals, Inc., 258 Elm St., New Canaan, CT 06840.

consisting of a complete forward and reverse stroke. Adjust tautness of the cables with a spring scale to approximately 5 lb.

8.2 *Sponge and Holder*—Add sufficient weight to the holder in the form of lead sheets or other flat weights to give a combined weight of 1500 g, including the dry sponge.

NOTE 2—Check the compression of the damp sponge under the 1500-g weight to ensure that the holder does not drag along the panel and tear the film.

9. Procedure

9.1 Clean the top of the glass plate (or preferably the suction plate) and both sides of the black plastic panel to be sure they are free of specks. Place the black panel on the plate and tape one end to the plate. Smooth the panel along the plate to ensure a close fit.

9.2 Stir the test material thoroughly and strain to remove all skins and particles. Draw down the material on the panel, starting from the taped end of the panel. For latex paints, the 0.25-mm (10-mil) side of the applicator will generally be satisfactory, whereas the 0.18-mm (7-mil) side can be used for solvent-based coatings. However, the film thickness of paint to be applied may be varied as mutually agreed upon between the purchaser and the seller. The rate of application should be fairly slow, 3 to 4 s from end to end, to prevent pinholes or holidays in the film. Air dry in a horizontal position for 7 days in a room preferably maintained at 23 ± 2°C (73.5 ± 3.5°F) and 50 ± 5 % relative humidity, or under conditions mutually agreeable to the purchaser and the seller.

9.3 On the last day of drying, measure the directional reflectance (green filter) of a portion of the panel in accordance with Test Method E1347. Record this value as R_1.

9.4 After reading the reflectance, use the applicator with the 3-mil (75-µm) clearance to draw down a film of soilant medium perpendicular to the coating film and in the area where the reflectance was measured. Permit the stained panel to dry for 16 to 24 h under the same drying conditions specified in 9.2.

9.5 Clean the glass surface on which the test panel is to be mounted and also the back of the test panel. Attach the test panel to the glass plate and place the mounted test panel, coated side up, in the pan. Clamp the assembly securely to the pan with the "C" clamps, centering the pan so that the sponge boat can move lengthwise on the panel.

9.6 Remove the sponge from the holder and soak it in reagent water at room temperature. Remove the sponge and squeeze repeatedly with one hand until no more water drips from the sponge. Replace the sponge in the holder and pour 15 ± 1 mL of water on the exposed face of the sponge. Stir the scrub medium and spread uniformly across the face of the sponge 10.0 ± 0.1 g of nonabrasive scrub medium. (Use a spatula if necessary when applying the abrasive scrub medium, to apply uniformly over the sponge.)

9.7 Remove excess soilant by covering the soiled area with a folded absorbent paper towel and exerting pressure by rolling the towel with a 2.25 kg (5 lb) rubber roller. Repeat blotting procedure twice. Attach the sponge holder, with the sponge and cleaner face down, to the cables of the washability machine. Add 5 mL of water on each side of the holder in the path of the sponge. Start the motor and allow the sponge to travel 25 cycles at the rate of 37 ± 1 cpm. Ensure that the sponge and holder are level during the run, otherwise uneven wear will occur on the test panel. At the end of 25 cycles, stop the machine, remove the sponge, clean in running water, squeeze dry, and resoak in water. Wipe off excess stain outside the test area. Repeat the procedure starting in 9.6 with " remove the sponge and squeeze it repeatedly....." for an additional 25 cycles. Repeat the 25-cycle procedure for a total of 100 cycles, each time trying to start and stop the sponge outside the stained area of the panel.

9.8 Remove the test panel from the pan, rinse with running tap water, gently moving the palm of the hand over the path of the sponge to remove clinging particles of scrub medium. Blot the panel and then allow to dry at room temperature. After the panel has dried thoroughly, wipe off excess stain outside the test area and measure reflectance in the soiled and washed area of the panel. Record as R_2.

9.9 Repeat the test on a second panel and, for each, calculate the reflectance recovery in percent as $(R_2/R_1) \times 100$.

9.10 If the mean reflectance recovery for the two panels is less than 96 %, repeat the test on another set of panels using the abrasive scrub medium specified in 7.7.2 and report the results with both mediums.

10. Report

10.1 Report the mean of the two determinations and the type of scrub medium used.

10.2 Report any deviations from the standard procedure.

10.3 Note if erosion occurred in the soiled area.

11. Precision and Bias[15]

11.1 On the basis of an interlaboratory study in which operators in six laboratories tested six coatings, including solvent and water-based systems, and covering a range of pigment volume concentrations (PVC's), the following criteria should be used for judging the acceptability of the results at the 95 % confidence level:

11.1.1 *Repeatability*—Two results obtained by the same operator should be considered suspect if they differ by more than 1.5 % in reflectance recovery with the abrasive cleaner and 9 % in reflectance recovery with the nonabrasive cleaner.

11.1.2 *Reproducibility*—Two results, each the mean of two measurements, obtained by operators in different laboratories should be considered suspect if they differ by more than 6 % in reflectance recovery with the abrasive cleaner and 25 % with the nonabrasive cleaner.

11.2 *Bias*—The concept of bias is not applicable to this test method.

[15] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D01-1065. Contact ASTM Customer Service at service@astm.org.

12. Keywords

12.1 soilant resistance; washability