



Standard Test Methods for Scrub Resistance of Wall Paints¹

This standard is issued under the fixed designation D2486; 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 Department of Defense.

^{ε1} NOTE—Footnotes in 6.3.1 were editorially updated in February 2012.

1. Scope

1.1 These test methods cover a procedure for determining the resistance of wall paints to erosion caused by scrubbing, referred to herein after as “scrub resistance.”

1.2 Two test methods are covered as follows:

1.2.1 *Test Method A*—Cycles-to-failure obtained on test paint.

1.2.2 *Test Method B*—Ratio expressed as a percentage of cycles-to-failure obtained on the test paint to that obtained on a concurrent run with a known reference paint.

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

D3924 Specification for Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials

D4213 Test Method for Scrub Resistance of Paints by Abrasion Weight Loss

3. Summary of Test Method

3.1 In Test Method A, the test paint is applied to a black plastic panel. After curing, the coated panel is placed over a 12.7 wide by 0.25-mm thick (½-in. by 10-mil) shim and held in place on a drawdown plate in a washability machine by

means of a gasketed frame. The coated panel is then scrubbed with a bristle brush and an abrasive scrub medium until the paint film is removed in one continuous thin line across the shim.

3.2 In Test Method B, the test paint and a reference paint are applied simultaneously perpendicular to the length of the black plastic panel. After curing, the coated panel is placed over two 12.7 by 0.25-mm (½-in. by 10-mil) shims that are positioned under each coating. The coatings are then scrubbed with a bristle brush and an abrasive scrub medium until each paint film is removed in one continuous thin line across its own shim.

4. Significance and Use

4.1 Paints often become soiled, especially near doorways, windows, and in work and play areas. These test methods cover the determination of the relative resistance of different paints to erosion when repeatedly scrubbed during the life of the paint.

4.2 Test Method **D4213** is a similar scrub resistance test using a weight-loss technique and reporting volumetric film erosion rates.

4.3 Test Method A measures scrub resistance by the traditional cycles-to-failure concept. Poor correlation in scrub testing can be attributable to among other things variations in the stiffness of the brush bristles, condition of washability tester, application and drying conditions. In an attempt to improve reproducibility, Test Method B has been developed.

5. Apparatus

5.1 *Straight Line Washability Machine.*

5.1.1 Accessory Apparatus: (see **Figs. 1 and 2**).

5.1.1.1 *Nylon Bristle Brush and Accessories*, (total weight 454 ± 10 g).

5.1.1.2 *Drawdown Plate*, 454 by 165 by 6.3 mm (17⅞ by 6½ by ¼ in.).

5.1.1.3 *Brass Shims*, 12.7- by 0.25-mm (½-in. by 10-mils). Its length can be fitted to the width of the drawdown plate.

5.2 *Film Applicator*, having 0.18-mm (7-mil) clearance and 6.25-mm (¼-in.) edge and width of 135 mm (5¼-in.).

¹ These test methods are under the jurisdiction of ASTM Committee **D01** on Paint and Related Coatings, Materials, and Applications and are 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.

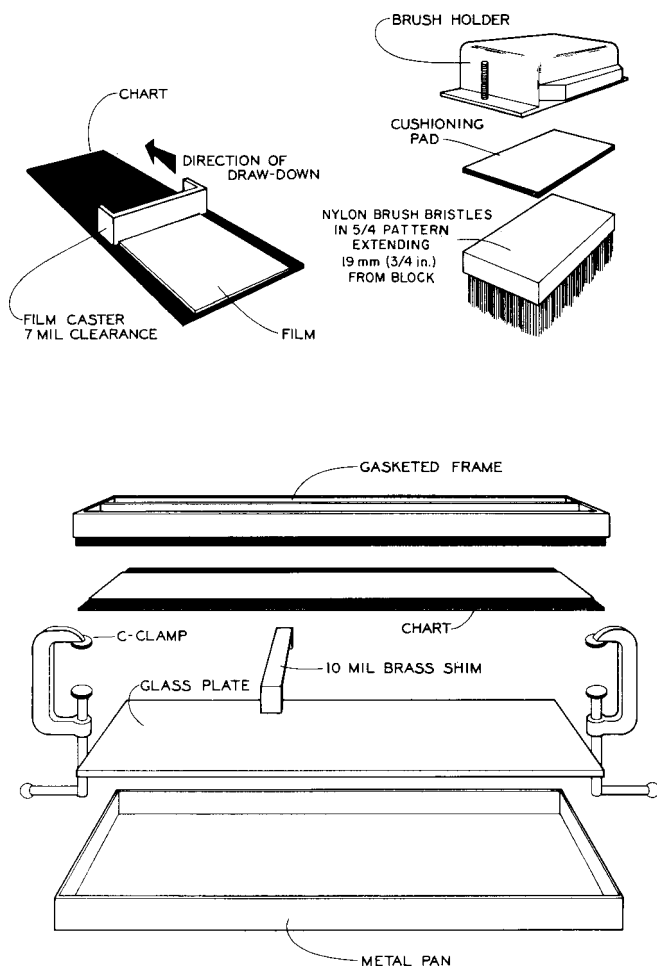


FIG. 1 Accessory Apparatus for Scrub Test

6. Reagents and Materials

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests.

6.2 *Black Plastic Panels*.^{3,4}

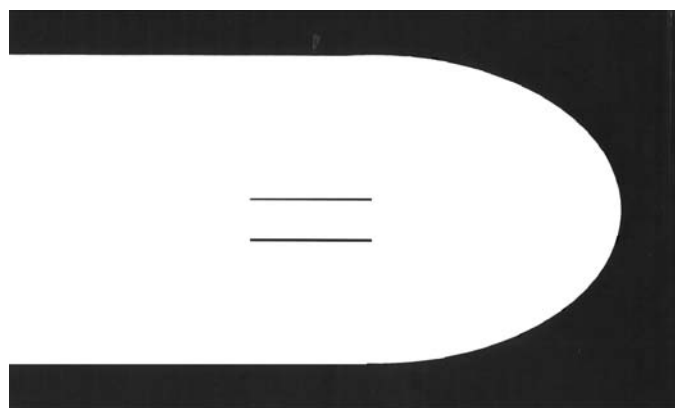
6.3 *Abrasive Scrub Medium*.^{4,5}

6.3.1 Laboratory standardized abrasive scrub medium consisting of the following:

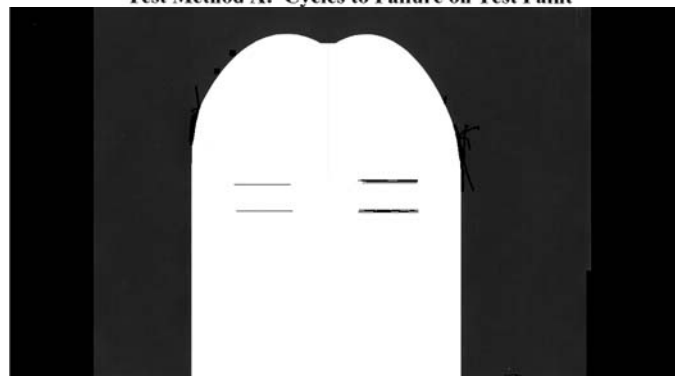
³ Dull black plastic panels, P-121-10N, 165 by 432 by 0.25 mm (6 1/2 by 17 in. by 10 mils) manufactured by The Leneta Co., 15 Whitney Rd., Mahwah, NJ 07430 were used in the original development of this standard in order to get the results in these test methods.

⁴ 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.

⁵ The sole source of supply of the abrasive scrub medium known to the committee at this time is The Leneta Company.



Test Method A: Cycles to Failure on Test Paint



Test Method B: Ratio of Cycles to Failure of Test Paint and Reference Paint

FIG. 2 Accessory Apparatus for Scrub Test

	grams
Water, distilled or deionized	49.4 ^A
Hydroxyethyl cellulose ^{4,6}	0.8
Ammonium hydroxide, 28 %	0.1
Detergent ^{4,7}	2.0
Trisodium phosphate, anhydrous	2.0
Silica ^{4,8}	45.0
Acetic acid (glacial)	0.7 ^B
Preservative ^{4,9}	0.03g

^A Adjust to achieve viscosity of 110 to 120 Krebs units before use.

^B Vary to achieve a pH of 9.5 to 10.

6.4 Reference paint when using Test Method B.

⁶ Cellosize QP-4400H, The Dow Chemical Company, Midland, Michigan, was used in developing the Precision and Bias statement. Other equivalent molecular weight cellulosic thickeners can be used such as Natrosol 250 MR, Ashland Aqualon, Wilmington, Delaware.

⁷ The sole source of supply of the Triton X-100 detergent known to the committee at this time is The Dow Chemical Company, Midland, Michigan.

⁸ The sole source of supply of the Imsil 45 known to the committee at this time is Unimin Specialty Minerals Inc., 258 Elm St., New Canaan, CT 06840.

⁹ The preservative package recommended is BIT, 1,2-Benzisothiazol-3(2H)-one. There are several suppliers who offer BIT-based agents.

7. Preparation of Apparatus

7.1 Washability Machine—The straight line washability machine should be leveled before use and operated at 37 ± 1 cycles per minute.

7.2 Brush—Replace the brush when the bristles have become worn to a point that the bristles extend less than 15 mm ($\frac{5}{8}$ in.) from the block. Mark the ends of the brush to ensure it is oriented in the same direction for each use.

7.2.1 Brushes (that are in frequent use)—Brushes that are in frequent use shall be stored in water. Each time before starting the first test of the day, remove the brush and rinse in water, then precondition the brush, by running it for 400 cycles on a scrub panel, after which it is ready for test work.

7.2.2 Brushes (that are not in regular use)—Brushes that will not be used on a regular basis shall be washed out thoroughly in water after their last use and stored with the bristling side up under ambient conditions. Before being used again, the brush should be soaked in water for at least 24 h. Precondition the brush as directed in 7.2.1 before starting the test work.

7.3 Brush Holder—For washability testers that include a separate brush holder, insert a 3.2-mm ($\frac{1}{8}$ -in.) thick rubber mat in the holder above the brush block. When in operation, this mat allows the brush to ride evenly on the paint surface without tilting. The brush must fit loosely in the holder. Mount the brush in the holder being sure that the mat is in place above the brush block and that the brush and holder are always in the same position.

TEST METHOD A

8. Procedure

8.1 Stir the test paint thoroughly and strain to remove all skins and particles. Make three drawdowns of each paint. Draw down the paint on the black plastic panel using the same operator and same 0.18-mm (7.0-mil) clearance film applicator. The time for application should be fairly slow –3 to 4 s from end to end to prevent formation of pinholes or holidays in the film. Air dry in a horizontal position for 7 days in an conditioning chamber at $23 \pm 2^\circ\text{C}$ ($73.5 \pm 3.5^\circ\text{F}$) and 50 ± 5 % relative humidity in accordance with Specification D3924.

8.2 Soak the brush in water overnight. Clean the plate and set it in the pan of the washability tester. Ensure that the shim is smooth and free of burrs and placed perpendicular to the path of the brush. Wipe the test panel carefully and place it on top of the shimmed plate with the painted side up. Be sure that there are no defects in the film above the shim and that the test area is level. Place the frame over the drawdown being sure that the entire gasket is on the painted surface. Clamp the gasket in place. The clamps should be tight enough to ensure close contact, but not tight enough to cause warping of the panel.

8.3 Before beginning the test, it should be confirmed that the brush has been preconditioned for 400 cycles as outlined in 7.2.1. Remove the brush and shake vigorously to remove any excess water. Stir the abrasive scrub medium and spread 10 g uniformly over the brush bristles. Place the brush at one end of the path. Wet the panel with 5 mL of water in the path of the brush.

8.4 Start the test. After each 400 cycles before failure, remove the brush (do not rinse), add 10 g of stirred abrasive scrub medium and place 5 mL of water on the path of the brush before continuing.

8.5 Record the number of cycles to remove one continuous thin line of paint film across the 12.7-mm ($\frac{1}{2}$ -in.) width of the shim. Stop the machine and wipe off the shim area to determine, if necessary, if the end point is achieved.

8.6 Test two of the drawdowns. If the two results differ by more than 30 % of the average, test the third drawdown. If one of the three results is obviously discrepant, discard it, then average the results from the remaining drawdowns.

TEST METHOD B

9. Procedure

9.1 Stir the test paint and reference paint thoroughly and strain to remove all skins and particles. Draw down the test and reference paints side by side perpendicular to the length of the panel following procedures outlined in 8.1. Prepare three drawdowns for each test/reference paint. The paints should be drawn down simultaneously and the painted portion should be in the middle of the chart. Air dry in a horizontal position for 7 days at standard conditions.

9.2 Soak the brush in water overnight. Clean the plate and set it in the pan of the washability machine. Centrally place two shims, one each under the test paint and one under the reference paint drawdown areas on the chart. Wipe the test panel carefully and place it on top of the shimmed plate with the painted side up. Be sure that there are no defects in the film above the shims and that the test areas are level. Place the gasket over the painted surface and clamp in place.

9.3 Remove the brush and shake it vigorously to remove any excess water. Before testing, the brush shall be conditioned for 400 cycles as outlined in 7.2.1. Follow procedures outlined in 8.3 and 8.4. It is recommended that the first two panels to be tested are prepared by altering the position of the reference paint, that is, one panel has the reference paint on the right, and the second panel has the reference paint on the left.

9.4 Record respectively the number of cycles to remove one continuous thin line of paint film from both the test and reference paints across the 12.7-mm ($\frac{1}{2}$ -in.) width of each of the shims. Stop the machine and wipe off the shim areas to determine, if necessary, if each end point is achieved.

9.5 Test two of the drawdowns. If the two results differ by more than 30 %, test the third drawdown. If one of the three results is obviously discrepant, discard it, then average the results from the remaining drawdowns.

10. Report

10.1 Report the following information:

10.1.1 When using Test Method A, report the mean number of cycles to failure.

10.1.2 When using Test Method B, report a percentage as follows:

$$\frac{\text{Cycles for test paint}}{\text{Cycles for reference paint}} \times 100 \quad (1)$$

if:

Result is > 100 %, test paint has better scrub resistance than reference paint.

if:

Result is < 100 %, test paint has poorer scrub resistance than reference paint.

10.1.3 Method used (Test Method A or Test Method B).

10.1.4 Referenced paint used, if using Test Method B.

10.1.5 Outline any deviations from standard procedures.

11. Precision and Bias

11.1 *Precision*—In an interlaboratory study of these test methods, scrub resistance was recorded in five laboratories using three coatings. The following criteria should be used for judging the acceptability of results of scrub resistance tests at a 95 % confidence level.

Test Method A

11.1.1 *Repeatability*—Duplicate results by a single operator should be considered suspect if they differ by more than 30 % of their mean value.

11.1.2 *Reproducibility*—Two results (each the mean of duplicate measurements) obtained by operators in different laboratories should be considered suspect if they differ by more than 58 % of their mean.

Test Method B

11.1.3 On the basis of an interlaboratory study in which operators in five laboratories tested five coatings, including both flat and semi-gloss coatings, the following criteria should be used for judging the acceptability of the results at the 95 % confidence level:

11.1.3.1 *Repeatability*—Two results (each the mean of duplicate measurements) obtained by the same operator should be considered suspect if they differ by more than 25 % of their mean value.

11.1.3.2 *Reproducibility*—Two results (each the mean of duplicate measurements) obtained by operators in different laboratories should be considered suspect if they differ by more than 58 % of their mean.

11.2 *Bias*—Bias is not applicable to these test methods.

12. Keywords

12.1 scrub resistance; wet abrasion resistance

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