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Standard Test Method for Evaluating Clear Water Repellent Coatings on Wood[1]

This standard is issued under the fixed designation D 5401; 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 evaluates the effectiveness of clear water repellent coatings on wood before or after exterior exposure.

1.2 Intralaboratory results with this test method can be used to compare the effectiveness of clear water repellent coatings. The agreement between results obtained in different laboratories may be less satisfactory unless a known water repellent is used as a reference.

1.3 *This standard does not purport to address all of the safety problems, 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 358 Specification for Wood to be Used as Panels in Weathering Tests of Coatings[2]

D 1006 Practice for Conducting Exterior Exposure Tests of Paints on Wood[3]

D 1193 Specification for Reagent Water[4]

D 3924 Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *clear water repellent coating*—a transparent coating formulated for the purpose of protecting porous substrates by preventing the penetration of liquid water.

4. Summary of Test Method

4.1 Five Ponderosa pine specimens are treated with the clear water repellent under test and allowed to dry for seven days. Five untreated specimens serve as controls. The treated and untreated specimens are each weighed and then allowed to float in water for 30 min. The specimens are removed, the excess water is wiped off, and each are reweighed. The effectiveness of the water repellent coating is then calculated.

5. Significance and Use

5.1 Water is known to penetrate wood substrates, causing dimensional instability and eventual deterioration. Clear water repellent coatings are designed to protect wood from damaging effects of water. This test method is used to evaluate the effectiveness of water repellent coatings on wood soon after application or after long-term exterior exposure.

6. Apparatus

6.1 *Conditioning Room or Chamber*, having a controlled temperature of 73.5 ± 3.5°F (23 ± 2°C) and a controlled relative humidity of 50 ± 5 % as described in Specification D 3924. This is used to establish a uniform moisture content in the test specimens and during the test.

6.2 *Balance*, accurate to at least 0.1 g.

6.3 *Saw*, sharp, fine-toothed, with a minimum of ten teeth/in. to obtain a smooth surface on the test specimen.

7. Reagents and Materials

7.1 *Purity of Water*—Unless otherwise clearly indicated, references to water shall be understood to mean reagent water as defined by Type IV of Specification D 1193.

7.2 *Wood*—Wood used for these tests shall be randomly selected standard commercial “two-by-fours,” straight-grained, knot free, flat-sawn, kiln-dried, Ponderosa pine sapwood, selected in accordance with Specification D 358.

NOTE 1—Species other than Ponderosa pine may be used by mutual agreement.

8. Test Specimens

8.1 Cut away and discard 3 in. (76 mm) of end grain from the selected “two-by-four” to avoid any pretreatment that may have been applied by the supplier and to ensure an even cut on every specimen.

8.2 Using the fine-toothed saw (see 6.3) to ensure a smooth surface, cut a supply of 12 in. (305 mm) long test specimens sufficient for the intended test program, with an ample overage to allow for possible discards. Five specimens are required for each water repellent being tested and five for an untreated control set.

8.3 Weigh each specimen to 0.1 g and calculate its mean weight. Discard specimens that vary more than 10 % from the

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

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

[4] *Annual Book of ASTM Standards*, Vol 11.01.

mean and cut additional specimens as necessary to obtain sufficient specimens within the specified weight range to perform all of the planned tests.

8.4 Store the test specimens for at least six days in a conditioned room or chamber as described in 6.1, on a raised screen or rack to provide ventilation around each specimen, and allow them to come to constant weight. (Constant weight is defined as a change of no more than 1 g in 24 h.)

9. Treatment

9.1 Prior to treatment, weigh the test specimens on two successive days to ensure constant weight.

9.2 Immerse each of the five test specimens in the water repellent coating for 30 s. To ensure even coverage, allow excess water repellent to drain longitudinally for 1 min from one end of the specimen, then invert to allow similar drainage for 1 min from the other end.

9.3 Allow the treated specimens to air dry on a raised screen or rack for 24 h.

10. Procedure

10.1 Return the treated specimens to the conditioning chamber along with five untreated specimens for at least seven days or until they reach constant weight, then record their weight to 0.1 g.

10.2 Place the specimens in a container of water at 73.5± 3.5°F (23 ± 2°C) and allow to float for 15 min, then turn them over and allow them to float for another 15 min to give a total immersion time of 30 min.

10.3 Remove the specimens from the water, allow to drain briefly, wipe the specimens with a slightly dampened cloth to remove excess water, reweigh and record each weight to 0.1 g.

10.4 *Optional Weathering Procedure*—Following , subject the treated and untreated specimens to agreed conditions and an agreed time period of exterior exposure in accordance with Practice D 1006, then test as described in Section 10 to determine the water repellent efficiency of the treatment after exposure with respect to untreated wood.

11. Calculations

11.1 Calculation the water repellent efficiency, (WRE) in percent, for each specimen as follows:

$$WRE = 100\,[(A - B) - (C - D)]/(A - B) \quad (1)$$

where:

A = weight of the untreated specimen after water contact, g,
B = weight of the untreated specimen before water contact, g,
C = weight of the treated specimen after water contact, g, and
D = weight of the treated specimen before water contract, g.

11.2 Calculate the mean WRE value for each five-specimen set.

12. Report

12.1 Report the following information:

12.1.1 Mean water repellent efficiency (WRE) of each coating (See 11.2),

12.1.2 Mean weight for each five-specimen set both before and after water immersion (Section 10),

12.1.3 If the specimens were weathered, report the exposure time and conditions of exterior exposure, and

12.1.4 Any significant deviations from the standard test method as described herein.

13. Precision and Bias [5]

13.1 *Precision*—In an interlaboratory study of this test method, one operator in each of five laboratories measured the water gain of five specimens of Ponderosa pine, and of three five-specimen sets that were treated with three water repellent coatings ranging from moderate to high water repellency.

13.1.1 The intralaboratory standard deviation of the weight gains of the untreated panels was found to be 15.46 g with 17 df and the interlaboratory standard deviation 14.2 g with 4 df, after discarding one result from each of 3 laboratories because they differed widely from the other results from the same laboratory and other laboratories.

13.1.2 The intralaboratory standard deviation of the water repellent efficiency was found to be 2.99 % absolute with 57 df and the interlaboratory standard deviation 3.9 % with 12 df, after discarding one result from each of two sets from the same laboratory because they differed significantly from other results in the same sets and one result from other laboratory's set, because the range differed significantly from all the remaining sets.

13.1.3 Based on these standard deviations, the following criteria should be used for judging, at the 95 % confidence level, the acceptability of results:

13.1.4 *Water Absorption by Untreated Wood*:

13.1.4.1 *Repeatability*—Results obtained by the same operator using panels of the same wood should be considered suspect if they differ by more than 62 g for four panels and 67 g for 5 panels at weight gains of 45 to 100 g.

13.1.4.2 *Reproducibility*—Two results, each the mean of five repeats obtained by operators in different laboratories, should be considered suspect if they differ by more than 90 g in the same weight gain range.

13.2 *Bias*—Bias cannot be established because there is no standard material.

14. Keywords

14.1 architectural paints and coatings; water repellents

[5] Supporting data are available from ASTM Headquarters. Request RR:D01-1082.