Designation: D5795 – 16

# Standard Test Method for Determination of Liquid Water Absorption of Coated Wood and Wood Based Products Via "Cobb Ring" Apparatus[1]

This standard is issued under the fixed designation D5795; 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 is intended to serve as a means for measurement of liquid water that passes through a wetted paint film, and which is subsequently absorbed and retained by the underlying wood or wood-based substrate. Alternative techniques for the use of the "Cobb Ring" apparatus are described.

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]

D9 Terminology Relating to Wood and Wood-Based Products

D16 Terminology for Paint, Related Coatings, Materials, and Applications

D1193 Specification for Reagent Water

D5235 Test Method for Microscopic Measurement of Dry Film Thickness of Coatings on Wood Products

D6132 Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Coating Thickness Gage

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

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

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *Cobb unit (C.U.), n*—the weight of distilled water absorbed by the underlying wood substrate in grams per 645 $cm^2$ (100 $in.^2$) of surface area (discounting additional areas contributed by texturing or grooves) per 24-h time period.

3.1.2 *Cobb unit (C.U.) factor, n*—a dimensionless mathematical term which, for a given ring size, may be multiplied times the weight change after 24 h to calculate the Cobb unit value.

3.1.2.1 *Discussion*—The C.U. factor is calculated as follows:

SI Units

$$C.U.Factor = \frac{64516}{RingArea(mm^2)} = \frac{64516}{\pi r^2} \quad (1)$$

Imperial Units

$$C.U.Factor = \frac{100}{RingArea(in.^2)} = \frac{100}{\pi r^2} \quad (2)$$

where:

$r$ = radius, mm (in.)

For example, for 100 mm (4 in.) inside diameter or 50 mm (2 in.) internal radius ring:

$$C.U.\ Factor = \frac{64516}{3.14(50)^2} - \frac{64516}{7850} - 8.22 \quad (3)$$

3.1.3 *wood based products, n*—boards or other form of structured or decorative materials manufactured from wood fibers, flakes or strands or veneers and various resin binders otherwise known as engineered wood products or wood composite.

## 4. Summary of Test Method

4.1 Suitable size rings of metal or plastic are adhered or clamped to the flat, coated surface of composite wood panels to be tested.

[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 D01.52 on Factory Coated Wood Products.

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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.

4.2 The assembly is equilibrated at a constant temperature and humidity and weighed.

4.3 The weighed assembly is placed on horizontal surface[3] in a controlled temperature and humidity room or environmental chamber. Water is placed in the ring and left in contact with the board face for 24 h.

4.4 After 24 h the remaining water is removed from the ring, the assembly blotted dry and reweighed.

4.5 The increase in weight of the assembly due to water uptake is calculated by simple subtraction and then converted to Cobb units through the use of the C.U. factor (see 3.1.2).

## 5. Significance and Use

5.1 This test method provides a simple quantitative measure of water absorption by coated wood or wood based products.

5.2 This test method has demonstrated utility for wood or wood based products ranging in thickness from approximately 6 to 25 mm (¼ to 1 in.).

5.3 Conditioning of substrate, coated sample preparation, application method, dry film thickness, cure conditions, and number of replicate specimens should be agreed upon between the purchaser and the supplier of the coating material.

5.4 Such measurements are used as indicators or predictors of the anticipated performance of coated wood or wood based products during exterior exposure. They may be used for developmental evaluation of coatings, substrates, or both. They may also be useful for quality control or monitoring of the production of coated wood and wood based products.

## 6. Apparatus

6.1 *Rings,* may be cut from stainless steel, aluminum or plastic pipes. To avoid damage to the test assembly caused by warping of the wooden substrate due to water absorption on one side only, it is recommended to use flexible rings. Measure the rings diameter to the nearest 1 mm (0.040 in.).

NOTE 1—The ring diameter can be any size, but useful results have been obtained with rings of 102 mm (4 in.) or larger inside diameter, wall thickness of 10 mm (⅜ in.) and height of 25 mm (1 in.). Rings of 100 to 254 mm (4 to 10 in.) are commonly used. If suitable flexible rings cannot be purchased, they can be prepared in the laboratory. To prepare flexible rings, an appropriate film made from a semi-flexible non-absorbent plastic (for example, surface treated polyethylene film with thickness about 0.10 mm (0.004 in.) could be used. Wrap the film around on a rigid pipe of the required diameter, and heat weld or glue the wrapped film along its edge. Subsequently cut the pipe with wrapped and welded polyethylene film into suitable rings.

6.2 *Environmental Chamber,* capable of maintaining 23 ± 2°C (73 ± 4°F) and 50 ± 5 % relative humidity, or other agreed upon options.

6.3 *Saw,* suitable for cutting of samples.

6.4 *Caulk Gun or Applicator,* or, a clamp and gasket device for holding the ring tightly against the board is needed.

6.5 *Balance,* with sufficient capacity (typically 400 g) and 0.01-g accuracy.

## 7. Materials

7.1 *Butyl or Silicone Caulk,* which has been determined not to contribute to assembly weight change through absorption of water or interaction with the coating.

7.2 *Distilled Water,* (see Specification D1193).

7.3 *Test Boards,* appropriately identified, coated or uncoated, cut to a square size that is 25.4 mm (1 in.) greater than the ring diameter. A minimum of three replicates is recommended.

7.4 *Control Samples,* coated or uncoated without rings will also be required. These will be used to assess the degree of equilibration that is achieved.

## 8. Hazards

8.1 Use saws with goggles, dust mask, and proper machine safeguards to prevent injury.

8.2 Caulking compounds may be flammable and contain toxic solvents. See manufacturer's instructions for proper use and disposal.

## 9. Procedure

9.1 Measure and record the coating thickness on the samples designated for testing, including thickness of individual coats (if distinguishable). Follow procedures described in Test Methods D5235 or D6132 (if applicable).

9.2 *Sealing of Rings to the Coated Face of the Samples:*

9.2.1 A continuous bead of caulk is applied to one edge of the ring. The caulked side of the ring is then attached to the sample with gentle pressure and a slight twisting motion; to maintain an accurate and uniform test area, only minor caulk "squeeze-out" should occur inside of the ring. Carefully remove this minor caulk "squeeze-out" to prevent errors in later calculations. Care must be taken not to smear caulk over the coating surface to avoid invalidating results. Consider the use of caulks with contrasting colors to aid in verification of removal. If flexible rings are used, they should be supported from the inside by a segment of rigid pipe with the appropriate diameter during the sealing process. Flexible rings with a wall thickness of less than 0.5 mm (0.20 in.) do not require sealant on the edge against the coating but can be anchored entirely by the caulk filled around the outside at the base of the ring. After the caulk cures, remove the supporting ring.

9.2.2 Alternatively, the assembly may be produced with a clamp and gasket device. Satisfactory results can also be obtained from clamp and gasket devices that are of self design and locally produced by any machine shop.

9.2.3 To enhance reproducibility, do not generate data by a combination of the caulk procedure and the clamp and gasket procedure.

9.2.4 Also, for improved reproducibility, all rings must be of the same nominal internal diameter.

9.3 *Equilibration:*

9.3.1 Allow the samples with rings and controls without rings to equilibrate for seven days at 23 ± 2°C (73 ± 4°F) and

[3] The specification of a solid, continuous horizontal surface or a discontinuous (wire rack, expanded metal, etc.) is required. Surface must be consistent from laboratory to laboratory since this can influence the rate of evaporation of moisture and, thus, retention of moisture and Cobb values.

50 ± 5 % relative humidity. If flexible rings are used, be sure that the supporting rings are removed before testing after sealant cure.

9.4 *Initial Weighing:*

9.4.1 Weigh (grams) the controls and samples with rings to the nearest 0.01 g; record the weight.

9.5 Fill each ring with the volume of distilled water required to achieve a depth of 13 ± 3 mm (½ ± ⅛ in.) of distilled water.

9.6 Store test assemblies on a level surface[3] so that the water depth is maintained at 13 ± 3 mm (½ ± ⅛ in.) over the entire test area at the same conditions used for equilibrating the panels.

9.7 *Final Weighing:*

9.7.1 After 24 h, pour out the water and blot the surface inside the ring completely dry with a soft paper towel. Immediately weigh (grams); record the new weight of the samples with rings.

9.7.2 After all measurements from 9.7.1 have been completed, weigh (grams) and record the weights of the control boards without rings. Compare the weights with the initial weights. If the weight change of the control boards is more than 20 % of the weight change of the test boards, the absolute values of the test results may be questionable.

9.8 *Additional Procedures:*

9.8.1 Caulked rings can be removed from the coated boards by pulling the ring from the board and cleaning in lacquer solvent.

9.8.2 For textured boards without a groove in the coated panel, apply additional caulk to the outside of the ring to get a satisfactory seal after attaching the ring to the coated board.

9.8.3 For boards with a groove in the coated board, attach the ring to the board so that at least one groove length will be the same as the diameter of the ring. Apply extra caulk in the groove at the appropriate spot before attaching the ring in order to get a good seal. Extra caulk may have to be applied in the groove outside the ring after attaching the ring in order to get a good seal.

9.8.4 During equilibration and testing of the boards with rings, store the boards test side up and single high on a flat surface that is impervious to moisture.

9.8.5 If an environmental chamber is used, the control boards with ring assemblies must not be stacked upon each other. It is recommended that the control boards and ring assemblies be stored coated side up and single high on wire racks at least 50 mm (2 in.) above or below adjacent rings. Care must be taken so as not to overload the humidity chamber with rings containing water.

## 10. Calculations

10.1 Calculate and record the weight change by subtraction of the initial weight of 9.4.1 from the final weight of 9.7.1.

10.2 Calculate the Cobb unit (C.U.) factor for the ring sizes used (see 3.1.2.1).

10.3 Multiply the C.U. factor times the weight change recorded in 10.1 and calculate the Cobb unit values for the samples.

10.4 Average, then record the replicate results.

## 11. Report

11.1 Description of the substrate tested, including thickness, type, density and surface characteristics. In the case of wood, include a description of the wood species, surface roughness and type of grain (flat or edge).

11.2 Type of coating applied, including manufacturer.

11.3 Method of coating application, including number of coats, drying or curing conditions and conditioning (if any).

11.4 Coating thickness, including thickness of the individual coats (if distinguishable).

11.5 Internal diameter of the Cobb's rings and number of specimens tested.

11.6 Calculated water absorption in Cobb units.

## 12. Precision and Bias[4]

12.1 *Precision*—Interlaboratory Test Program—An interlaboratory study of Hardboard Siding "Cobb Ring" water permeability was conducted in accordance with Practice E691 in seven laboratories with five materials, with each laboratory obtaining seven test results for each material (see Table 1).

12.1.1 The terms repeatability limit and reproducibility limit in Table 1 are used as specified in Practice E177.

12.1.2 Some of the deviations in Table 1 are believed due to the concern expressed in 4.3, 9.2.3 and 9.2.4. This will be addressed in a future round robin.

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D01-1093. Contact ASTM Customer Service at service@astm.org.

**TABLE 1 Precision**

| Material | 24-h Average, gm/100 in.$^2$ | Repeatability, Standard Deviation, Sr | Reproducibility, Standard Deviation, SR | Repeatability Limit, Y | Reproducibility Limit, R |
|---|---|---|---|---|---|
| E | 5.225 | 0.851 | 0.880 | 2.38 | 2.46 |
| C | 6.629 | 1.780 | 1.917 | 4.98 | 5.37 |
| A | 7.185 | 2.256 | 2.398 | 6.32 | 6.72 |
| D | 14.020 | 1.055 | 1.596 | 2.95 | 4.47 |
| B | 20.545 | 1.146 | 2.117 | 3.21 | 5.93 |

12.2 *Bias*—Since there is no accepted reference material, method, or laboratory suitable for determining the bias for the procedure in this test method, no statement on bias is being made.

## 13. Keywords

13.1 absorption; coated hardboard; Cobb ring; composite wood products; wood; wood-based