Designation: D779 – 16

Standard Test Method for Determining the Water Vapor Resistance of Sheet Materials in Contact with Liquid Water by the Dry Indicator Method[1]

This standard is issued under the fixed designation D779; 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 the determination of the time required for water vapor to pass through a sheet membrane in contact with liquid water using the dry-indicator method.

1.2 The method has been used to evaluate water resistive barriers, flexible flashing and other materials used in building construction in order to measure their resistance to water vapor transmission.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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]

D585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Product (Withdrawn 2010)[3]

D685 Practice for Conditioning Paper and Paper Products for Testing

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

E631 Terminology of Building Constructions

3. Terminology

3.1 *Definitions*—For definitions of general terms related to building construction used in this test method, refer to Terminology E631.

4. Summary of Test Method

4.1 This test method consists of bringing one side of the test specimen in contact with water and finding the time required for water vapor to pass through the specimen, as indicated by the development of color in an indicator powder consisting of a mixture of water-soluble dye, sugar, and starch. The sugar serves the two-fold purpose of masking the color of the particles of dye as long as they are dry, and of absorbing the transuded moisture and holding it in close proximity to the dye. The starch increases the stability of the mixture.

4.2 Five tests are made on each side of the test specimen and reported as two separate averages. If the material being tested is intended to be exposed to water on only one side then five tests are to be made on the side specified for water exposure.

5. Significance and Use

5.1 The dry indicator used in this test method is so strongly hygroscopic it will change color in a moderate- to high-humidity atmosphere without contacting liquid water. It will also change when in contact with liquid water.

5.2 This test method is of value for materials that come in contact with water on one face and where it is important to evaluate the length of time for water vapor to pass through the material.

6. Interferences

6.1 This test method is sometimes not applicable to materials containing large amounts of water-soluble components.

7. Apparatus

7.1 Any form of apparatus for applying the test may be used that fulfills the following conditions:

7.1.1 One surface of the specimen is wetted uniformly at the moment the count of time is begun,

7.1.2 The indicator on the opposite surface is continuously visible,

[1] This test method is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.55 on Performance of Building Enclosures.

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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.

7.1.3 No moisture reaches the indicator except that which passes through the specimen from the wetted surface, and

7.1.4 No moisture that does so reach the indicator escapes from contact with it.

7.1.5 A float arrangement is one apparatus that fulfills the requirements of 7.1 and is made of a thin-walled aluminum pan approximately 5 in. (127 mm) in diameter and 1 in. (25.4 mm) high, with a hole 2 in. (50.8 mm) in diameter cut in the bottom. The surface is coated with paraffin or beeswax to make it more water repellent. The watch glass is clamped over the specimen by means of a wire-frame clamp hinged at one side and fastened under a spring at the opposite side.

7.1.6 Instead of using the float arrangement described in 7.1.5, it is also permissible to form a boat, by folding up the edges of the specimen or by dipping the four edges of the specimen in hot wax, and floating it on the surface of the water. If the specimen does not easily float on its own it can be supported by a hollow cylinder having the upper end barely submerged under the surface of the water in a suitable vessel. The dry indicator powder is applied to the top surface in accordance with Section 12 (with watch glass) or Section 13 (without watch glass) just before floating the specimen on the water.

7.2 *Shaker and Desiccator Assembly (Fig. 1) for the Indicator*—The shaker is prepared from a 10-mL screw-top vial by cutting away most of the metal of the flat portion of the top, fitting a 70-mesh (27.5-mesh/mm) wire screen inside the top, and screwing it back in place. The desiccator is made of a small wide-mouth bottle containing desiccant covered with a layer of glass wool. A hole is bored in the cork stopper just large enough to admit the shaker. The bottle remains on its side and the vial is inserted through the hole with the screened end inside. The assembly is kept in the usual type of laboratory desiccator when not in use.

7.3 *Watch glass,* 2-in. (50-mm) diameter.

7.4 *Stopwatch or electric timer,* reading to 1 s.

8. Reagents and Materials

8.1 *Desiccant*—Anhydrous calcium chloride, activated alumina, or silica gel.

8.2 *Indicator*—The water-transudation indicator is composed of pure, powdered cane sugar (do not use confectioner's sugar, which contains starch), pure soluble starch, and methyl violet dye (Color Index 680). Pass each ingredient separately through a No. 100 screen (39.4 mesh/mm), and completely dry it in a desiccator over a desiccant (see 8.1) before making the mixture. When dry, weigh and mix the following proportions by weight:

Sugar	45
Soluble starch	5
Dye	1

8.2.1 Mix the ingredients by screening repeatedly through a No. 60 screen (23.6 mesh/mm) until the mixture is uniform. Keep the indicator in a desiccator when it is not being used.

8.3 *Water*—Distilled or demineralized

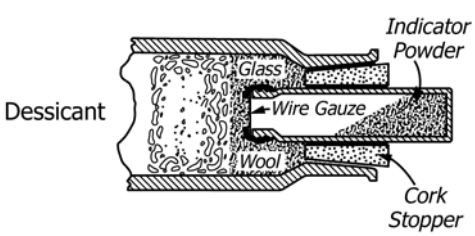

FIG. 1 Longitudinal Section Showing Construction of Desiccator and Shaker

9. Sampling, Test Specimens, and Test Units

9.1 For acceptance purposes, sample the lot of material in accordance with Practice D585.

9.2 When sampling for other purposes, Practice E122 may be used for an alternative.

9.3 From each test unit obtained in accordance with 9.1 or 9.2, cut ten test specimens, free from folds, wrinkles, or other blemishes not commonly inherent in the material. A convenient size is approximately 2.5 by 2.5 in. (63 by 63 mm).

9.4 Use a suitable code designation such as Side I and Side II, or when there is an obvious difference between the sides, such as Side I, coated, and Side II, uncoated. The side designated is that which is to be in contact with the water.

10. Preparation of Apparatus

10.1 The water on which the specimens are floated should be 73.4 ± 0.9°F (23 ± 0.5°C).

11. Conditioning

11.1 Condition and test the specimens in a standard atmosphere in accordance with Practice D685.

12. Procedure A

12.1 Place a test specimen on a level, smooth surface that will not affect the moisture content of the specimen, and sprinkle the indicator on the specimen by gently tapping the inverted shaker until a thin, even layer is formed, avoiding either a very sparse covering or one in which the powder is piled up. In the former case, the color change produced by too few dye particles may be insufficient to attract attention, unless they are exposed for a longer time than the proper end point. When the powder is placed on too thickly, the upper layer may obscure changes in the indicator in contact with the paper. Also, the greater total quantity of powder may require more time to change, since it would necessitate more moisture to affect all the dye. Handle the test specimen with care once the powder is applied, for jarring or excessive tipping may cause rearrangement of the particles of powder, which then tend to form in clusters, thus destroying the intimate contact and uniform thin layer that is desirable. As soon as the application of the layer of the indicator powder is completed, cover it with the watch glass and keep it covered during the test. Seal the perimeter of the watch glass with paraffin wax, beeswax or similar material so that moisture cannot escape.

12.2 Place the specimen on the water, making contact with the water at a slight angle to avoid trapping air bubbles that

might cause uneven wetting of the specimen. When testing materials having uneven surfaces, wet the bottom surface, using a soft brush, immediately before placing the specimen on the water. Examine each specimen after the test, and if there is evidence of uneven wetting, discard the test result.

12.3 Measure the time interval from the instant of contact of the test specimen with water until the rate of change in the color of the indicator is at a maximum. This time interval is conveniently determined as the mean of the values corresponding to the development of pronounced color in one fourth and in three fourths of the area covered by the indicator. For materials on which the color develops uniformly over the whole area, it may be necessary to tabulate the values of the time interval against the intensity of the color to determine the maximum rate of change. Artificial light, when used for viewing the test specimen, should be reasonably brilliant but completely shaded from the eyes. The light should be applied to one side of the specimen (thus avoiding reflection from the cover glass) and the eye should view from the side next to the illuminant, to avoid interference of shadows cast by the indicator particles with the judgment of the color. The light source should generate as little heat as possible or be kept at a distance from the test specimen so as not to affect the results due to an increase in specimen temperature. Record the test time in minutes and seconds.

12.4 Run five tests on each side of the material.

13. Procedure B

13.1 Same as Procedure A except without using the watch glass to cover the indicating powder.

14. Report

14.1 Report the following information:

14.1.1 Report the average value of the time of transudation from each side of the specimen to the nearest second for end points up to 5 min, otherwise in minutes rounded to the next highest value for partial minutes.

14.1.2 Report whether procedure A or B was used.

15. Precision and Bias

15.1 *Precision*—This is a significant revision of the standard to adapt it for use with building materials. Expected results for building materials are in the order of several minutes and higher. Once the standard is approved, an interlaboratory study will be conducted to determine precision, repeatability, and reproducibility for higher timeframes than previously measured. Results will be available on or before September 30, 2018.

15.1.1 *Repeatability:*

15.1.1.1 Repeatability within a single laboratory appears to vary as a function of the water resistance level of the material. Other aspects of material composition and uniformity can also impact test repeatability.

15.1.1.2 Tests in one laboratory on three different grades of paper having vapor resistance values less than 60 s resulted in the estimates of repeatability shown in Table 1.

15.2 *Bias*—No information can be presented on the bias of the procedure in this test method, because the water vapor resistance, as determined by the dry indicator method, is defined only in terms of the test method.

16. Keywords

16.1 desiccant; dry indicator; water vapor resistance

TABLE 1 Repeatability Limit

Sample	Result Range	Standard Deviation	95 % Repeatability Limits
	s	s	s
A	5 to 10	1.1	3.1
B	10 to 20	0.8	2.3
C	20 to 40	1.9	5.4
K	5 to 10	0.45	1.2
L	10 to 20	0.85	2.4
M	20 to 40	1.05	2.9

APPENDIX

(Nonmandatory Information)

X1. ACCELERATED TESTING

X1.1 Investigations of the use of high temperatures (up to the boiling point of water) in the dry-indicator test have shown that, in general, there is good correlation between transudation time and temperature. For products that show such relation, the use of hot water is of value in shortening the test period, and in some instances in making the end point more distinct.[4,5]

[4] Codwise, P. W., "Resistance of Sized Paper & Paperboard to Water at Elevated Temperatures," *Technical Association Papers*, TAPAA, Vol 26, No. 165, 1943; *Paper Trade Journal*, Vol 116, No. 9, pp. 30–33; TS 90–93, March 4, 1943.

[5] Mullen, E. G., "Use of the Dry Indicator Method for Testing the Water Resistance of Asphalted Papers," *Paper Trade Journal*, Vol 119, No. 2, pp. 41–42; TS 11–12, July 13, 1944.