



Standard Test Method for Water Resistance of Tape and Adhesives Used as Box Closure¹

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1. Scope

1.1 This test method covers a procedure to determine the water resistance of an adhesive or tape as measured by the amount of tape or adhesive dissolved or dispersed in water.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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

D644: Test Method for Moisture Content of Paper and Paperboard by Oven Drying

D996: Terminology of Packaging and Distribution Environments

D1974: Practice for Methods of Closing, Sealing, and Reinforcing Fiberboard Boxes

3. Terminology

3.1 *Definitions:*

3.1.1 General definitions for packaging and distribution environments are found in Terminology **D996**.

3.2 *Description of Term Specific to This Standard:*

¹ This test method is under the jurisdiction of ASTM Committee **D10** on Packaging and is the direct responsibility of Subcommittee **D10.27** on Paper and Paperboard 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.

3.2.1 *box closure*—the means of securing the flaps or covers of a box so that the box will not accidentally open during normal shipment, handling, and storage.

4. Summary of Test Method

4.1 *Procedure A*—The water resistance of a tape (gummed or pressure sensitive) is measured by immersing the tape in water at least 24 h at $73.4 \pm 4^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$] and determining the percent of tape that is dissolved or dispersed.

4.2 *Procedure B*—The water resistance of an adhesive is measured by coating the adhesive on a paper surface, immersing in water at least 24 h at $73.4 \pm 4^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$], and determining the percent of adhesive that is dissolved or dispersed.

5. Significance and Use

5.1 When a box becomes wet, the performance of the box and its closure are reduced. It is desirable to have box closure methods that retain an ability to keep the box closed when wet. Sealing or reinforcing methods sometimes are useful to improve performance of wet boxes and closures. Water resistance is sometimes a regulatory or contractual requirement.

5.2 A test result indicating that a box closure tape or adhesive is soluble or dispersible in water is an indication that its function will be significantly impaired when wet. A test result that does not indicate solubility or dispersibility does not necessarily ensure that the bonding ability will be satisfactory when wet or that the performance of the box closure will be satisfactory when wet. Package performance testing described in the water resistance section of Practice **D1974** is useful to further investigate the effects of water on package and closure functions.

6. Apparatus and Materials

6.1 *Drying Oven*, capable of maintaining $221 \pm 9^\circ\text{F}$ [$105 \pm 5^\circ\text{C}$] and providing adequate air circulation.

6.2 *Testing Chamber*, capable of keeping samples at $73.4 \pm 4^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$].

6.3 *Balance*, capable of reading the mass of specimens at least to the nearest 0.00035 oz. [1 mg].

6.4 *Container*, capable of holding at least 1 qt [1 L] of water.

6.5 *Stainless Steel Screen*, or other means of holding test specimens under water and allowing for water to circulate to test specimens.

6.6 *Water*, tap water is usually acceptable. Distilled or deionized water shall be used for referee purposes.

6.7 *Dispensing System*, as required, when adhesives are to be tested.

6.8 *Specimen Marking Device*, such as a pencil or a pen with water resistant ink.

6.9 *Paper or Paperboard*, when adhesives are to be tested, which has the ability to remain intact for at least 24 h of water immersion. The approximate size shall be 10 × 10 in. [250 × 250 mm].

7. Test Specimens

7.1 Samples of tape and adhesives shall be representative of the items under investigation.

NOTE 1—Water resistance is a property that is relatively constant for a given formulation of tape and adhesive. This type of testing is usually conducted only for design qualification or first article of manufacture, not on a periodic or lot-by-lot basis.

8. Procedures

8.1 Procedure A—Tape:

8.1.1 Obtain three samples of tape, each with an approximate area of 12 in.² [7500 mm²]. Dry each specimen in an oven at 221 ± 9°F [105 ± 5°C] for 2 h. Weigh each specimen to the nearest 0.00035 oz. [1 mg] immediately after removal from the oven; weighing procedures in Practice D644 are recommended for referee purposes. Place specimens in a container with at least 1 qt [1 L] of water at 73.4 ± 4°F [23 ± 2°C]. Hold specimens under water by a stainless steel screen or by other means that allow circulation of water to all surfaces of the specimens but will not disrupt the adhesive surface. Keep specimens under water at 73.4 ± 4°F [23 ± 2°C] for 25 ± 1 h. Remove from water and repeat the drying and weighing operations.

8.1.2 Calculate the percentage water soluble or dispersible components as follows:

$$\% \text{ loss} = [(M_I - M_F)/M_I] \times 100 \quad (1)$$

where:

M_I = mass of oven-dried tape before water submersion, and

M_F = mass of oven-dried tape after water submersion.

8.1.3 The test result shall be calculated as the arithmetic mean of the three specimens.

8.1.4 *Interpretation*—A maximum acceptable percentage loss may be specified in a contract or specification. It is generally accepted that a result of up to 2 % loss of mass could be attributed to incidental materials in the tape and experimental variation. A result of over 2 % loss indicates that functional components of the tape are removed by water.

8.2 Procedure B—Adhesives:

8.2.1 Mark six paper samples for identification purposes. Pick three of the six samples. Dry each specimen in an oven at 221 ± 9°F [105 ± 5°C] for 2 h. Weigh each specimen to the

nearest 0.00035 oz. [1 mg] immediately after removal from the oven; weighing procedures in Practice D644 are recommended for referee purposes. Place specimens in a container with at least 1 qt [1 L] of water at 73.4 ± 4°F [23 ± 2°C]. Hold specimens under water by a stainless steel screen or by other means that allow circulation of water to all surfaces of the specimens but will not disrupt the surface. Keep specimens under water at 73.4 ± 4°F [23 ± 2°C] for 25 ± 1 h. Remove from water and repeat the drying and weighing operations.

8.2.2 Calculate the percentage water soluble or dispersible components (S_P) in the paper (without adhesive) as follows:

$$S_P \% = [(M_I - M_F)/M_I] \times 100 \quad (2)$$

where:

M_I = mass of oven-dried paper before water submersion, and

M_F = mass of oven-dried paper after water submersion.

Average the results from the three sheets of paper.

8.2.3 Oven dry and weigh the other three paper samples as previously described. Apply generous amounts of adhesive over the paper in a manner similar to that used on a box and in accordance with manufacturer's instructions. Let the adhesive set on the paper for two hours. Oven dry and weigh the specimens as previously described; take care not to disrupt the adhesive. Place specimens under water for 25 ± 1 h as previously described. Remove from water and repeat the drying and weighing operations.

8.2.4 Calculate the mass of the adhesive (M_A) on each sheet of adhesive coated paper as follows:

$$M_A = M_T - M_P \quad (3)$$

where:

M_T = mass of oven-dried paper with adhesive before water immersion, and

M_P = mass of oven-dried paper only for the same specimens.

8.2.5 Calculate the gross percentage water soluble or dispersible components (S_G) in the paper and adhesive as follows:

$$S_G \% = [(M_T - M_W)/M_A] \times 100 \quad (4)$$

where:

M_W = mass of oven-dried paper and adhesive after water immersion.

Average the three specimens.

8.2.6 Correct the gross percentage of loss of the adhesive and paper (S_G) by subtracting the percentage lost by the paper (S_P). This net test result is the percent of water soluble or dispersible components in the adhesive.

8.2.7 *Interpretation*—A maximum acceptable percentage loss may be specified in a contract or specification. It is generally accepted that a result of up to 2 % loss of mass could be attributed to incidental materials in the adhesive and experimental variation. A result of over 2 % loss indicates that functional components of the adhesive are removed by water.

9. Report

9.1 Report the following information:

9.1.1 Statement that this test method was used, indicating any deviations from the method,



9.1.2 Complete identification of the tape or adhesive that was tested,

9.1.3 Anomalous behavior during the test, and

9.1.4 The percent of tape or adhesive dissolved or dispersed in water as determined by this test.

10. Precision and Bias

10.1 No statement is made about either precision or bias of this test method since the result merely indicates whether there is conformance to the criteria for success specified in the procedure.

11. Keywords

11.1 adhesive; box closure; tape; water resistance

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