Designation: D3833/D3833M – 96 (Reapproved 2011)

Standard Test Method for Water Vapor Transmission of Pressure-Sensitive Tapes[1]

This standard is issued under the fixed designation D3833/D3833M; 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.

1. Scope

1.1 This test method covers one procedure for measuring the water vapor transmission rate of pressure-sensitive tape.

1.2 The values stated in either SI 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 must be used independently, without combining values in any way.

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]

D996 Terminology of Packaging and Distribution Environments

D3715/D3715M Practice for Quality Assurance of Pressure-Sensitive Tapes

D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing

E96/E96M Test Methods for Water Vapor Transmission of Materials

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

3. Terminology

3.1 *Definitions*—General terms in this test method are defined in Terminology D996.

4. Summary of Test Method

4.1 The pressure-sensitive tape is secured by its adhesive to a test cup containing a desiccant. The assembly is exposed to a controlled atmosphere and weighed after two intervals of that exposure. The gain in weight is used to calculate the water vapor transmission rate (WVTR).

5. Significance and Use

5.1 The results of this test method will indicate the relative permeability by water vapor of the tape through its smallest dimension (generally normal to the tape's backing).

5.1.1 The pathway for the water vapor parallel to the adhesive-cup interface is great compared to the tape's thickness and the latter is usually the nearly exclusive source of transmitted vapor.

5.1.2 Some tape types allow a relatively free path in a direction normal to the backing or along backing pathways parallel to the adhesive-cup interface allowing the adhesive to become the principal barrier.

5.2 If the adhesive does not continue to adhere to the cup flange during the exposure periods allowing unintended pathways for water vapor to occur, the measurement should be considered as not having been made. Consequently, the tape might be considered as being inappropriate for use on surfaces like the cup flange under moisture conditions approximating those of the test.

NOTE 1—It may be that the interest is simply in the tape material as a water vapor barrier. In this case, how well the tape adheres to the cup flange may be of little consequence, and steps to prevent any edge effects are in order. These are referred to in Section 10.

6. Apparatus

6.1 *Test Cups,* [3] made from materials that are nonhygroscopic. The cup shall have a *zero* WVTR. The cups shall be rectangular with a flat, smooth, rigid flange, and shall have the following dimensions:

[1] This test method is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.14 on Tape and Labels.

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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 sole source of supply of the apparatus known to the committee at this time is Chemsultants International, 9349 Hamilton Dr., Mentor, OH 44061–1118. 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.

Flange:
Outside–50.8 by 152.4 ± 0.5 mm [2.0 by 6.0 ± 0.02 in.]
Inside (opening) –25.4 by 101.6 ± 0.5 mm [1.0 by 4.0 ± 0.02 in.]
Body:
Inside–25.4 by 101.6 by 38.1 (depth) ± 0.5 mm [1.0 by 4.0 by 1.5 (depth) ± 0.02 in.]

The mass shall not exceed 80 % of the balance capacity used in weighing.

6.2 *Calcium Chloride,* anhydrous, passing a No. 8 (2.36-mm) sieve.

NOTE 2—Regenerate calcium chloride to a sufficiently anhydrous state by heating it for 2 h at approximately 200°C [392°F].

6.3 *Test Chamber,* controlled at 90 to 95 % relative humidity at 38 ± 1°C [100.0 ± 2.0°F]. The air shall be circulated within the chamber to provide uniform conditions for all specimens and shall give no visible condensation on the test cups.

6.4 *Balance,* accurate to ±1 mg.

7. Sampling

7.1 *Acceptance Sampling*—Sampling shall be in accordance with Practice D3715/D3715M.

7.2 *Sampling for Other Purposes*—The sampling and the number of test specimens depends on the purpose of the testing. Practice E122 is recommended. It is common to test at least five specimens of a particular tape. Test specimens should be taken from several rolls of tape and wherever possible, among several production runs of a tape. Strong conclusions about a specific property of a tape cannot be based on test results of a single unit (roll) of a product.

8. Test Specimens

8.1 Prepare three specimens for each sample or sample roll.

8.2 Specimens shall be 50 minus 2.5 mm [2.0 minus 0.1 in.] wide and 155 minus 2.5 mm [6.0 minus 0.2 in.] long from the sample material.

8.3 When the sample material is pressure-sensitive tape wound in roll form, unwind and discard at least three, but no more than six, outer wraps of tape from the sample roll before taking specimens for testing.

8.4 Remove specimens from a freely rotating roll at the rate of 500 to 750 mm [20 to 30 in.]/s. Where width or other factors causing high adherence to backing make it impossible to remove the specimens at the prescribed rate, remove it at a rate as close to 20 in. [500 mm]/s as possible.

9. Conditioning

9.1 Weigh in the standard conditioning atmosphere as described in Practice D4332.

10. Procedure

10.1 Prepare each specimen assembly individually.

10.2 Fill the test cup to within approximately 3 mm [⅛ in.] of the opening with the anhydrous calcium chloride and make sure it will not come into contact with the adhesive of the specimen.

10.3 Apply the specimen to the flange, adhesive against it, allowing no bubbles or wrinkles. Use finger pressure to achieve this. When the sample material is larger than the specimen dimension trim it to the edges of the flange.

10.3.1 When the adhesive is lacking or has insufficient bonding strength to the flange to maintain a seal during the exposure period, and when the parties concerned are interested exclusively in the barrier properties for pathways normal to the surface of the tape backing, a sealing material such as aluminum foil-backed pressure-sensitive tape can provide assurance that only the 25.4 by 101.6-mm [1.0 by 4.0-in.] area at the flange opening is exposed and all edges are covered.

10.4 Prepare the remaining assemblies in the same way as the first.

10.5 Place the assemblies into the test chamber for approximately a 24-h period, remove, cool for 15 min to the weighing conditions, and weigh to the nearest 5 mg. This will be W_1 for the equation in Section 11.

10.5.1 For materials with an expected WVTR of 40 g/m^2 [2.5 g/100 in.^{2}] in 24 h or less, return the assemblies to the test chamber for 72 h following the initial weighing. Remove and cool them to the weighing conditions for 15 min and weigh again to the nearest 5 mg. Use this as W_2 for the equation in Section 11.

10.5.2 For materials with an expected WVTR greater than 40 g/m^2 [2.5 g/100 in.^{2}] in 24 h, return the assemblies to the test chamber for 48 h. Remove, cool, and weigh them as in 10.5.1 to obtain W_2.

NOTE 3—For tapes of unknown WVTR, return the assemblies to the test chamber for 48 h following the initial weighing. Remove, cool, and weigh as in 10.5.1 to obtain W_2. Again, return the assemblies to the test chamber for another 48 h. Remove, cool, and weigh them as in 10.5.1 to obtain a second W_2. Use the previously obtained W_2 as W_1 in the equation in Section 11. Continue these 48-h exposure periods and reweighings until a steady-state WVTR is determined.

11. Calculation

11.1 Calculate the water vapor transmission rate (WVTR) for each specimen in g/m^2 [g/100 in.^{2}] of tape area in 24 h to the nearest 0.05 g as follows:

$$WVTR = \frac{(W_2 - W_1)\ 2400}{T \times A} \quad (1)$$

where:

W_1 = weight from 10.5, g,
W_2 = weight from 10.5.1 or 10.5.2, g,
T = time of exposure between W_1 and W_2, h, and
A = area of cup opening, m^2 (0.00258 m^2) [in.^{2}].

12. Report

12.1 The report shall include the following:

12.1.1 Statement that this test method was used. Indicate any deviations from this test method as written.

12.1.2 Whether the edges were sealed or unsealed.

12.1.3 Manufacturer's name and designation for the tape.

12.1.4 Report the results found in Section 11 as the average and the standard deviation. Report the number of samples.

13. Precision and Bias[4]

13.1 *Precision:*

13.1.1 An interlaboratory evaluation of two types of pressure-sensitive tape by four laboratories has been conducted. The following summary presents the standard deviations as percentages of the mean. These may be larger or smaller for any particular tape type or any particular manufacturer. Careful treatment of outliers (individual extreme datum) may reduce the reported measures of precision.

Residual (within roll and replication error)	25.1 %
Between rolls (of one tape type)	2.1 %
Between people (testers in one laboratory)	19.7 %
Between laboratories	5.7 %

13.1.2 These deviations may be combined in several ways to obtain the desired estimate of precision. Since the repeatability (within-laboratory replication error) can be determined by a laboratory for a particular tape, this information can be used with the reported information to obtain more meaningful estimates of precision.

13.2 *Bias*—No measure of bias is possible with this test method because an accepted reference or referee value is not available.

14. Keywords

14.1 pressure-sensitive tape; water vapor transmission

[4] Supporting data are available from ASTM International Headquarters. Request RR: D-10-1002, Report 2.