



Designation: D4279 – 95 (Reapproved 2022)

Standard Test Methods for Water Vapor Transmission of Shipping Containers—Constant and Cycle Methods¹

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1. Scope

1.1 These test methods cover the determination of water vapor transmission rates for bulk shipping containers, as follows:

1.1.1 Method A, for Reclosable Containers, and

1.1.2 Method B, for Containers Not Designed for Reclosing.

1.2 Within each procedure details are given for the constant and cycle methods of test atmosphere.

1.3 The test may be applied to the container as packed, or after one or more performance tests such as drum (Method D782), vibration (Methods D999), drop (Test Method D5276), impact resistance (Test Methods D880, D4003, and D5277), or performance tests (Practice D4169), as required.

1.4 For small shipping containers requiring greater accuracy in weighing, the water vapor transmission may be determined in accordance with Test Method D895 or Test Method D1251.

1.5 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.

1.6 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ These test methods are under the jurisdiction of ASTM Committee D10 on Packaging and are the direct responsibility of Subcommittee D10.21 on Shipping Containers and Systems - Application of Performance Test Methods.

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2. Referenced Documents

2.1 *ASTM Standards:*²

D782 Test Method for Shipping Containers in Revolving Hexagonal Drum (Withdrawn 1999)³

D880 Test Method for Impact Testing for Shipping Containers and Systems

D895 Test Method for Water Vapor Permeability of Packages (Withdrawn 1999)³

D996 Terminology of Packaging and Distribution Environments

D999 Test Methods for Vibration Testing of Shipping Containers

D1251 Test Method for Water Vapor Permeability of Packages by Cycle Method (Withdrawn 1999)³

D4003 Test Methods for Programmable Horizontal Impact Test for Shipping Containers and Systems

D4169 Practice for Performance Testing of Shipping Containers and Systems

D5276 Test Method for Drop Test of Loaded Containers by Free Fall

D5277 Test Method for Performing Programmed Horizontal Impacts Using an Inclined Impact Tester

3. Terminology

3.1 *Definitions*—General definitions for the packaging and distribution environments are found in Terminology D996.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *water vapor transmission rate of a shipping container (constant atmosphere method), n*—for the purpose of this test method, the rate at which water is transmitted into the container from the test atmosphere (normally of 90 % $\pm$ 2 % relative humidity and a temperature of 100 °F $\pm$ 2 °F (37.8 °C $\pm$ 1.1 °C) surrounding it while a desiccant is sealed within.

3.2.2 *water vapor transmission into a container (cycle atmosphere method), n*—for this test method, the amount of

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.

water transmitted into the container from the test atmosphere during one cycle while a desiccant is sealed within.

3.2.3 *cycle, n*—one series of test atmospheres to which the test specimens are exposed. Normally one cycle will consist of 1 week of exposure to a temperature of $0^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($-17.8^{\circ}\text{C} \pm 2.8^{\circ}\text{C}$) to be followed by 3 weeks of exposure at a temperature of $100^{\circ}\text{F} \pm 2^{\circ}\text{F}$ ($37.8^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$) and a relative humidity of $90\% \pm 2\%$.

4. Significance and Use

4.1 These test methods are normally used for the following purposes:

4.1.1 To evaluate materials and constructions for a specific type of container,

4.1.2 To compare performance of different types of containers,

4.1.3 To determine adequacy of protection for a specific product or application, and

4.1.4 To maintain quality control.

METHOD A—RECLOSABLE CONTAINERS

5. Apparatus

5.1 *Desiccant*—A desiccant shall be used that has a powerful affinity for water and a high drying efficiency, that is, a low vapor pressure after absorbing a large amount of water. The desiccant shall be in the form of small lumps that will pass a No. 8 (2.36 mm) sieve and be free from fines that will pass a No. 30 (600 μm) sieve. Anhydrous calcium chloride and anhydrous magnesium perchlorate have been found suitable. When the test is made to determine the suitability of a specific container for a particular product, that product may be used inside the test specimen instead of the desiccant, in which case the specimen shall be filled to normal capacity.

5.2 *Weighing Balance*—A weighing balance accurate to within 1 g shall be used. When the required amount of desiccant is greater than can be weighed on a balance of this sensitivity, two or more receptacles shall be used and weighed individually. When product tests are made, a regular laboratory balance and drying oven or other appropriate equipment are required for making standard moisture determinations peculiar to the product.

5.3 *Receptacle for Desiccant*—A nonmoisture-absorptive receptacle $\frac{3}{4}$ in. to $1\frac{1}{2}$ in. (19 mm to 38 mm) deep shall be used for holding the desiccant within the container being tested. It should be equipped with a cover that will rest on the top rim of the receptacle to protect the desiccant from picking up moisture while being weighed. The size of the weighing receptacle or receptacles shall be such that the exposed area of desiccant is not less than 10 % of the area of the test specimen. For testing large containers, this may require using two or more weighing receptacles.

5.4 *Test Chamber*—A test room or cabinet provided with conditioned air that is continuously circulated around the specimens under test. The conditions in the chamber shall be such that no condensation occurs on the specimens except during that portion of the cycle when the exposure is changed from a low temperature to a high temperature.

6. Test Specimens

6.1 Test specimens shall be representative of the containers being tested, and shall be closed and sealed in the normal manner.

6.2 The performance shall be based on tests of not less than two representative specimens of a given size and type of container.

7. Procedure

7.1 Locate the weighing receptacle or receptacles centrally within the test specimen, using a nonabsorptive support when required. Place the selected quantity of the desiccant in the receptacle sufficient to uniformly cover the area of the receptacle to a depth of not less than $\frac{1}{2}$ in. (13 mm). Cover, and after weighing, immediately transfer into the test specimen. Uncover the receptacle and close and seal the specimen in the normal manner. The desiccant may require one or more replacements if it becomes noticeably moist during the test.

NOTE 1—When the test is conducted to determine the water vapor transmission of the shipping container for research, development, manufacturing control, specification acceptance, etc., a desiccant shall be used as the water absorbing medium. When the test is used to determine the suitability of the shipping container with respect to water vapor resistance for a particular product, the product shall be used in lieu of the desiccant.

7.2 Place the specimen inside the test room or cabinet in a position where free access of the conditioned circulating air is provided on all surfaces of the container according to the following:

7.2.1 *Constant Atmosphere Method*—Normally surrounding conditions are $90\% \pm 2\%$ relative humidity and a temperature of $100^{\circ}\text{F} \pm 2^{\circ}\text{F}$ ($37.7^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$).

7.2.2 *Cycle Atmosphere Method*—Place the specimen in the low temperature test room or cabinet (normally maintained at 0°F (-17.8°C)) for a period of 1 week. Follow immediately by 3 weeks of exposure to the high temperature and humidity (normally 100°F (37.8°C)) and 90 % relative humidity).

7.3 Make successive weighings of the receptacle at suitable intervals and plot the mass gained against time using these schedules:

7.3.1 *Constant Method*—Accuracy of the test is adversely affected by too frequent weighings. For highly permeable containers a minimum weighing frequency of 3 days is recommended. For containers having a low rate of transmission, a weighing frequency of biweekly to monthly is recommended.

7.3.2 *Cycle Method*—Make successive weighings of the receptacle at the completion of each cycle. It is suggested that the test be carried on for a minimum of three complete cycles.

7.4 The weighing procedure, which should be conducted as rapidly as possible, shall be as follows: Remove the specimen from the test chamber, open, remove the receptacle, and place the cover on the receptacle. Temporarily close the specimen to prevent the entrance of moisture from the surrounding atmosphere. Weigh the receptacle, open the specimen, and return the receptacle. Uncover the receptacle, reclose the specimen, and return it without delay to the test room or cabinet. Continue until a constant rate of gain is attained as indicated by at least