Designation: D814 – 95 (Reapproved 2020)

Standard Test Method for Rubber Property—Vapor Transmission of Volatile Liquids[1]

This standard is issued under the fixed designation D814; 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 measurement of the rate of vapor transmission of volatile liquids through a rubber sheet, disk, or diaphragm.

1.2 The values stated in SI units are to be regarded as 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D3767 Practice for Rubber—Measurement of Dimensions

3. Significance and Use

3.1 The rate of transmission of a liquid through a rubber sheet, that acts as a barrier, is important in rubber diaphragm performance and other similar industrial applications. This transmission is referred to as vapor transmission since the liquid diffuses through the rubber in a molecular sense and escapes into free atmosphere in vapor form.

3.2 This test method is applicable only to the materials in sheet form of moderate thickness and is principally useful for comparing the relative vapor transmission of different liquids in the same rubber or of the same liquid through different rubbers. Comparisons should not be made in which both different rubbers and different liquids are used.

4. Apparatus

4.1 The test apparatus shall consist essentially of glass vapor transmission jars (4.2) for each liquid, on which the test specimens are mounted, and a suitable rack for supporting the jars in an inverted position in such a way as to allow free circulation of air over the surface of the specimen. The apparatus shall be kept in a constant temperature cabinet or room at 23 ± 2°C (73.4 ± 3.6°F).

4.2 *Vapor Transmission Jar*—A glass jar of approximately 236-cm^3 (½-pt) capacity with an opening of 60.3 ± 0.4 mm (2.375 ± 0.015 in.) in inside diameter and a wall 3.2 mm (0.125 in.) in thickness at the opening, which shall be ground flat without rounded edges to a smooth ground-glass finish at the contact surface. The opening shall be equipped with a metal screw ring clamp holding a smooth-edged, flat, sheet-metal ring 55.6 ± 0.4 mm (2.188 ± 0.015 in.) in inside diameter and approximately 68.3 mm (2.69 in.) in outside diameter. The ring clamp and ring serve as a clamping device for holding the specimen against the ground-glass-edge of the jar with a circular specimen area 55.6 mm (2.188 in.) in diameter exposed to the air while permitting the screw clamp to be tightened to form a leak-proof seal without subjecting the specimen to torsional strain. When testing extensible materials, a circular disk of 16 to 20-mesh screen shall be placed inside the screw ring clamp between it and the flat metal ring to prevent stretching of the specimen during the test. The screen disk may be soldered in place on top of the sheet metal ring if desired.

NOTE 1—A suitable vapor transmission jar may be prepared from a ½-pt Mason jar equipped with a Kerr-type screw cap, provided the edge of the jar is properly ground and finished with fine emery and the cap is cut with smooth, flattened edges to form the required circular opening.

4.3 *Dial Micrometer*—The dial micrometer shall conform to the requirements of Method A of Practice D3767.

4.4 *Balance*—The balance shall be of suitable capacity capable of weighing to 0.005 g.

5. Test Specimen

5.1 The test specimens shall consist of circular disks 68 mm (2.69 in.) in diameter, cut with a sharp-edged die from a sheet

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.10 on Physical Testing.

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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.

of the material being tested. The thickness of the sheet, which shall not exceed 3.2 mm (0.125 in.), shall be measured using the dial micrometer described in 4.3.

5.2 For evaluating the vapor transmission of a particular liquid with respect to a given rubber, three specimens having the same nominal thickness within a tolerance of ±3 % shall be tested. The vapor transmission of the liquid shall be taken as the average of the values obtained from the two rubber specimens giving the lowest results, providing these check within ±20 % of the average so determined.

6. Procedure

6.1 With the vapor transmission jar in an upright position, place 200 cm^3 of the test liquid in it, after which fit the test specimen over the mouth of the jar, place the ring and wire screen in position, and screw down the screw ring clamp lightly. Hold the assembly in the constant temperature cabinet or room at 23 ± 2°C (73.4 ± 3.6°F) with the test disk lightly in place until temperature equilibrium is obtained. Then screw down the ring tightly and allow the assembly to stand in an upright position for 2 h. Make a tare assembly using a duplicate jar and a test specimen of the same size but without the addition of the test liquid. Place suitable weighting material such as lead shot in the tare jar to bring its mass to approximately that of the assembled jar and contents. Condition the tare jar at the test temperature, seal it, and handle throughout the test in a manner similar to that used for the test jar. Place the test jar on a balance of suitable capacity capable of weighing to 0.005 g, and counterbalance it against the tare jar, adding weights as required for equilibrium. Take the original mass of the test assembly as that of the tare corrected for the added weights and record to the nearest 0.005 g.

6.2 After weighing, invert each test jar assembly and place on the rack, supporting each in such a way that the entire inner surface of the specimen remains in contact with the liquid throughout the test. If the rack is located in a conditioning cabinet, take care to remove diffused vapors from the chamber and to assure free circulation of fresh air by means of a fan or other suitable device. Twenty-four hours after inverting the jar, again weigh it against the tare jar. Any excessive loss of mass indicates that leakage due to improper seal is occurring. Remove such test assemblies and replace them by new assemblies properly prepared. Return the test assembly to the rack and reweigh against the tare after periods of 120 ± 2 h and 192 ± 2 h from the initial inversion. Consider the difference in mass between those obtained at 120 h (5 days) and at 192 h (8 days) divided by 3 as the average mass of liquid lost per 24 h.

NOTE 2—In this test, the specimens are allowed to remain in contact with the liquid for 5 days before starting measurement of the loss in order to permit the rate of diffusion of the liquid to become uniform.

7. Calculation

7.1 Express the vapor transmission rate (VTR) of each test liquid with respect to the rubber employed and calculate as follows:

$$\text{Vapor transmission rate } (VTR),\ \text{mg}/(\text{s}\cdot\text{m}^2) = 4.77 \times \text{average mass in grams of liquid lost per 24 h} \quad (1)$$

8. Report

8.1 The report shall include the following:

8.1.1 Identification of the test rubber,

8.1.2 Thickness of the test rubber to the nearest 0.025 mm (0.001 in.),

8.1.3 Identification of the test liquid, and

8.1.4 Vapor transmission rate (VTR) of the liquid, expressed in milligrams per second per square metre of wetted area.

9. Precision

9.1 Due to a lack of laboratories willing to participate in round-robin testing, no precision data are available for this test method.

10. Keywords

10.1 vapor transmission; volatile liquids