NOTICE: This standard has either been superseded and replaced by a new version or withdrawn.
Contact ASTM International (www.astm.org) for the latest information

Designation: F 372 – 99 (Reapproved 2003)

Standard Test Method for Water Vapor Transmission Rate of Flexible Barrier Materials Using an Infrared Detection Technique[1]

This standard is issued under the fixed designation F 372; 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 a rapid procedure for determining the rate of water vapor transmission of flexible barrier materials in film or sheet form. This test method is applicable to sheets and films up to 3 mm in thickness, consisting of single-layer or multilayer synthetic or natural polymers and metal foils including coated materials.

1.2 *This standard does not purport to address all of the safety problems, 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]

D 374 Test Methods for Thickness of Solid Electrical Insulation

D 1898 Practice for Sampling of Plastics[3]

E 96/E 96M Test Methods for Water Vapor Transmission of Materials

E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions:*

3.1.1 *water vapor transmission rate (WVTR)* (of a body between two specified parallel surfaces)— the time rate of water vapor flow normal to the surfaces, under steady conditions, through unit area, under the conditions of test (for example, temperature and relative humidity). An accepted unit of WVTR is g/day·m^2. The test conditions must be stated.

3.1.2 *water vapor permeance* (of a body between two specified parallel surfaces)—the ratio of its WVTR to the vapor pressure difference between the two surfaces. An accepted unit of permeance is a metric perm, or 1 g/day·m^2·mm Hg. Since the permeance of a specimen is generally a function of relative humidity and temperature, the test conditions must be stated.

4. Summary of Test Method

4.1 A dry chamber is separated from a wet chamber of known temperature and humidity by the barrier material to be tested. The time for a given increase in water vapor concentration of the dry chamber is measured by monitoring the differential between two bands in the infrared spectral region, one in which water molecules absorb and the other where they do not. This information is then used to calculate the water vapor movement through a known area of barrier material.

5. Significance and Use

5.1 The purpose of this test method is to rapidly obtain reliable values for the WVTR of barrier materials.

5.2 The WVTR is an important property of packaging materials, which can be related to shelf life and product stability.

5.3 In any application, the WVTR of a barrier material is determined by its permeance under the given conditions. In most cases, the WVTR will increase when the absolute humidity is increased on the wet side of the barrier and when the temperature of the environment increases, particularly if a polymeric material is the primary water vapor barrier in the construction.

5.4 Values for water vapor permeance and water vapor permeability must be used with caution. The inverse relationship of WVTR to thickness and the direct relationship of WVTR to the partial pressure differential of the water vapor are not always linear.

6. Apparatus

6.1 *Water Vapor Transmission Apparatus*, [4] (Fig. 1) with the following:

6.1.1 *Temperature Control*, capable of maintaining humid chambers and test material at 37.8 ± 0.1°C (100 ± 0.2°F).

[1] This test method is under the jurisdiction of ASTM Committee F02 on Flexible Barrier Materials and is the direct responsibility of Subcommittee F02.10 on Permeation.

Current edition approved May 10, 1999. Published July 1999. Originally published as F 372 – 73. Last previous edition F 372 – 94.

[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] Withdrawn.

[4] Modern Controls, Inc. no longer supplies the IRD-2, but some are still in use.

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.

Documents
Document Sharing Hub
Full document details: ASTM F372-99(2003)

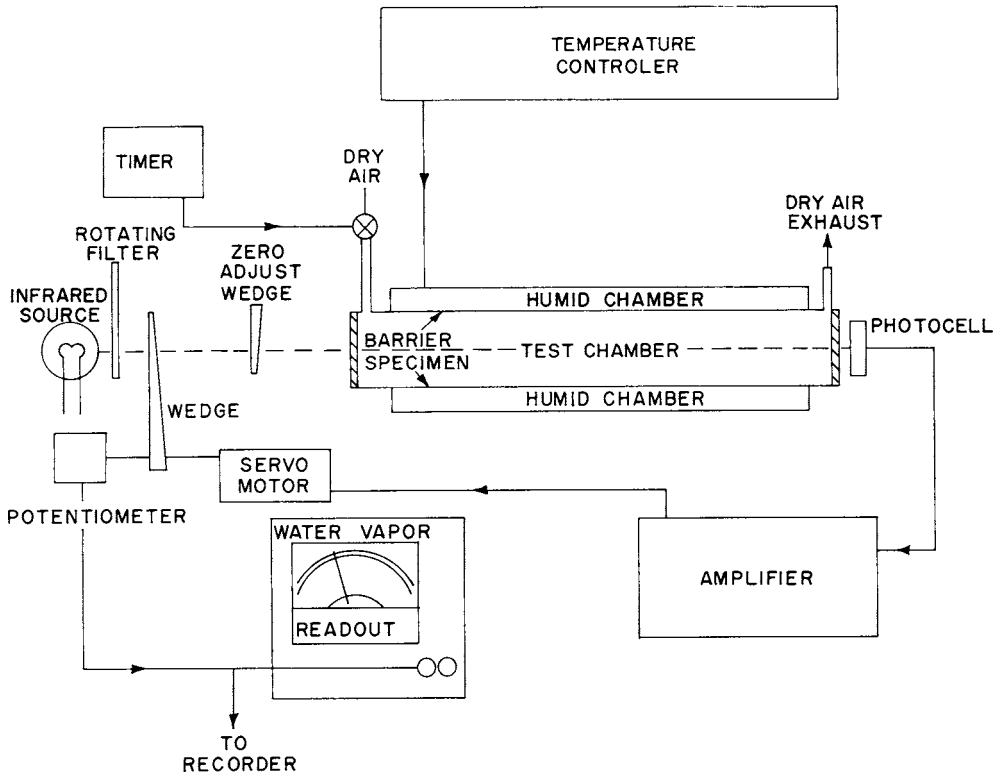

FIG. 1 Functional Diagram of Diffusometer

6.1.2 *Infrared Detection System*, capable of detecting changes of 1 µg of water vapor per litre or in other terms 1 ppm by volume or 0.002 % relative humidity at 37.8°C.

6.2 *Micrometer*, graduated to 0.0025 mm (0.10 mil) or better, and accurate to 0.00125 mm (0.05 mil) to measure specimen thickness.

6.3 *Analytical Balance* , accurate to 0.0001 g.

6.4 *Clock or Watch*.

6.5 *Schwartz U-Shaped Drying Tube*.

6.6 *Calcium Chloride Drying Tube*.

6.7 *Sponges*.

7. Reagent and Materials

7.1 *Desiccant for Drying Air Stream.* [5]

7.2 *Desiccant for Drying Tubes.* [6]

7.3 *Distilled Water*, for controlling humidity at 100 % relative humidity at 37.8°C.

7.4 *Zinc Sulfate Solution*, saturated at 37.8°C.

7.5 *Ammonium Sulfate Solution*, saturated at 37.8°C.

7.6 *Sealing Grease*.

8. Sampling

8.1 Practice D 1898 provides guidance in developing sampling procedures.

8.2 The material shall be sampled in accordance with standard methods of sampling applicable to the material under test. The sample shall be selected as representative of the material to be tested, and shall be of uniform thickness. If the material is of nonsymmetrical construction, the two faces shall be designated by distinguishing marks (for example, on a one-side-coated sample, "I" for the coated side and "II" for the uncoated side).

9. Test Specimens

9.1 Test specimens shall be representative of the sample. Test at least three specimens by the same method. If the surfaces of the sample differ, ensure that they are positioned properly relative to the wet and test chambers. Take care not to contaminate the test area of the specimen.

9.2 Determine the average thickness from measurements taken to the nearest 0.0025 mm (0.10 mil) on the surface area interfacing the humid chamber(s) and the test chamber. The number of measurements will depend upon the size of the total interfacing area.

10. Procedure for Gravimetric Calibration of Instrument and Preparation of Standard Film

10.1 Set the operating temperature in the humid chambers within 1°F (0.5°C) of the desired temperature. Check the sponges and dampen if necessary with distilled water for 100 % relative humidity, saturated zinc sulfate for 90 % relative humidity, or saturated ammonium sulfate for 81 % relative humidity.

10.2 Purge the test chamber with dry air and then measure the time for a given increase in water vapor concentration as

[5] Linde Molecular Sieve, Type 4A, ⅛-in. (3.2-mm) pellets from Union Carbide Corp., Linde Div., Molecular Sieve Products, 120 Riverside Plaza, Chicago, IL 60605, have been found suitable.

[6] Anhydrone, available from J. T. Baker Chemical Co., Phillipsburg, NJ, has been found satisfactory.

AVA Documents
Document Sharing Hub

Full document details: ASTM F372-99(2003)