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# Water vapor transmission rate of paper and paperboard at high temperature and humidity

## 1. Scope

1.1 This method is for the gravimetric determination of the water vapor transmission rate (WVTR) of sheet materials at 37.8°C (100°F) with an atmosphere of 90% RH on one side and a desiccant on the other.

1.2 It is generally suitable for any material up to 3 mm (1/8 in.) thick, although it may be used with caution for thicker materials if the edges of the specimen are completely sealed.

1.3 For testing at other conditions see TAPPI T 448 "Water Vapor Transmission Rate of Paper and Paperboard at 23°C (73°F) and at 50% RH."

1.4 This test can be used for both creased and uncreased specimens. See TAPPI T 465 "Static Creasing of Paper for WVT Tests" or TAPPI UM 590 "Creasing of Paperboard for Water Vapor Transmission Rate (WVTR) Testing."

## 2. Significance

2.1 This method provides a means for measuring the ability of a material to protect contents, that are enclosed within the material, from undesirable changes due to the transmission of water vapor to or from the surrounding environment.

2.2 The influence of temperature and humidity on the water vapor transmission rate of paper or paperboard is seldom linear, so test results obtained at lower temperatures and humidities cannot safely be extrapolated to apply to warmer, more humid conditions.

2.3 If sheet materials are not homogeneous, there may be a considerable difference in the transmission rate depending on which side faces the high humidity. Usually the test is made so as to simulate the use of the material in practice; for example, a material for enclosing a dry product would be tested by exposing to the dry atmosphere that surface which would face the product in the package.

Approved by the Standard Specific Interest Group for this Test Method

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### 3. Definitions

The water vapor transmission rate (WVTR) of a sheet material is the mass of water vapor transmitted per unit time per unit area from one face of the sheet to the other under specified steady conditions. The standard unit is  $\text{g/m}^2 \cdot \text{day}$  and for this method, the specimen has an atmosphere approaching 0% RH on one face and 90% RH on the other, at a temperature of 37.8°C (100°F).

**NOTE 1:** WVTR is a distinctive characteristic, often erroneously termed “permeability” or “moisture-vapor transfer” (MVT).

### 4. Apparatus<sup>1</sup>

4.1 *Test dish*, a light, shallow, non-permeable dish, that can be weighed on an analytical balance, having an opening as large as is practical, with an area of at least 50 cm<sup>2</sup> (about 8 in.<sup>2</sup>) and an inside depth of 10 - 15 mm (0.4 - 0.6 in.). The design of the test dish is such that a wax seal made between the dish and the specimen is impervious to water vapor and clearly defines the test area. A suitable design is shown in Fig. 1.

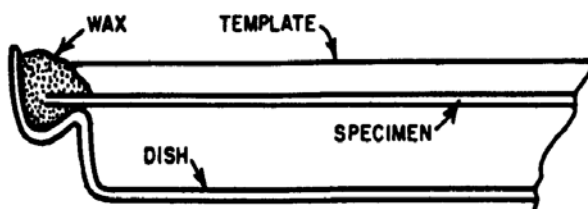


Fig. 1. Design of test dish.

4.2 *Template*, to define the test area and the location of the wax seal. It is made of a circular metal disk 3-6 mm (about 1/8 - 1/4 in.) thick, with its edge beveled at an angle of approximately 45°. The diameter of its smaller, bottom face defines the test area and must be measured accurately. It is approximately equal to, and not greater than, the diameter of the effective opening of the dish in contact with the specimen. There is a small hole through the disk to allow air passage, and a handle to facilitate removal of the disk after the wax solidifies. Positioning lugs may help to center the template in the dish.

4.3 *Balance*, of 200-g capacity, sensitive to at least 0.5 mg, with a pan large enough to hold the test dishes.

4.4 *Testing room or cabinet*, maintained at  $37.8 \pm 0.6^\circ\text{C}$  (about 100°F) and  $90 \pm 2\%$  RH, with air continuously circulated over the exposed surface of the test specimens at a speed of at least 30 m/min. (about 100 ft/min.). The test area must be such as to avoid the dripping of any condensate on the assemblies during the test.

**NOTE 2:** Take care to ensure by actual measurement that the air circulated over the test specimen is actually between 88 and 92% RH and between 37.2 and 38.4°C during normal operation. If the test specimen assemblies cannot be weighed inside the 37.8°C (100°F), 90% RH cabinet, it is recommended that the cabinet be located in a controlled constant temperature-humidity environment [e.g., 23°C (73°F) and 50% RH] in which the weighing can also be performed.

4.5 *Cutting template*, a circular disk to cut specimens of such a size that they lie flat over the groove on the dish for sealing.

4.6 *Weighing covers*. If the test specimen assemblies must be removed from the conditioned enclosure for weighing, covers may be used to prevent appreciable change in weight of the assemblies during weighing (see 8.7.2). The covers are circular disks of aluminum, 1–2 mm (about  $\frac{1}{32}$ – $\frac{3}{32}$  in.) thick, with a knob in the center for lifting. The circumference of each cover fits the inside beveled surface of the annular wax ring just above the plane of the specimen and is smoothed so as not to remove any wax when lifted. A numbered cover is required for each correspondingly numbered test dish.

<sup>1</sup> Names of suppliers of testing equipment and materials for this method may be found on the Test Equipment Suppliers list, available as part of the CD or printed set of Standards, or on the TAPPI website general Standards page.