



Standard Test Method for Sorption of Bibulous Paper Products (Sorptive Rate and Capacity Using Gravimetric Principles)¹

This standard is issued under the fixed designation D 5802; 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.

INTRODUCTION

The interaction of water in either the gaseous or liquid state is an extremely important property of paper and paper products. In addition to being the basis for performance characteristics of various different types of paper, such as paper for printing and writing, paper for wrapping and packaging, and paper for liquid absorbing tasks, measured values for many of the physical properties of paper vary, depending upon the amount of water present in the sheet when it is tested.

The amount of moisture present in paper and paper products may be measured by procedures such as Test Method D 644.

To enable physical measurements on different paper materials to be easily compared, equilibration of specimens to a standard moisture content before testing is done using procedures such as Practice D 685.

Where paper materials are to be used as barriers to the transfer of water vapor in, for example, packaging or wrapping applications, their gaseous moisture barrier properties may be measured by TAPPI T 523. A method for measuring the barrier properties of similar paper materials to liquid water is found in Test Method D 3285.

Where the interaction between a paper material and a liquid is important in an application such as printing, measurements may be made using procedures such as Test Methods D 5455, and Test Methods D 724.

Where paper materials are required which will absorb and retain water or water based fluids, as for example, absorbent tissue or blotting papers, test methods such as Test Methods D 824, D 2177, or D 4250, may be useful. The first two of these methods measure absorbent rate, the third, absorptive capacity. Similar test methods for absorptive rate are found in TAPPI T 431 and T 432. The absorbency of paperboard is measured using TAPPI T 491, which operates on the same gravimetric principles found in Test Method D 4250. Similar standardized testing procedures for absorbent structures are found in, for example, INDA Test Method IST 10, which gives instructions for the determination of absorbency time, capacity, and wicking rate of absorbent structures such as napkins, towels, and diapers.

These procedures are all similar in that they measure either the time (seconds) required for absorption of a specified volume of liquid under specified conditions by a test specimen, or the saturation capacity (grams) of a specimen under specified conditions, or both, in the case of the INDA Test Method IST 10.1.

While such information is of use in setting minimum material performance specifications, procedures which measure both rate and capacity simultaneously may also be used for such purposes, while providing significantly improved understanding of a material's absorbent character by true rate data (volume or weight/time) at points of interest prior to saturation. Numerous workers have published proposals for such testing procedures for paper or paper products, but few have been subjected to the consensus standardization process of ASTM or a similar organization. An excellent summary of such work is contained in the *Handbook of Physical and Mechanical Testing of Paper and Paperboard*.²

This test method is based upon the work of Miller and Tyomkin³ and Painter⁴ and provides a procedure whereby absorptive capacity and rate may be measured simultaneously and dynamically to provide an absorption curve showing the time dependency of the absorption process. This test method also provides test values comparable to those of existing manual procedures showing the time required

for absorption of a specified amount of liquid or the liquid capacity at saturation.

1. Scope

1.1 This test method determines the liquid sorption of bibulous paper, paperboard, and paper products using gravimetric principles.

1.1.1 The procedure in this test method describes testing of absorbent materials such as those in 1.1. Similar testing may be done on composite absorbent products, incorporating cellulose and nonwoven fabrics, polymer films, or other similar materials for use such as absorbent pads, wipes, and so on with slight modification. This test method does not describe the application of this technique to textiles.

1.2 The standard test liquid is distilled water.

1.2.1 Other test liquids of interest may be used if desired, provided they are compatible with the liquid delivery system specified.

1.2.1.1 Examples of such test liquids include, but are not limited to, buffered solutions of distilled water, fruit or vegetable juices, milk, synthetic body liquids such as urine, and organic fluids such as salad oil, cooking oil, motor oil, and others.

1.3 The test liquid is delivered at an effective negative head pressure after initiating liquid flow (wicking). This allows the controlling sorptive properties to be demand wettability, the ability of the specimen to absorb through capillarity and surface wetting.

1.3.1 Using the equipment and principles described, absorption at other instrument configurations and head pressures, as well as desorption may be measured.

1.4 This test method measures both the rate and capacity of liquid sorption through demand wettability or wicking. Liquid capacity is defined as the point in the analysis where the sorption rate falls below 3.0 mg in 5 s. Agreed intermediate points are measured during the analysis to determine rate.

1.5 An analog or digital report of the sorptive behavior of the test specimen may be produced, if desired, to further characterize its sorptive behavior.

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

2. Referenced Documents

2.1 ASTM Standards:

D 585 Practice for Sampling and Accepting a Single Lot of

Paper, Paperboard, Fiberboard, or Related Product⁵

D 644 Test Method for Moisture Content of Paper and Paperboard by Oven Drying⁵

D 685 Practice for Conditioning Paper and Paper Products for Testing⁵

D 724 Test Method for Surface Wettability of Paper (Angle-of-Contact Method)⁵

D 824 Test Method for Rate of Absorption of Water by Bibulous Papers⁵

D 828 Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus⁵

D 1193 Specification for Reagent Water⁶

D 1968 Terminology Relating to Paper and Paper Products⁵

D 2177 Test Method for Ink Absorption of Blotting Paper⁵

D 3285 Test Method for Water Absorptiveness of Nonbibulous Paper and Paperboard (Cobb Test)⁵

D 4250 Test Method for Water-Holding Capacity of Bibulous Fibrous Products

D 5455 Test Method for Short Term Liquid Sorption into Paper (Bristow Test)⁵

E 122 Practice Relating to Choice of a Sample Size to Estimate a Measure of Quality for a Lot or Process⁷

2.2 TAPPI Test Methods:

T 431 Ink Absorbency of Blotting Paper⁸

T 432 Water Absorbency of Bibulous Papers⁸

T 491 Water Immersion Test of Paperboard⁸

T 523 Dynamic Measurement of Water Vapor Transfer Through Sheet Materials⁸

2.3 INDA Test Method:

IST 10 Method for Absorption of Water⁹

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology D 1968 or the *Dictionary of Paper*.¹⁰

4. Summary of Test Method

4.1 A specimen of the sample is placed on a horizontal test plate, such that its bottom surface rests on the plate and its upper surface is covered by a test weight. The test plate, in turn, is connected to a liquid reservoir by means of a siphon tube. The spatial relationship between the bottom surface of the test specimen in contact with the effluent of the siphon tube and the top surface of the liquid in the liquid reservoir is variable, and may be continuously adjusted to maintain a constant spatial relationship during the test. The liquid reservoir is placed on a suitable electronic load cell or weighing device, such as an electronic balance.

¹ This test method is under the jurisdiction of ASTM Committee D-6 on Paper and Paper Products and is the direct responsibility of Subcommittee D06.92 on Test Methods.

Current edition approved Oct. 15, 1995. Published February 1996.

² Hollmark, "Absorbency of Tissue and Toweling", *Handbook of Physical and Mechanical Testing of Paper and Paperboard*, Vol 2, Chapter 20, Richard E. Mark, ed., Marcel Dekker, New York, NY.

³ Miller, B., and Tyomkin, I., *Textile Research Journal*, Vol 54, pp. 706–712, November 1984.

⁴ Painter, V., *TAPPI 68(12)*, pp. 54–59, 1985. See also U.S. Patent 4,357,827.

⁵ *Annual Book of ASTM Standards*, Vol 15.09.

⁶ *Annual Book of ASTM Standards*, Vol 11.01.

⁷ *Annual Book of ASTM Standards*, Vol 14.02.

⁸ Available from the Technical Association of the Pulp and Paper Industry (TAPPI), Technology Park/Atlanta, P.O. Box 105113, Atlanta, GA 30348.

⁹ Available from INDA.

¹⁰ Available from TAPPI.