



Standard Test Method for Short-Term Liquid Sorption Into Paper (Bristow Test)¹

This standard is issued under the fixed designation D 5455; 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 measures the amount of test fluid absorbed onto the surface of a paper specimen under specified test conditions.

1.2 The conditions required in this test method specify reagent water as the absorbed test fluid, and a calculated time available for test fluid absorption of 1.6 s.

1.3 This test method may also be used for the measurement of solution absorption of liquids other than water having viscosities up to 100 millipascal seconds, including but not limited to inks and other water or solvent-based fluids, for surfaces other than paper, and for calculated time periods available for fluid absorption ranging from about 0.01 to about 4.0 s, or any combination of these variables, upon prior agreement of those involved.

1.4 Further information regarding the use of this test method under conditions other than the standard ones in accordance with 1.2 are included in Appendix X1.

1.5 *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 528 Test Method for Machine Direction of Paper and Paperboard²

D 585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Product²

D 685 Practice for Conditioning Paper and Paper Products for Testing²

D 1193 Specification for Reagent Water²

D 1968 Terminology Relating to Paper and Paper Products²

D 5039 Test Methods for Identification of Wire Side of Paper²

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process³

E 691 Practice for Conducting an Interlaboratory Study to

Determine the Precision of a Test Method³

3. Terminology

3.1 *Definitions*—For definitions of terms used in this Test Method, refer to Terminology D 1968 or *Dictionary of Paper*⁴

4. Summary of Test Method

4.1 A test specimen of defined dimensions is affixed to the smooth rim of a wheel free to rotate at a defined constant speed in contact with a stationary test fluid applicator pressing against the test specimen with a defined pressure. The test fluid applicator consists of a test solution storage compartment affixed above a 1 by 15-mm test fluid delivery slot, the slot being positioned so that the long dimension is perpendicular to the direction of rotation of the rim of the wheel, and parallel to the wheel axis. A defined quantity of test fluid is placed, through the fluid reservoir, onto the fluid delivery slot. With the wheel with the test specimen affixed rotating at constant speed, the test solution applicator is brought into contact with the rotating test specimen and held in place under defined pressure. The test fluid is transferred from the test solution applicator onto the test specimen in a band whose width, controlled by the applicator slot width, is approximately 15 mm, and whose length is a function of the sorptive characteristics of the test fluid interaction with the test specimen under the defined test conditions. The amount of liquid sorbed per unit area of test specimen is calculated from the volume of test fluid originally placed in the applicator, and the average width and length of the band created on the test specimen by the transferred test fluid. The time available for liquid sorption is calculated from the volume of test fluid originally placed in the applicator and the applicator geometry.

5. Significance and Use

5.1 The Bristow test provides a measure of the short-term sorption of water or other liquids by paper. The U.S. Postal Service has used this test method to predict the drying times of bar codes sprayed onto envelopes by inkjet. The Bristow test is also used to measure ink sorption by paper for a variety of printing purposes. The particular significance of this test method is its ability to characterize the sorptive properties of a paper or paper product surface independent of the thickness or bulk of the material under test.

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.

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² *Annual Book of ASTM Standards*, Vol 15.09.

³ *Annual Book of ASTM Standards*, Vol 14.02.

⁴ Formerly published by American Paper and Pulp Assoc. (currently API), New York, NY.



6. Apparatus

6.1 The Bristow device consists of a stationary applicator, an applicator support fixture, and a Bristow wheel free to move about its own axis at a constant speed.

6.1.1 The Bristow device wheel used in this test method is described as follows:

6.1.1.1 A wheel fabricated of aluminum, 1.0 m in circumference and 25 mm wide.

6.1.1.2 A means to support the wheel so that it is free to rotate unencumbered about its own axis with its axis parallel to the laboratory bench surface or floor.

6.1.1.3 A means of rotating the wheel about its own axis at a constant circumference speed of 7.50 cm/min (1.25 mm/s). The Bristow wheel speed can be calculated in revolutions per minute, if desired, by dividing the circumference speed (7.5 cm/min) by the circumference (100. cm); in that case the rotational speed may be stated as 0.075 revolutions/min. It is the circumference speed that is critical to the use of the Bristow wheel, and that is the critical parameter specified in this test method.

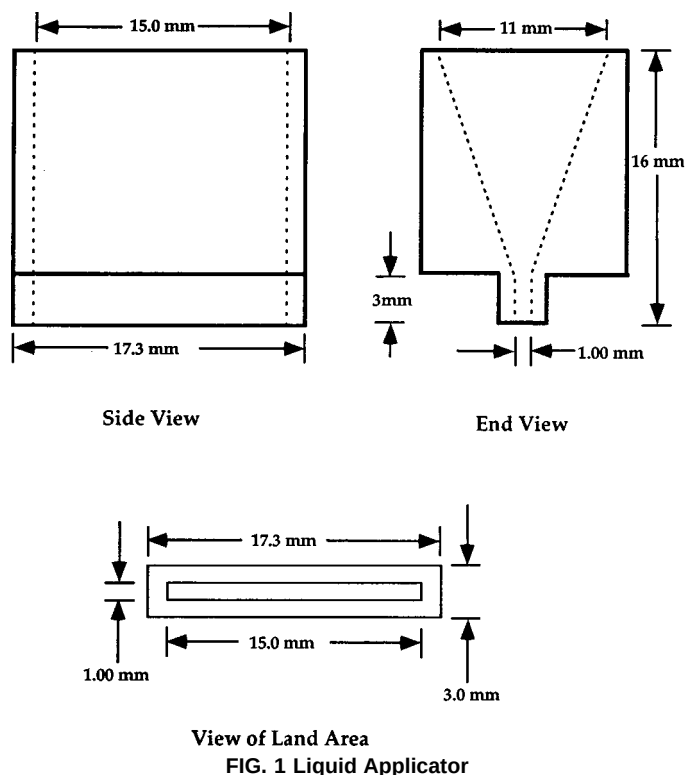
6.1.1.4 Equipment to perform the Bristow test is manufactured with wheels of differing circumference and width from that stated in 6.1.1.1, and with the capability to be operated at a constant speed of from 3.0 to 1500 cm/min for use with a variety of different test fluids, as described in Appendix X1. The dimensions and speed stated in 6.1.1.1 and 6.1.1.3 are standard for this test method, and any deviations from the conditions stated therein must be included in the report.

6.1.2 The Bristow device liquid applicator is described as follows:

6.1.2.1 A rectangular base made of nickel-plated or chrome-plated brass having dimensions of 3.0 ± 0.2 mm and 17.3 ± 0.4 mm, centered within which is a smaller rectangular slot of dimensions 1.00 ± 0.04 mm by 15.0 ± 0.4 mm. With the slot properly positioned, the applicator will have a leading edge 1.0 mm wide, a slot 1.00 mm wide, and a trailing edge 1.0 mm wide, the slot positioned centrally across the 17.3-mm width of the applicator such that a land area of approximately 1.15 mm is present beyond the ends of the slot on each side of the slot. The dimensions of the Bristow device test fluid applicator itself, the dimensions of the slot, and the positioning of the slot within the applicator are all quite important, and the pressure required in 6.1.2.3 is achieved at the stated applicator total measured weight only when the applicator has the dimensions specified here. Likewise, the calculation for time available for fluid sorption (see 11.5) is based on adherence to the dimensions specified here.

6.1.2.2 An applicator fluid reservoir is affixed above the rectangular base whose interior walls rise vertically from the outer edges of the slot to a height of about 3 mm, and then flare outward to provide a convenient guide or volume for filling purposes. See Fig. 1.

6.1.2.3 The pressure exerted by the contacting land area of the liquid applicator when the contacting land area is in contact with the specimen on the wheel must be about 0.1 ± 0.01 MPa. This is achieved for purposes of this test method by adding mass to the applicator assembly of dimensions conforming to 6.1.2.1 to a total measured weight of 400 g.



View of Land Area
FIG. 1 Liquid Applicator

6.1.2.4 The side of the rectangular base that will be in contact with the test specimen affixed to the Bristow wheel must be smooth. If it becomes scratched or otherwise flawed, as evidenced by streaks in the band of test fluid transferred to the test specimen during a test, it must be reground following the advice of the manufacturer. The total weight must be readjusted to 400 g following regrounding, if necessary.

6.1.3 Support fixture for the test solution applicator:

6.1.3.1 Several designs are in use. The important feature is that the fixture must maintain the test fluid applicator in a constant position relative to the rotating wheel in such a manner that the long (15 mm) dimension of the applicator slot is parallel with the axis of rotation of the wheel and centered over its 25-mm width (that is, perpendicular to the circumference of the wheel and centered over the test specimen affixed to that rim) and free to exert the total mass of the applicator applying the pressure specified in 6.1.2.3 through the land area contacting the wheel.

6.1.4 Equipment conforming to the requirements of 6.1 and subsections is commercially available from several sources. It may be necessary to specify specific wheel circumference and speed required for this test method, as variations, stated in 6.1.1.3, are also available.

6.2 Rule, calibrated in millimetres.

6.3 Magnifying Glass, a simple 5 or 10 $\times$, for use in accurately estimating measurements made with the rule.

6.4 Fluid Measuring Device—A calibrated pipet or syringe capable of delivering a volume of test fluid of 50.0 ± 0.5 μ L.

6.5 A quantity of fine monofilament polyester line, for clearing the applicator of bubbles. *In no case should a metal wire be used in place of the polyester*, as metal wire can damage the applicator base or slot, or both, particularly if left