

Test Method for Vertical Wicking of Textiles

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Foreword

Historically, the textile industry has utilized many different test procedures for determining the wicking characteristics of textile fabrics, i.e., the movement of water or liquid through fabrics. Within the last decade, the industry has developed new technologies that have changed water movement and absorbency responses of textiles leading to the use of the labeling term “moisture management” to describe these phenomena. Many interested groups (textile manufacturers, chemical suppliers, and retailers, as well as independent testing laboratories) participated in the efforts to standardize test methods to measure the vertical wicking properties of fabrics with moisture management attributes.

Unofficial techniques for determining the absorbency and wicking properties of textile fabrics were published in the 2004 AATCC/ASTM International's *Technical Supplement: A Compilation of Procedures and Guidelines for Textile Products* and the 2008 AATCC/ASTM International's *Moisture Management Technical Supplement: Applicable to Apparel, Linens and Soft Goods* (see 13.1). This test method is based on one of the testing procedures for wicking published in this *Technical Supplement*.

1. Purpose and Scope

1.1 This test method is used to evaluate the ability of vertically aligned fabric specimens to transport liquid along and/or through them, and is applicable to woven, knitted, or nonwoven fabrics.

2. Principle

2.1 The rate (distance per unit of time) liquid travels along and/or through a fabric specimen is visually observed, manually timed and recorded at specified intervals.

3. Terminology

3.1 **fabric**, n.—in *textiles*, a planar structure made from yarns or fibers (ASTM D123 and see 13.4).

3.2 **vertical wicking**, n.—in *a textile held vertically*, the upward movement of liquid from a cut edge.

3.3 **vertical wicking rate**, n.—the speed at which liquid travels along or through a textile.

3.4 **wicking**, n.—in *textiles*, the movement of a liquid, by capillary action, along or through a material.

3.5 **wicking distance**, n.—the linear measurement that the liquid travels along or through a textile from a starting point to a stopping point.

3.6 **wicking time**, n.—the measurable period during which liquid travels along or through a textile.

4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedures and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers MUST be consulted for specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Good laboratory practices should be followed. Wear safety glasses in all laboratory areas.

5. Uses and Limitations

5.1 The movement of liquid through a fabric may be influenced by fiber content, fabric construction, mechanical or chemical processing or a combination of these.

5.2 This test method is used to evaluate the wicking ability of vertically aligned test specimens, exposed to distilled or deionized water, where wicking is influenced by gravity.

5.3 Liquids other than distilled or deionized water (tinted water, dye solutions, etc.) may be used in this test. If a liquid other than water is chosen, its surface tension should be measured and reported as solutions of different surface tensions may yield different results.

5.4 Dark fabric colors or prints and designs may be difficult to test. The use of a soluble ink of a contrasting color may help in making the marks more clearly visible.

5.5 The procedure measures the time and distance water will move up from the cut edge of a specimen, but does not duplicate an end-product's exposure during wear.

5.6 The results obtained by this test

are not a measure of comfort which is beyond the scope of this method.

5.7 The relationship between results obtained by vertical and horizontal wicking tests is not known.

6. Apparatus, Reagents, Materials

6.1 Distilled or deionized water at $21 \pm 2^\circ\text{C}$ ($70 \pm 4^\circ\text{F}$).

6.2 Marking pens, with fine point, permanent and soluble ink (see 13.2).

6.3 Stopwatch or digital timer.

6.4 Tape or ruler, mm graduations.

6.5 Surface tensiometer, if using liquid other than water (see 9.1).

6.6 Erlenmeyer flask or elongated pan (see Figs. 2 and 3).

6.7 Pipette and bulb.

6.8 Scissor jack (optional).

6.9 Straight pins or a holder that permits the suspension of a specimen into a flask or other device (see Figs. 2 and 3 and 13.3).

6.10 Small paper clip or clamp (optional).

6.11 Template, 165 (or longer) \times 25 mm.

6.12 Disposable gloves, such as latex or nitrile.

6.13 Double-sided tape.

7. Specimens

7.1 Determine whether the fabric has a hydrophobic or hydrophilic side. Upon agreement between interested parties, determine whether both fabric sides are to be tested. If only one fabric side is to be tested, mark the selected side. If testing is to be performed after laundering, use a marking pen with permanent ink to denote the fabric side chosen for testing.

7.2 Minimize handling of the test specimens or use gloves as oils from the skin may affect moisture movement.

7.3 All specimens should be cut at least 100 ± 5 mm from the selvage. If testing garments, take specimens from different garment panels away from seams, pockets, plackets or other assembly features. Take each specimen such that different sets of (fabric) length and width yarns are present.

7.4 Cut three specimens at least $165 \pm 3 \times 25 \pm 3$ mm with the long dimension parallel to the fabric direction(s) chosen to be tested. For length direction testing, align the long direction of the template with the warp yarns (wales); for width direction testing, align the long direction of the template along the filling yarns (courses). Cut an extra specimen to determine water level in the flask or beaker

before starting the testing (see 9.2.4).

7.5 If testing the durability of finishes or evaluating wicking properties after laundering, take specimens as described in 7.4 from fabric swatches that have been laundered according to conditions chosen from the AATCC LPI.

8. Conditioning

8.1 Prior to testing, condition the specimens as directed in ASTM D1776, Standard Practice for Conditioning and Testing Textiles (see 13.4). Condition specimens for at least 4 h in an atmosphere of $21 \pm 2^\circ\text{C}$ ($70 \pm 4^\circ\text{F}$), $65 \pm 5\%$ RH by laying each test specimen separately on a screen or perforated shelf of a conditioning rack.

8.2 Perform all tests in the standard atmosphere for testing.

9. Procedure

9.1. If necessary, the surface tension of the chosen liquid (including tinted water or dye solution) should be measured as directed in ASTM D1331-89, Standard Test Methods for Surface and Interfacial Tensions of Solutions of Surface-Active Agents (see 13.4) and reported.

9.2 Option A—Measure time at a given distance.

9.2.1 Using a marking pen with soluble ink, mark a line across the end of each specimen at a distance of 5 ± 1 mm from the end on the fabric side to be tested. The 5 mm line denotes the level to which a specimen is to be lowered into the water in the flask or beaker which is the test start time.

9.2.2 Using a marking pen with soluble ink, measure from the 5 ± 1 mm line, and mark lines across the width of the specimen at distances of 20 ± 1 and 150 ± 1 mm (see Fig. 1). To facilitate the measurement of wicking distances, intervals of 10 ± 1 mm may be marked along the specimen length between the 20 ± 1 mm and 150 ± 1 mm lines.

9.2.3 Alternative wicking distances may be used depending on the desired end use of the fabric. When comparing results, the same wicking distance benchmarks should be used.

9.2.4 To determine the amount of water for the test, use the extra specimen and position it at the opening of an Erlenmeyer flask (which may be placed on a scissor jack) by the insertion of a straight pin or other device near the end of the specimen (see Fig. 2). Allow the specimen to hang into the flask. Add water up to the level at which the specimen's 5 ± 1 mm line is reached and then mark the required water level on the outside of the flask. Special care should be taken to insure that the lip and the neck of the flask remain dry to prevent premature bleeding

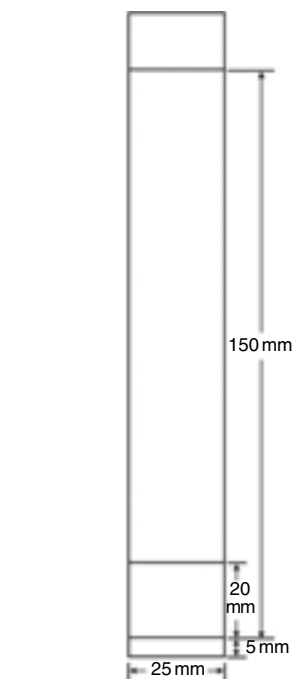


Fig. 1—Vertical wicking specimen and marking.

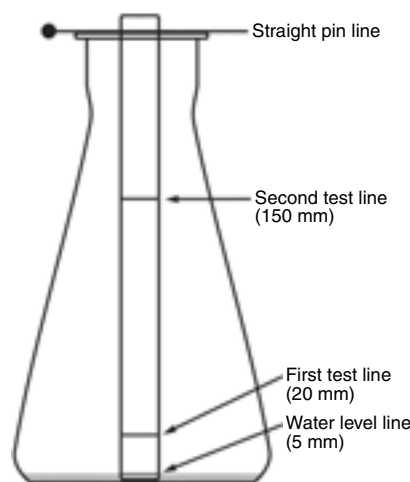


Fig. 2—Vertical alignment test configuration.

of soluble ink marks on the specimen.

9.2.5 Some light weight woven, knitted, or hydrophobic fabrics may float on the water, in which case, a small paper clip or clamp may be attached to the end of the specimen that is to be submerged. If a paper clip or clamp is used, it should be noted in the report (see 11.1.1).

9.2.6 Fill the flask with distilled or deionized water to the line marked as instructed in 9.2.4. Insert the specimen into the flask, or raise the scissor jack to position the specimen so that the water is at the 5 ± 1 mm line.

9.2.7 Alternatively, the approximate

amount of water required may be added to a flask as instructed in 9.2.4 for determining and marking a water level fill line on the outside of a flask. After a specimen is suspended in the flask, a pipette can be used to raise the water level to the appropriate height.

9.2.8 Use a clean flask with fresh water for testing subsequent samples.

9.2.9 Start stopwatch or timer as soon as the water reaches the 5 ± 1 mm line and the soluble ink begins to migrate upwards. Monitor the rise of the water. Record the time, to the nearest second, that it takes for the soluble ink at the marked 20 ± 1 mm line to start to migrate. Continue monitoring the rise of the water and record to the nearest second the time and distance that the test was terminated.

9.2.10 The test should be terminated if the water does not wick to either the 20 ± 1 mm line in 5.0 ± 0.1 min or if the total time of the water to wick to the 150 ± 1 mm line exceeds 30.0 ± 0.1 min. In either case, measure the distance the water has migrated and the time that the test was stopped. Record the time and distance and the reason for termination of the test.

9.2.11 Remove the specimen from the flask.

9.2.12 Repeat steps 9.2.2 through 9.2.11 for the remaining specimens.

9.3 Option B—Measure distance at a given time.

9.3.1 Place a ruler vertically against the back of the elongated pan (see Fig. 3) inside the box so that the ruler touches the bottom. Fill the elongated pan with distilled or deionized water to a depth of 38 ± 2 mm (1.5 ± 0.1 in.) water.

9.3.2 Remove the ruler from the back of the pan. Secure the ruler with tape on the outside of the pan so that the top of the water surface is at the “0” mm mark on the ruler.

9.3.3 Use double-sided tape to secure a specimen to the top of the box so that the bottom edge just touches the top surface of the water (same as the “0” mm mark on the ruler) and start the stopwatch or timer immediately.

9.3.4 Some light weight woven, knit-



Fig. 3—Multiple specimen elongated pan.