

Test Method for Horizontal Wicking of Textiles

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. While, traditionally, wicking tests measured the movement of liquids through the vertical plane of fabrics (commonly referred to as vertical wicking), (see AATCC TM197, Test Method for Vertical Wicking of Textiles), the improvements in the last decade have also led to an interest in measuring the movement of liquids across the horizontal plane of fabric surfaces (horizontal wicking). 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 and horizontal 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 14.1). This test method is based on the testing procedures for wicking published in those Technical Supplements.

1. Purpose and Scope

1.1 This test method is used to evaluate the ability of horizontally 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 (area per unit of time) liquid travels 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 14.3).

3.2 **horizontal wicking**, n.—in textiles, the movement of liquid across the horizontal plane of a textile from a site where a specific volume has been applied.

3.3 **horizontal wicking rate**, n.—the change in the area of the liquid with respect to time as the liquid travels 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 This method is primarily applicable to fabrics that absorb the full volume of the test liquid, without pooling on the surface or allowing dripping. If the full volume of the test liquid is not available to measure the wicking rate, inconsistent results should be expected. Hence, the results obtained on fabrics that fully absorb the test liquid cannot be compared with those obtained on fabrics that do not. In addition, the movement of liquid within a fabric may be influenced by fiber content, fabric construction, mechanical or chemical processing or a combination of these.

5.2 This method evaluates the wicking ability of horizontally aligned test specimens to distilled or deionized water. In this test, wicking may be influenced by the properties of the test liquid, but not by gravity.

5.3 Liquids other than distilled or

deionized water (tinted water, dye solutions, etc.) may be used to evaluate the wicking of textiles. 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 liquid more clearly visible.

5.5 The results obtained by this test are not a measure of comfort which is beyond the scope of this method.

5.6 The relationship between vertical and horizontal wicking test results is not known. Caution should be used when comparing results using different alignments.

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 14.2).

6.3 Stopwatch or digital timer.

6.4 Tape or ruler, mm graduations.

6.5 Surface tensiometer, if using liquid other than water (see 10.1).

6.6 Beaker or Petri dish.

6.7 Burette, 10 (± 0.05 mL) mL with 0.5 mL numbered graduations that allows a delivery rate of 15-25 drops per milliliter, or handheld electronic pipette.

6.8 Embroidery hoop, 152 ± 5 mm (6.0 ± 0.2 in.) diameter (see 14.1).

6.9 Laboratory sealing film (optional).

6.10 Ring stand and clamp.

6.11 Template, 100 ± 3 mm diameter.

7. Sampling

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 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. Each specimen shall be taken so that different sets of length and width yarns are present.

8. Specimens

8.1 Cut five specimens, $200 \times 200 \pm 5$ mm, aligned with the fabric selvage or longitudinal alignment of the garment panels. For testing horizontal wicking of garment samples, it may not be necessary to cut out individual specimens.

8.2 Cut an extra specimen from either fabric or garment samples to determine placement of the drop in the center of the marked circle before starting the testing (see 10.2).

8.3 If testing the durability of finishes or evaluating wicking properties after laundering, take specimens as described in 8.1 from fabric swatches that have been laundered according to conditions chosen from the AATCC LP1.

9. Conditioning

9.1 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 prior to testing according to ASTM D1776, Standard Practice for Conditioning and Testing Textiles (see 14.3).

9.2 Perform all tests in the standard atmosphere for testing.

10. Procedure

10.1 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 14.3) and reported.

10.2 Use a template and a fine-point marking pen with soluble ink to mark a 100 ± 3 mm diameter circle in the middle of each specimen. Mark the circle on the side of the fabric to be tested. The placement of the water volume for the test is to be in the center of the circle (see Fig. 1).

10.3 Fill a 10.0 mL burette with distilled or deionized water and lower the water level to the top graduation level, sighting to the bottom of the meniscus.

10.3.1 Insert a trial specimen into an embroidery hoop, ensuring that its surface is taut, without creases or wrinkles. Place the embroidery hoop horizontally on the top of the beaker or Petri dish. Lower the burette so that the tip is 10 ± 1 mm above the fabric surface. Slowly open the burette stopcock to verify that 1.0 ± 0.1 mL volume of water can be dispensed into the center of the marked circle. Determine (and record) the approximate position of the stopcock opening that ensures a consistent delivery of the test liquid, i.e., the position that permits delivery of the specified number of drops of the test liquid in 10 ± 2 s. Discard the trial specimen.

10.4 Insert test specimen into the embroidery hoop with the chosen fabric side to be tested facing up for exposure to the water. The use of laboratory sealing film on the embroidery hoop ring surfaces may be utilized to prevent slippage of light weight fabric and help maintain a taut fabric surface.

10.5 Open the stopcock, to the position

determined in 10.3.1, and dispense 1.0 ± 0.1 mL of water from the 10 ± 1 mm height onto the center of the 100 ± 3 mm marked circle. A handheld electronic pipette may be used instead of a burette but the same height of 10 ± 1 mm from the fabric surface should be maintained. Immediately after opening the stopcock or pressing the dispense button, start the timer. The test should be terminated when the water reaches the 100 ± 3 mm circle. Record the distance the liquid has spread in the length and width direction of the fabric and the time elapsed.

10.6 The test should be terminated if the water stops migrating and does not reach the 100 ± 3 mm circle in 5 ± 0.1 min. Record the time that the test was terminated.

10.7 Repeat steps 10.4-10.6 for each remaining specimen.

11. Calculation

11.1 Record the time to the nearest second for each specimen.

11.2 Calculate the horizontal wicking rate for each specimen and the average wicking rate for each sample. Use formula 1 below for the calculation of horizontal wicking rate:

$$W = \pi(1/4)(d_1)(d_2)/t \quad (\text{Eq. 1})$$

where:

W = wicking rate, mm²/s

d_1 = wicking distance in length direction, mm and d_2 = wicking distance in width direction, mm

t = wicking time, s

11.3 The wicking rate can be calculated from either the time it takes to reach the edge of the circle or the distance traveled in the 5.0 ± 0.1 min time period.

12. Report and Interpretation

12.1 Report the wicking time, the wicking distance in the length and width direction, and the average wicking rate for each sample. Report any dripping or pooling of test liquid.

12.2 Report if a solution other than distilled or deionized water at $21 \pm 2^\circ\text{C}$ ($70 \pm 4^\circ\text{F}$) was used and its surface tension and temperature.

12.3 Report if testing was performed after laundering, the laundering conditions used and the number of launderings completed.

12.4 Shorter horizontal wicking times indicate faster wicking (see 5.1 and 5.5).

13. Precision and Bias

13.1 Precision.

13.1.1 *Interlaboratory Study.* Tests for wicking of textiles using horizontal orientations were conducted in 2009, with

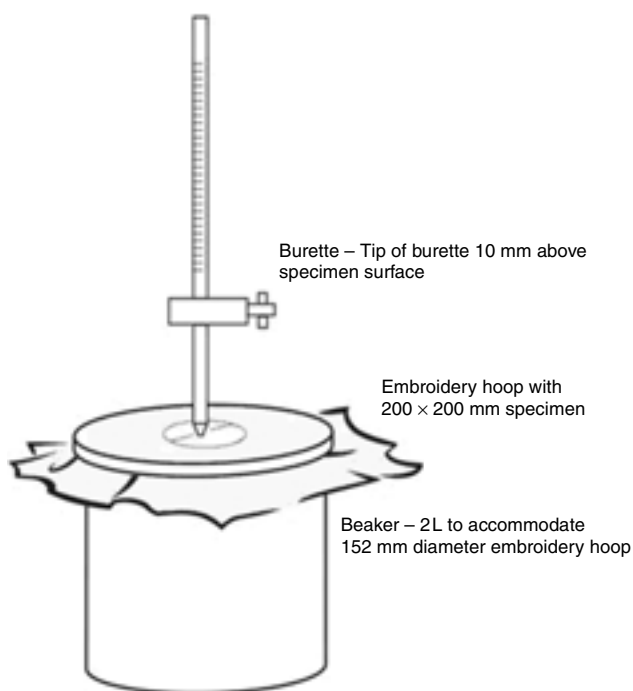


Fig. 1—Horizontal alignment test configuration.