Drying Time of Textiles: Moisture Analyzer Method

Developed in 2011 by AATCC Committee RA63; revised 2012, 2013.

Foreword

Historically, the textile industry has utilized many different test procedures for determining the drying characteristics of textile fabrics, whether those characteristics are drying rate, time or some other drying parameter. Within the last decade, the industry has developed new technologies that have resulted in an improvement in these characteristics, as one of many attributes associated with the use of the term "moisture management." Many interested groups (textile manufacturers, chemical suppliers, retailers, as well as independent testing laboratories) participated in the effort to develop and publish standard test methods to measure the drying characteristics of fabrics. Unofficial techniques for determining the drying properties of textile fabrics were published in the 2008 AATCC/ASTM International's *Moisture Management Technical Supplement: Applicable to Apparel, Linens and Soft Goods*. This test method formalizes an additional technique that has been used by several companies.

1. Purpose and Scope

1.1 This test method is intended to evaluate the drying time of knit, woven or nonwoven fabrics at an elevated temperature using a gravimetric moisture analyzer. By performing the test at non-standard textile testing conditions, it is possible to simulate drying at body temperature or to perform testing at temperatures that simulate conditions of use.

2. Principle

2.1 Water is applied to the test specimen and then dried at a pre-selected temperature (37° ± 2°C [99 ± 4°F]; if an alternative temperature is used it should be reported), in an automated moisture analyzer. The time required for a test specimen to reach a designated endpoint is measured and recorded as the drying time.

3. Terminology

3.1 **drying rate,** n.—the change in volume per unit time of a liquid that evaporates from a textile.

NOTE: Drying rate is dependent upon textile construction, fiber content, apparel construction, finishes, the atmosphere in which the test is performed, and the volume challenge of the liquid.

3.2 **drying time,** n.—the time it takes for a specified amount of liquid to evaporate from a textile under controlled testing conditions.

NOTE: In this test method the amount of water is determined in a preparatory step so that the specimen is wet-out to a given level. The testing conditions are controlled by the analyzer.

3.3 **endpoint,** n.—the point of termination of a drying test that is either to the original dry weight of a specimen or some other agreed value such as dry weight +4.0% moisture content.

3.4 **moisture retention,** adj.—*for this test method*, the percent moisture retention of the specimen after being submerged in deionized water for 1 min, and hanging vertically for 5 min in a controlled environment (see 9.3.2 and formula 1).

3.5 **test side,** n.—the side, either the face or back of a specimen, which is uppermost when placed on the moisture balance analyzer support platform; the side onto which the test volume of water is applied.

3.6 **weight loss,** n.—the difference between the saturated weight of a specimen and the weight after drying.

3.7 **wet pick-up,** n.—*in textile processing*, the amount of liquid, and material carried by the liquid, applied to 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 users' 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 manufacturers' 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 drying of a fabric may be influenced by fiber content, fabric construction (e.g., thickness or raised surface, such as fleece), mechanical or chemical processing or a combination of these aspects.

5.2 Other factors that may influence drying include the temperature and humidity conditions of the test and the amount of liquid to be dried. This test method is performed in non-standard textile testing conditions. Since this test can be performed at various temperature settings of the moisture analyzer, test temperatures can be selected to simulate the temperature of a human body at rest, during exercise, or when exposed to outdoor temperatures.

5.3 This method is based on the application of a controlled amount of water to test specimens, measurement of the drying rate of that application, and calculation of the moisture retention based on that application.

5.4 This method is limited to fabrics with at least one side that exhibits an absorbency time within 30 ± 2 s (see AATCC TM 79, Absorbency of Textiles). It is not applicable to fabrics that exhibit an absorbency of more than 30 s, as in such fabrics water would begin evaporating from the surface of the fabric as the temperature is being raised, thereby skewing the results.

5.5 One possible use of this method is to compare the moisture retention characteristics of untreated versus treated fabrics, or to compare the moisture retention characteristics of a textile material with or without an additive.

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 drying time measured by this test and absorbency has not been defined. Although AATCC TM 79 is used in the preparatory steps to determine which side of a fabric should be used in testing, this test does not measure absorbency.

6. Apparatus and Materials

6.1 Moisture analyzer with a ceramic heating element and accurate to at least 0.001 g (see 14.1).

6.2 Deionized water.

6.3 Vertical specimen stand. The stand should have a horizontal hanger of suitable size to hang the specimen using binder clips. (see Fig. 2).

6.4 Tweezers.

6.5 400 mL beaker.

6.6 Wire screen—standard 0.25 × 0.25 in. mesh (see 14.2).

6.7 Specimen support platform (see Fig. 3).

6.8 Electronic motorized pipette with 2.5 mL tip, and a dispensing speed of 4 mL/min (see 14.1).

6.9 Computer with software for data capture (optional).

7. Specimens

7.1 Cut ten 70 ± 1 mm round specimens diagonally across the width of a sample, to ensure that different sets of length and width yarns are in each specimen or from different sites from a product are taken. If the sample being tested is not large enough to cut ten 70 ± 1 mm diameter specimens across the width, it is acceptable to test a smaller specimen size, but must be reported with the test results. Two of the specimens are to be used for the preliminary steps, and eight are for the testing (see Section 9).

8. Conditioning

8.1 Place the specimens on a flat smooth, horizontal surface without tension before testing. Condition them to moisture equilibrium in a standard atmosphere for testing according to ASTM D1776, Standard Practice for Conditioning and Testing Textiles, Table I, Textiles, General (see 14.3).

9. Preparation

9.1 Turn on the moisture analyzer to 37 ± 2°C (99 ± 4°F) and allow it to warm up for at least 30 min.

9.2 Using AATCC TM 79, place a drop of water on the face of an extra fabric specimen to judge absorbency; on the back of another extra specimen, repeat to determine which is the most absorbent side to use for testing. If there is no difference, either side can be used for testing by this method. If both sides of the specimen have absorbency times greater than 30 s, see 5.4.

9.3 Weigh and record the original weight (W_1) of the specimen. Submerge the specimen in water, as shown in Fig. 1.

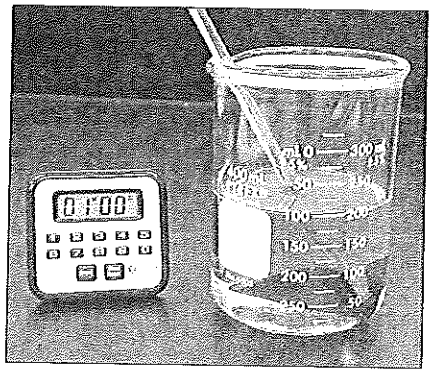

Fig. 1—Submersion of specimen in water.

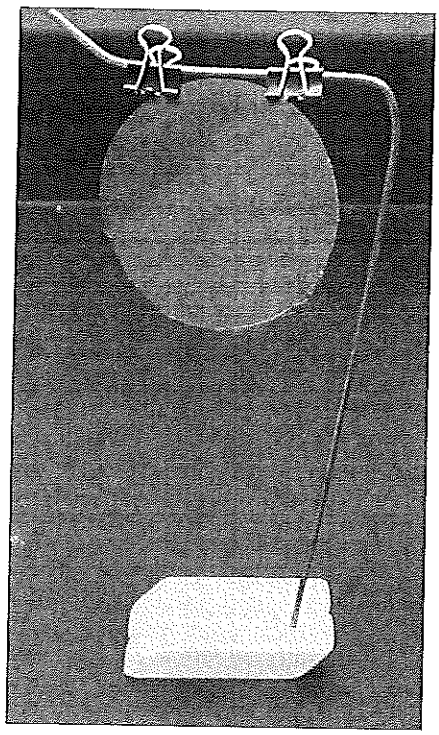

Fig. 2—Vertical specimen stand.

9.3.1 Using tweezers, remove the specimen after 1 min and hang on the vertical stand, as shown in Fig. 2.

9.3.2 After 5 min, remove the specimen with tweezers. Weigh and record the specimen weight (W_2). Use formula 1 to determine the moisture retention.

$$\text{Moisture Retention (\%)} = \frac{W_2 - W_1}{W_1} * 100 \qquad (1)$$

where:

W_1 = dry weight, in g
W_2 = saturated weight, in g

Use formula 2 to determine the amount of water to add to the fabric:

$$y = x * W_1 \qquad (2)$$

where:

y = amount of water to add, in mL
x = moisture retention (see result of formula 1)
W_1 = dry weight, in g

NOTE: This equation assumes the density of water is 1 g/mL at 25°C (77°F).

9.4 Set the electronic motorized pipette to pickup and dispense the calculated amount of water determined in 9.3. This amount will be used for all specimens from a sample without regard to variation in weight of individual specimens from the same sample.

9.5 Follow the manufacturer's instruction for setting the program operation.

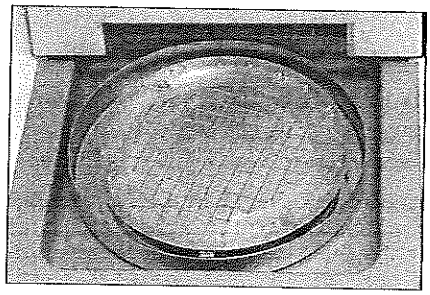

Fig. 3—Specimen support platform.

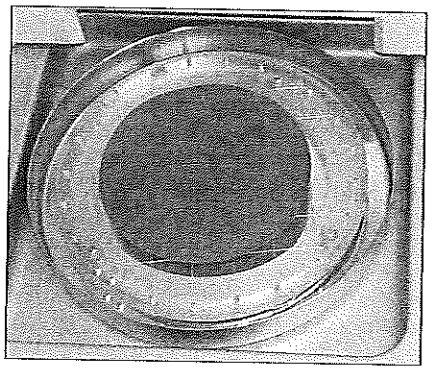

Fig. 4—Placement of specimen on support platform.

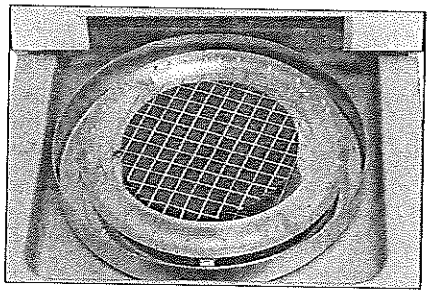

Fig. 5—Placement of wire screen on top of specimen.

The test endpoint should be agreed upon by interested parties.

10. Procedure

10.1 Open the sample chamber and place the support platform and wire screen in the sample chamber (as shown in Fig. 3).

10.2 Tare the moisture analyzer. Place the specimen with the selected test side up on the support platform (see Fig. 4).

10.3 Using an electronic motorized pipette, apply the specified amount of deionized water in a uniform manner over the surface of the specimen.

10.4 Place the wire screen on top of the specimen (see Fig. 5) and start the ana-

lyzer and software (if applicable). The moisture analyzer or the software will automatically terminate the test when the selected endpoint is reached.

10.5 Repeat 10.1-10.4 for remaining specimens.

10.6 Record the drying time to the nearest minute for each specimen.

11. Calculations and Evaluation

11.1 Calculate the average drying time and the standard deviation for the sample.

12. Report

12.1 Report moisture retention, average drying time and standard deviation, amount of water applied, temperature, and the end point.

12.2 If the specimens tested were not 70 ± 1 mm in diameter, report the specimen diameter used.

13. Precision and Bias

13.1 *Precision.* Tests for drying time of textiles using a moisture analyzer were conducted in 2010, with one laboratory, two operators, and five samples. The five samples used in this study were (a) 100% cotton interlock knit, (b) 100% polyester twill weave, (c) 100% cotton jersey knit, (d) 65/35 polyester/cotton blend woven, and (e) 100% polyester interlock knit.

13.2 *Table I Statistical Summary.* Data includes mean drying time, standard deviation and the 95% confidence level for both operators.

13.3 *Between-laboratory* precision has not been established for this test method. Until such precision information is available, users of the method should use standard statistical techniques in making any comparison of test results for *between-laboratory* averages.

13.4 *Bias.* The true value of the drying time of textile fabrics can be defined only in terms of a test method. There is no independent method for determining the true value. In estimating this property, the test method has no known bias.

Table I—Statistical Summary Data

	Operator 1			Operator 2		
Drying Time by Fabric	Mean Drying Time, min	Std Dev	95% CI	Mean Drying Time, min	Std Dev	95% CI
A	147	4.7	3	158	5.2	4
B	115	4.2	3	121	4.5	3
C	73	2.5	2	78	2.6	2
D	28	1.7	1	28	1.3	1
E	85	1.8	1	93	3.5	2

14. Notes

14.1 These items may be obtained from any lab equipment supplier.

14.2 This item may be obtained from any hardware or home improvement store.

14.3 Available from ASTM International, 100 Barr Harbor Dr., W. Conshohocken PA 19428; tel: +1.610. 832.9500; fax: +1.610.832. 9555; web site: www.astm.org.