

# Test Method for Water Repellency: Tumble Jar Dynamic Absorption

## 1. Purpose and Scope

1.1 This test method is applicable to any textile fabric, which may or may not have been given a water-resistant or water-repellent finish. It measures the resistance of fabrics to wetting by water. It is particularly suitable for measuring the water-repellent efficacy of finishes applied to fabrics, because it subjects the treated fabrics to dynamic conditions similar to those often encountered during actual use. It is not intended for use in predicting the probable rain penetration resistance of fabrics, since it measures absorption of water into, but not through, the fabric.

1.2 The results obtained with this test method depend primarily on the resistance to wetting or water repellency of the fibers and yarns in the fabric, and not upon the construction of the fabric.

## 2. Principle

2.1 Prew weighed specimens are tumbled in water for a fixed period of time and are reweighed after the excess water has been removed from them. The percentage increase in mass is taken as a measure of the absorption or resistance to internal wetting.

## 3. Terminology

3.1 **absorbency**, *n.*—the propensity of a material to take in and retain a liquid, usually water, in the pores and interstices of the material.

3.2 **water repellency**, *n.*—*in textiles*, the characteristic of a fiber, yarn or fabric to resist wetting.

## 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.

4.2 Observe wringer safety especially at nip points. Normal safeguards should not be removed. A foot-operated kickoff

is recommended.

4.3 The manufacturer's safety recommendations should be followed when operating laboratory testing equipment.

## 5. Apparatus and Materials (see 11.1)

5.1 Dynamic Absorption Tester (see Fig. 1 and 11.2).

5.2 Wringer (motor-driven) (see 11.3).

5.3 Laboratory balance, accurate to 0.1 g.

5.4 White AATCC Textile Blotting Paper, 25 × 25 cm (see 11.4).

5.5 Water, distilled.

5.6 Plastic container, or gallon "zipper" type plastic bag.

## 6. Test Specimens

6.1 The fabric samples and the blotting paper should be conditioned at  $65 \pm 5\%$  RH and  $21 \pm 2^\circ\text{C}$  ( $70 \pm 4^\circ\text{F}$ ) for a minimum of 4 h before testing.

6.2 Test two specimens from each sample. Each specimen consists of five  $20 \times 20$  cm pieces cut on a  $0.79$  rad ( $45^\circ$ ) bias. Remove loose corner yarns and spread a drop of liquid latex or rubber cement on yarns at the corner to prevent raveling. Mark a corner of each piece of specimen for identification as a part of the specimen set.

## 7. Procedure

7.1 Rinse the tumble jar of the Dynamic Absorption Tester thoroughly to free it from all extraneous matter, particularly soaps, detergents and wetting agents.

7.2 Roll together the five pieces of each specimen (constituting a specimen set) and weigh to the nearest 0.1 g.

7.3 Pour 2 L of distilled water at  $27 \pm 1^\circ\text{C}$  ( $80 \pm 2^\circ\text{F}$ ) in the tumble jar of the Dynamic Absorption Tester. Put both specimen sets (see 11.5) into the jar, one piece at a time, and rotate for 20 min.

7.4 Remove a piece of one specimen immediately passing it through the wringer at a rate of 2.5 cm/s with the edge of the piece parallel to the rolls and then sandwich the specimen between two pieces of unused blotter paper and pass it through the wringer again. Leave the piece sandwiched in the wet blotters. Repeat this process for the remaining four pieces of the same specimen set. Then remove the blotters and roll the five pieces together, put them in a tared plastic container or gallon-sized zippered plastic bag, close the container and weigh the wet specimen set to the nearest 0.1 g. The mass of the wet specimen should not be more than twice its dry mass.

7.5 Repeat 7.4 for the second specimen.

## 8. Calculations

8.1 Calculate the water absorbed for each specimen to the nearest 0.1% using the following equation:

$$WA = (W - C)/C \times 100$$

where:

$WA$  = water absorbed, %

$W$  = wet specimen weight, g

$C$  = conditioned specimen weight, g

8.2 Calculate the dynamic absorption of the fabric sample by averaging together the water absorbed by each of the two specimens.

## 9. Report

9.1 Report the average of the two specimens as the percent of water absorbed by the fabric.

9.2 Report the test method number.

## 10. Precision and Bias

10.1 *Precision.* In 1998, a limited intralaboratory study was completed. All samples were tested by the same operator.

10.1.2 Four sets of fabrics were analyzed. There was no statistical difference found between the sets of data, thus precision parameters were calculated on the pooled data.

10.1.3 Users of the method are advised of the limited nature of this study and ad-



Fig. 1—Dynamic absorption tester.

vised to apply these findings with due caution.

10.1.4 Analysis of the combined data yielded a repeatability standard deviation of 1.8, and components of variance and critical differences as displayed in Table I. Differences between two averages of (*N*) determinations, for the appropriate precision parameter, should reach or exceed the table value to be statistically significant at the 95% confidence level.

**Table I—Components of Variance and Critical Differences**

| Det in Avg ( <i>N</i> ) | 95% Confidence Interval | Critical Differences |
|-------------------------|-------------------------|----------------------|
| 2                       | + 16.2                  | 32.4                 |
| 3                       | + 4.5                   | 9.0                  |
| 4                       | + 2.9                   | 5.8                  |
| 5                       | + 2.2                   | 4.4                  |

10.2 *Bias*. Dynamic absorption of fabrics can only be defined in terms of a test method. There is no independent, referee method for determining the true value. This test method has no known bias.

## 11. Notes

11.1 For potential equipment information pertaining to this test method, please visit the online *AATCC Buyer's Guide* at [www.aatcc.org/bg](http://www.aatcc.org/bg). AATCC provides the possibility of listing equipment and materials sold by its Corporate members, but AATCC does not qualify, or in any way approve, endorse or certify that any of the listed equipment or materials meets the requirements in its test methods.

11.2 The Dynamic Absorption Tester (see Fig. 1) should consist of a motor driven, 6 L cylindrical or hexagonal-shaped jar approximately 15 cm in diameter and 30 cm in length, mounted to rotate end over end at  $55 \pm 2$  rpm

with a constant tangential velocity. The jar may be of glass, corrosion-resistant metal, or chemical stoneware.

11.2.1 The revolutions per min of the tumble jar should be determined by counting the number of revolutions in 1 min using a stopwatch calibrated in intervals of not more than 1 s.

11.3 The wringer, household laundry type, should be equipped with soft rubber squeeze rolls 5.1-6.4 cm in diameter and 28.0-30.5 cm in length, with a hardness of 70-80 when measured using the A Scale of a Shore Durometer. The wringer should be so constructed that the pressure on the top of the piece of fabric is maintained by a dead weight or lever system such that the total pressure (resulting from the total of the dead weight or lever system and the weight of the roller) is  $27.2 \pm 0.5$  kg. It should be power-driven at a constant rate so that the piece of fabric passes through the rolls at a rate of 2.5 cm/s.

The diameters of the squeeze rolls should be determined with a pair of calipers or directly with a suitable micrometer. Measurements should be made at five different places along the length of each roll, and the average of these measurements taken as the diameter of the roll.

The load applied by the dead weight or lever system should be measured using a spring scale or balance, and suspending the top roll of the wringer from the scale by means of two tapes of equal length. The tapes should be placed between the rolls near their ends and should be provided with a means of holding them sufficiently far apart so that there is no contact between the tapes and the top structural member of the wringer and loading system. The spring scale or balance should be suspended from a suitable rigid support and provided with a turnbuckle or other device for adjusting the height of the scale. The usual precautions concerning the zero correction of spring scales should be observed. The turnbuckle or other device should then be adjusted to place the weight of the top roll and its weighing system on the spring scale or balance, and the system should be considered to

be in equilibrium when the top roll of the wringer has been lifted just sufficiently from the bottom roll to permit vision between the bottoms of the tapes and the top of the bottom roll. At this point, the dead weight on the loading system should be adjusted until the spring scale or balance indicates a load of  $27.2 \pm 0.5$  kg. The calibration of the spring scale or balance should be verified by the use of known certified dead weights of 24.95, 27.22 and  $29.48 \text{ kg} \pm 0.23 \text{ kg}$  total weight. The spring scale should be accurate to within  $\pm 0.2268 \text{ kg}$  at each of the three verification loads.

The linear speed of the rolls should be measured by feeding a thin steel tape through the rolls. The steel tape should be at least 150 cm long and should be accurate to within 3 mm per 150 cm. The time required for exactly 150 cm of this tape to pass through the nip of the rolls should be measured in s to the nearest s with a stopwatch calibrated in intervals of not more than 0.5 s. The speed of the rolls should be adjusted until the time required for 150 cm of tape to pass through the nip of the roll is  $60 \pm 2$  s.

11.4 Blotters suitable for this test can be obtained from AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: +1.919.549.8141; fax: +1.919.549.8933; e-mail: [ordering@aatcc.org](mailto:ordering@aatcc.org); web site: [www.aatcc.org](http://www.aatcc.org).

11.5 Should it be necessary to run only one specimen, a specimen of similar material with respect to weight should be run as ballast with the specimen undergoing test. The cloth in the jar during any run should be the equivalent of two specimens (10 pieces).

## 12. History

12.1 Reaffirmed 2020.

12.2 Revised 2015, 2000, 1997, 1961. Reaffirmed 2014, 2010, 1989, 1988, 1983, 1978, 1975, 1972, 1967, 1964. Editorially revised and reaffirmed 2005, 1994. Editorially revised 2019, 2016, 2009, 2008, 1986, 1985.

12.3 Developed in 1952 by AATCC Committee RA63. Technically equivalent to ISO 18696.