Test Method for Water Resistance: Hydrostatic Pressure

Developed in 1968 by AATCC Committee RA63; reaffirmed 1971, 1974, 1977, 1980, 1989, 2003, 2013, 2018; editorially revised 1982, 1986, 2006, 2016, 2019; editorially revised and reaffirmed 1985, 2008; revised 1995, 1998, 2014, 2017. Related to ISO 811.

1. Purpose and Scope

1.1 This test method measures the resistance of a fabric to the penetration of water under hydrostatic pressure. It is applicable to all types of fabrics, including those treated with a water resistant or water repellent finish.

1.2 Water resistance depends on the repellency of the fibers and yarns, as well as the fabric construction.

1.3 The results obtained by this method may not be the same as the results obtained by the AATCC methods for resistance to rain or water spray.

1.4 This test method is performed without a restraint. If a restraint is required, use AATCC TM208, Test Method for Water Resistance: Hydrostatic Pressure Using a Restraint.

2. Principle

2.1 One surface of the test specimen is subjected to a hydrostatic pressure, increasing at a constant rate, until three points of leakage appear on its other surface. The water may be applied from above or below the test specimen.

2.2 This test is performed without a restraint.

3. Terminology

3.1 **hydrostatic pressure,** n.—the force distributed over an area exerted by water.

3.2 **water resistance,** n.—*of fabric*, the characteristic to resist wetting and penetration by water.

3.3 **water repellency,** n.—*in textiles*, the characteristic of 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 Manufacturer's safety recommendations should be followed when operating laboratory testing equipment.

5. Apparatus and Materials (see 11.1)

5.1 Hydrostatic Tester.

5.1.1 For Option 1, Hydrostatic Pressure Tester (see 11.2).

5.1.2 For Option 2, Hydrostatic Head Tester (see 11.3).

5.2 Water, distilled or de-ionized.

6. Test Specimens

6.1 A minimum of three fabric specimens should be taken diagonally across the width of the fabric to be representative of the material. Cut specimens at least 200 × 200 mm to allow proper clamping.

6.2 Handle the specimens as little as possible and avoid folding or contaminating the area to be tested.

6.3 Condition the test specimens at 21 ± 2°C (70 ± 4°F) air at 65 ± 5% RH for at least 4 h before testing.

6.4 The surface of the fabric to be exposed to water must be specified because different results may be obtained on the face and the back. Identify that surface on a corner of each specimen.

7. Procedure

7.1 Verify the water in contact with the test specimen is regulated at 21 ± 2°C (70 ± 4°F) (see 11.4).

7.2 Dry the clamping surface.

7.3 Clamp the specimen with the surface to be tested facing the water (see 11.5).

7.4 Operation.

7.4.1 Option 1—Hydrostatic Pressure Tester. Turn on the motor, press the lever to raise the overflow device at the rate of 10 mm/s, and close the air vent as soon as water flows from it.

7.4.2 Option 2—Hydrostatic Head Tester. Select the gradient of 60 mbar/min (1 mbar/s), press the start button (see 11.6).

7.5 Disregarding water droplets that appear within approximately 3 mm of the specimen clamping ring, record the hydrostatic pressure at the moment water droplets penetrate the fabric in three different places (see 11.7).

8. Calculation

8.1 Calculate the average hydrostatic pressure for each sample.

9. Report

9.1 Results for each specimen and the average for each sample.

9.2 The material and the side tested.

9.3 Water temperature and type.

9.4 Gradient (rate of increasing water pressure).

9.5 Tester option used.

9.6 Any modification to the method.

10. Precision and Bias

10.1 *Precision*. The test results are tester dependent. Precision statements for each tester are given in 10.2 and 10.3.

10.2 Suter Hydrostatic Pressure Tester (Option 1).

10.2.1 In 1993, a limited interlaboratory study was completed, which included six laboratories, two operators in each, running determinations on three specimens of two fabrics. No prior assessment was made of the relative level of the participating laboratories on performance of the test method.

10.2.2 The two fabrics were at different levels (Fabric 1 approximately 810 mm and Fabric 2 approximately 340 mm), and residual variances of the two fabrics were found to be different. Accordingly, precision is reported separately for each fabric.

10.2.3 Users of the method are advised of the limited nature of this study and advised to apply these findings with due caution.

10.2.4 Analysis of the data sets for each fabric yielded components of variance and critical differences as displayed in Tables I, II and III. 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.

10.3 Hydrostatic Head Tester (Option 2).

10.3.1 In a single-laboratory study, six different laboratory technicians ran determinations on three specimens of five fabrics.

Copyright © 2021 American Association of Textile Chemists and Colorists

Full document details: AATCC TM127 2018

10.3.2 The five fabrics were at different levels of approximately: A=103, B=33, C=37, D=12, and E=77. Data obtained in this study is recorded in millibars (SI standard). The residual variance of the five fabrics were found to be different, therefore, precision is reported separately for each.

10.3.3 Analysis of the data sets for each fabric yielded critical differences as shown in Tables IV, V, VI, VII and VIII. 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.

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

10.4 *Bias*.

10.4.1 Water resistance 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. 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 Hydrostatic Pressure Tester (Suter).

11.2.1 The apparatus consists essentially of an inverted conical well equipped with a coaxial ring clamp to fasten the cloth specimen under the well bottom. The apparatus introduces water from above the specimen over an area 114 mm in diameter and at a rate of 10.0 ± 0.5 mm of hydrostatic head per second. A mirror is affixed below the specimen to enable the operator to ascertain penetration of the specimen by drops of water. A valve is provided for venting the air in the well.

11.2.2 Hydrostatic testing apparatus of the type described is no longer available for sale.

11.3 Hydrostatic Head Tester.

11.3.1 The apparatus applies hydrostatic pressure at 60 mbar/min (selectable) to the bottom side of the fabric. A reservoir with a circular test area of 100 ± 5 cm^2 (15.5 ± 0.8 $in.^2$) contains distilled or deionized water which is applied to the fabric surface. The fabric specimen is secured with a clamp.

11.4 Some laboratories use water at ambient temperature. If water is other than 21 ± 2°C (70 ± 4°F), so state.

11.5 Lateral water leakage can be minimized by sealing the fabric with paraffin at the clamping area.

11.6 1 mbar = 10.2 mm H_2O.

11.7 An automated droplet detection system may be used in place of visual observation of water droplets if it is established that its accuracy is equivalent to visual observation.

Table I—Components of Variance for Two Fabrics (Option 1 Tester)

Component	Variance Fabric 1	Variance Fabric 2
Laboratory	13.450	7.323
Operator	3.127	2.145
Specimen	30.253	5.382

Table II—Fabric 1—Critical Differences—95% Confidence (Option 1 Tester)

Det in Avg (*N*)	Single Operator	Within Laboratory	Between Laboratory
1	15.25	16.02	18.97
2	10.78	11.84	15.61
3	8.80	10.08	14.31
4	7.62	9.06	13.62
5	6.82	8.04	13.19

Table III—Fabric 2—Critical Differences—95% Confidence (Option 1 Tester)

Det in Avg (*N*)	Single Operator	Within Laboratory	Between Laboratory
1	6.43	7.61	10.68
2	4.55	6.10	9.67
3	3.71	5.50	9.30
4	3.22	5.18	9.12
5	2.88	4.98	9.00

Table IV—Material A—Critical Differences—95% Confidence (Option 2 Tester)

Det in Avg (*N*)	Single Operator	Within Laboratory
1	72.49	72.49
2	51.26	51.26
3	41.85	41.85
4	36.25	36.25
5	32.42	32.42

Table V—Material B—Critical Differences—95% Confidence (Option 2 Tester)

Det in Avg (*N*)	Single Operator	Within Laboratory
1	10.08	12.85
2	7.13	9.09
3	5.82	7.42
4	5.04	6.43
5	4.51	5.75

Table VI—Material C—Critical Differences—95% Confidence (Option 2 Tester)

Det in Avg (*N*)	Single Operator	Within Laboratory
1	16.13	16.13
2	11.40	11.40
3	9.31	9.31
4	8.06	8.06
5	7.21	7.21

Documents Document Sharing Hub
Copyright © 2021 American Association of Textile Chemists and Colorists
Full document details: AATCC TM127 2018