# Liquid Moisture Management Properties of Textile Fabrics

**Developed in 2009 by AATCC Committee RA63; reaffirmed 2010.**

## 1. Purpose and Scope

1.1 This test method is for the measurement, evaluation and classification of liquid moisture management properties of textile fabrics. The test method produces objective measurements of liquid moisture management properties of knitted, woven and nonwoven textile fabrics.

1.2 The results obtained with this test method are based on water resistance, water repellency and water absorption characteristics of the fabric structure, including the fabric's geometric and internal structure and the wicking characteristics of its fibers and yarns.

## 2. Principle

2.1 The liquid moisture management properties of a textile are evaluated by placing a fabric specimen between two horizontal (upper and lower) electrical sensors each with seven concentric pins. A predetermined amount of test solution that aids the measurement of electrical conductivity changes are dropped onto the center of the upward-facing test specimen surface. The test solution is free to move in three directions: radial spreading on the top surface, movement through the specimen from top surface to the bottom surface, and radial spreading on the bottom surface of the specimen. During the test, changes in electrical resistance of specimen are measured and recorded.

2.2 The electrical resistance readings are used to calculate fabric liquid moisture content changes that quantify dynamic liquid moisture transport behaviors in multiple directions of the specimen. The summary of the measured results are used to grade the liquid moisture management properties of a fabric by using predetermined indices.

## 3. Terminology

3.1 **absorption rate – ($AR_T$) (top surface) and ($AR_B$) (bottom surface),** n.—the average speed of liquid moisture absorption for the top and bottom surfaces of the specimen during the initial change of water content during a test.

3.2 **accumulative one-way transport capability – (R),** n.—the difference between the area of the liquid moisture content curves of the top and bottom surfaces of a specimen with respect to time.

3.3 **bottom surface – (B),** n.—*for testing purposes*, the side of the specimen placed down against the lower electrical sensor which is the side of the fabric that would be the outer exposed surface of a garment when it is worn or product when it is used.

3.4 **maximum wetted radius – ($MWR_T$) and ($MWR_B$) (mm),** n.—the greatest ring radius measured on the top and bottom surfaces.

3.5 **moisture management,** n.—*for liquid moisture management testing*, the engineered or inherent transport of aqueous liquids such as perspiration or water (relates to comfort) and includes both liquid and vapor forms of water.

3.6 **overall (liquid) moisture management capability (OMMC),** n.—an index of the overall capability of a fabric to transport liquid moisture as calculated by combining three measured attributes of performance: the liquid moisture absorption rate on the bottom surface ($AR_B$), the one way liquid transport capability (R), and the maximum liquid moisture spreading speed on the bottom surface ($SS_B$).

3.7 **spreading speed, ($SS_i$),** n.—the accumulated rate of surface wetting from the center of the specimen where the test solution is dropped to the maximum wetted radius.

3.8 **top surface – (T),** n.—*for testing purposes*, the side of a specimen that, when the specimen is placed on the lower electrical sensor, is facing the upper sensor. This is the side of the fabric that would come in contact with the skin when a garment is worn or when a product is used.

3.9 **total water content – (U) (%),** n.—the sum of the percent water content of the top and bottom surfaces.

NOTE: Total water content measurements may be more accurately termed, "total surface water content" particularly in the case of fabric with cellulosic content. Total water content implies that all water in the specimen is being measured which may be the case with some manufactured fabrics. However, when testing cellulosic fibers, moisture trapped in the interior of the fiber (for example, in the lumen of cotton fibers) will not be included with a specimen's detected surface liquid moisture.

3.10 **wetting time – ($WT_T$) (top surface) and ($WT_B$) (bottom surface),** n.—the time in seconds when the top and bottom surfaces of the specimen begin to be wetted after the test is started.

## 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 This test method focuses on liquid moisture transport in the flat state. The test method may be applicable to the evaluation of fabrics in garments or textile products as they would be exposed to liquid moisture (e.g. perspiration) present on the surface of human skin. It does not measure gaseous moisture transport properties (e.g. water vapor transmission) or tactile properties that also influence human perceptions of comfort.

5.2 Because human perceptions of comfort are influenced by multiple liquid movement properties, as well as ergonomic (garment fit) factors, the use of a single unit of measurement from this test method or any other test method could be misleading as explained in the *AATCC/ASTM International Moisture Management Technical Supplement as Related to Textile Apparel, Linens and Soft Goods* (see 13.1). Consequently, this test method alone will not give an overall rating of the comfort of a garment or textile product. Overall performance schemes, such as the Grading Graph in 9.2.1, should be developed when trying to correlate a combination of absorption, wicking, liquid and vapor movement that can be related to the environment and preferences of fit and style in which the textile product is to be used and worn.

5.3 This method may not be applicable to coated, laminated, or complex fabric constructions. Caution should be used when analyzing fabrics with repellent surface finishes. This method may not be applicable to specimens exhibiting high overall absorbent capacity such as terry cloth or other thick knitted and woven fabrics. Thicker or highly absorbent fabrics may not allow for proper liquid moisture movement to be analyzed using the test solution volume.

5.4 This test method does not measure drying performance directly. Drying performance is inferred based on the area of liquid moisture spreading.

5.5 The wetting times measured in this method may be related to absorbency as measured by AATCC Test Method 79, Absorbency of Textiles (see 13.1).

5.6 The maximum wetted radius defined in 3.4 above should not be used to infer maximum spread areas. As this testing apparatus employs the use of concentric circular rings for measuring wetted radius, for specimens that exhibit non-circular, elliptical or amoeboid spread patterns, the radius may be misrepresented. For example, fabrics with a linear symmetry such as ribbed knits or fabrics with repellent finishes may exhibit irregular spreading patterns.

## 6. Apparatus and Materials

6.1 Moisture Management Tester (MMT) (see 13.2, Figures 1 and 2).

6.2 Computer with MMT software installed.

6.3 Distilled water.

6.4 Sodium chloride solution (0.9% NaCl).

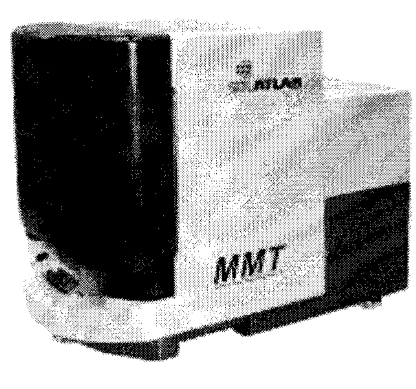


**Fig. 1—Moisture management tester**

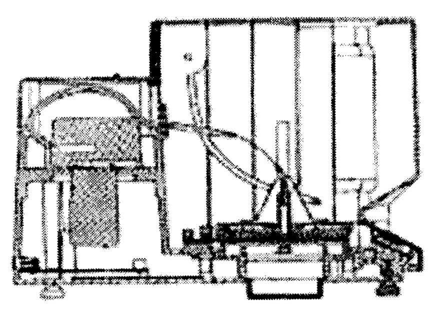

**Fig. 2—A cross-sectional side view of the equipment**

6.5 Conductivity meter.

6.6 White AATCC Textile Blotting Paper (see 13.1) or soft paper towels.

## 7. Test Specimens

7.1 Before cutting specimens, launder the sample(s) according to the conditions selected from the AATCC Monograph "*Standardization of Home Laundry Test Conditions*" (see 13.1) or as agreed between parties. It may be suitable to test a material unlaundered or after repeated launderings. Removal of sizing and/or finishes may affect the liquid moisture management properties of a fabric.

7.2 Cut five 8 × 8 cm specimens, taken 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 on a product.

7.3 Place the specimens on a flat smooth, horizontal surface without tension before testing, to condition them to moisture equilibrium in an environment controlled at 21 ± 1°C (70 ± 2°F) and 65 ± 2% RH as recommended by ASTM D 1776, Standard Practice for Conditioning and Testing Textiles (see 13.4).

## 8. Procedure

8.1 Prepare the test solution by dissolving 9 g sodium chloride (USP Grade) in 1 L of distilled water and adjust its electrical conductivity to 16 ± 0.2 milli Siemens (mS) at 25°C (77°F) by adding sodium chloride or distilled water as necessary. The test solution is used to provide a conductive medium for the instrument's sensors and does not duplicate perspiration.

8.2 Follow the manufacturer's instructions for starting the instrument, addition of the test solution, and the computer software's set up to collect test data.

8.3 Raise the upper sensor to its locked position and place a paper towel on the lower sensor. Press the "Pump" button for 1-2 min until the amount (0.22 cc) of test solution is drawn from the container and drips onto the paper towel and no air bubbles are present inside the tubing. Remove the paper towel.

8.4 Place the conditioned test specimen on the lower sensor with the specimen's top surface up (see 3.8). Release the upper sensor until it freely rests on the test specimen and shut the door of the tester. Confirm that the "Pump-On Time" is set at 20 s to assure the predetermined amount (0.22 cc) of test solution is dispensed. For each specimen, the percent (%) water content point on the graph should be 0.0 at the start of each test to avoid erroneous test results. Set the "Measure Time" for 120 s and start the test. At the end of the 120 s test time, the software will automatically stop the test and calculate all of the indices.

8.5 Raise the upper sensor and remove the tested specimen.

8.6 Before inserting the next specimen, keep the upper sensor in its locked position. Dry between the rings of pins on both upper and lower sensors using White AATCC Blotting Paper or a soft paper towel cut into narrow (0.5 cm) strips. Wait 1 min, or longer, to ensure there is no residual test solution present on the sensors, otherwise any leftover moisture will cause an erroneous start (see 8.4). If salt deposits are observed on the sensors after drying, use distilled water to remove.

8.7 Load a new specimen on top of the lower sensor with the fabric top surface up and repeat steps 8.4-8.6.

8.8 When testing has been completed for the day, use distilled water to clean and purge the pump and tubing.

## 9. Evaluation Measurement Units, Grading, and Classification

9.1 Measurement units – For each sample tested, compile the average values for each measurement unit as follows:

Wetting Time – $WT_T$ (top surface) and $WT_B$ (bottom surface),

Absorption Rate – $AR_T$ (top surface) and $AR_B$ (bottom surface),

Maximum Wetted Radius – $MWR_T$ (top surface) and $MWR_B$ (bottom surface),

Spreading Speed – $SS_T$ (top surface) and $SS_B$ (bottom surface),

Accumulative One-way Transport Capability – (R), and

Overall (liquid) Moisture Management Capability (OMMC).

9.1.1 Formulae used to calculate the units of measurement shown in 9.1 are given in Appendix A.

9.2 Grading – Using the average values from 9.1 and Table I, grade the tested sample(s). The grading developed is based on a study referenced in 13.2 which classifies material moving moisture from the back to the face with higher values.

9.2.1 Table II—Grading Summary Table can be used to summarize and illustrate the liquid moisture management properties of the tested sample(s).

9.2.2 Tables I and II are examples of grading schemes. Other schemes may be developed.

## 10. Report

10.1 Record the average and standard deviations of the measurements listed in 9.1.

10.2 Using the averages, grade the sample according to Table I and summarize using Table II.

10.3 Report the average, standard deviation and grade for each sample or the agreed upon measurements.