Test Method for Colorfastness to Perspiration

1. Purpose and Scope

1.1 This test method is used to determine the fastness of colored textiles to the effects of acid perspiration. It is applicable to dyed, printed or otherwise colored textile fibers, yarns and fabrics of all kinds and to the testing of dyestuffs as applied to textiles.

1.2 Work by Committee RA52 showed this test will correlate with limited field studies. Prior to this there were acid and alkaline tests; however, as a result of these studies the alkaline test was eliminated (see 13.1).

2. Principle

2.1 A specimen of colored textile in contact with other fiber materials (for color transfer) is wet out in simulated acid perspiration solution, subjected to a fixed mechanical pressure and allowed to dry slowly at a slightly elevated temperature. After conditioning, the specimen is evaluated for color change and the other fiber materials are evaluated for color transfer.

3. Terminology

3.1 **colorfastness,** n.—the resistance of a material to change in any of its color characteristics, to transfer of its colorant(s) to adjacent materials or both, as a result of the exposure of the material to any environment that might be encountered during the processing, testing, storage or use of the material.

3.2 **perspiration,** n.—a saline fluid secreted by the sweat glands.

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 Follow good laboratory practices. Wear safety glasses in all laboratory areas.

4.2 All chemicals should be handled with care.

4.3 Observe wringer safety. Normal safe guards on pad should not be removed. Ensure adequate guard at the nip point. A foot operated kick off is recommended for a motorized wringer.

5. Apparatus, Materials and Reagents (see 13.2)

5.1 Perspiration tester (with acrylic plates) (see Figs. 1 and 2).

5.2 Drying oven—convection.

5.3 Balance with a weighing accuracy of ± 0.001 g.

5.4 Cold cut Multifiber test fabric (8 mm [0.33 in.] bands) containing acetate, cotton, nylon, silk, viscose rayon and wool shall be used for specimens containing silk. Multifiber test fabric (8 mm [0.33 in.] bands) containing acetate, cotton, nylon, polyester, acrylic and wool shall be used with specimens with no silk present (see 13.3).

5.5 pH meter accurate to ± 0.01.

5.6 AATCC 9-Step Chromatic Transference Scale (AATCC Evaluation Procedure 8) or Gray Scale for Staining (AATCC Evaluation Procedure 2) (see 13.4).

5.7 Gray Scale for Color Change (AATCC Evaluation Procedure 1 or 7) (see 13.4).

5.8 Wringer.

Fig. 1—Horizontal perspiration tester.

5.9 White AATCC Textile Blotting Paper (see 13.4).

5.10 Acid perspiration solution.

5.11 Petri dish with a depth greater than 1.5 cm and capable of containing a 6 × 6 ± 0.2 cm test specimen

5.12 Un-dyed adjacent fabric

6. Preparation of Reagent

6.1 Prepare the acid perspiration solution by filling a 1 L volumetric flask half full of distilled water. Add the following chemicals and mix to be sure that all chemicals are thoroughly dissolved:

10 ± 0.01 g sodium chloride (NaCl)

1 ± 0.01 g lactic acid, USP 85%

1 ± 0.01 g sodium phosphate, dibasic, anhydrous (Na_2HPO_4)

0.25 ± 0.001 g ℓ-histidine monohydrochloride ($C_6H_9N_3O_2{\cdot}HCl{\cdot}H_2O$)

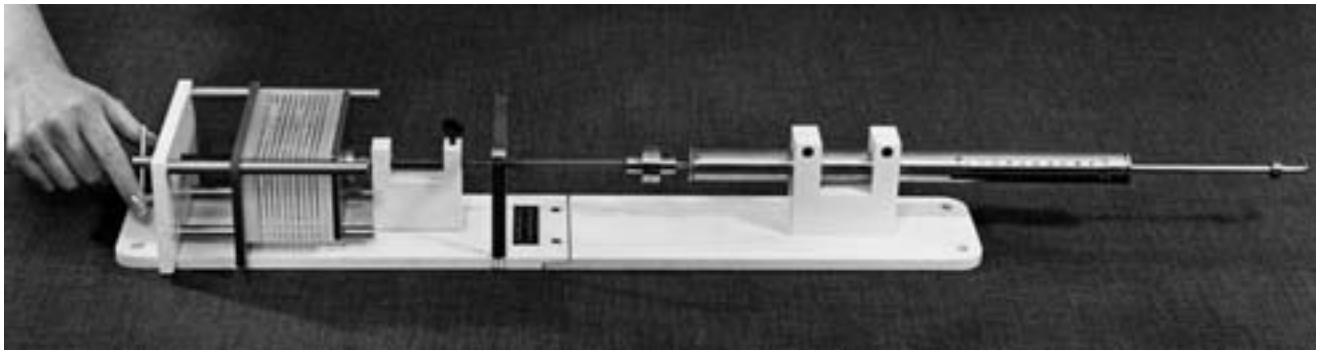

Fig. 2—Vertical perspiration tester.

Fill the volumetric flask with distilled water to the 1 L mark.

6.2 Test the pH of the solution with a pH meter. If it is not 4.3 ± 0.2, discard it and prepare a new one, making sure all ingredients are weighed accurately. The use of pH test paper is not recommended for this purpose because of its lack of accuracy.

6.3 Do not use perspiration solution that is more than three days old (see 13.5).

7. Verification

7.1 Verification checks on the operation of the test and apparatus should be made routinely and the results kept in a log. The following observations and corrective actions are extremely important to avoid incorrect test results.

7.2 Use an in-house perspiration fabric with a mid-range visual grade on the most heavily stained stripe of the multifiber cloth as a calibration specimen and conduct a perspiration test using three specimens. Verification checks should be performed periodically as well as each time a new lot of multifiber or undyed adjacent fabric is used.

7.2.1 Non-uniform color transfer may be due to improper wet-out procedures or may be a result of uneven pressure on the specimens due to warped plates in the tester. Check the wet-out procedures to be sure that the balance is accurate and that the procedure is being carefully followed. Check all plates to be sure they are in good condition and not warped.

8. Test Specimens

8.1 Number and size of specimens.

8.1.1 For fabric testing, one specimen 6 × 6 ± 0.2 cm is needed. Attach a piece of multifiber adjacent fabric measuring 5 × 5 ± 0.2 cm to the face of the specimen by sewing a single seam stitch along one edge of the fabric.

8.1.2 For yarn or loose fiber testing, weigh a 5 × 5 ± 0.2 cm piece of multifiber fabric and a 6 × 6 ± 0.2 cm piece of the un-dyed adjacent fabric together. Then take a mass of the yarn or loose fiber approximately equal to one half of the combined mass of the adjacent fabrics. Place it between the 5 × 5 ± 0.2 cm piece of multifiber fabric and a 6 × 6 ± 0.2 cm piece of the un-dyed adjacent fabric, and sew along all four sides.

8.1.3 Do not use multifiber test fabric that has fused, sealed, or pre-sewn edges because it might have thickness variations at the edges which would cause uneven compression during testing.

9. Procedure

9.1 Weigh each test specimen (as prepared in 8.1) to the nearest 0.1mg. Place each test specimen) in a petri dish. Add freshly prepared perspiration solution to a depth of 1.5 cm in the petri dish. Soak the test specimen in the solution for 30 ± 2 min with occasional agitation and squeezing to ensure complete wetting. For fabrics hard to wet out, alternately wet the specimen and pass it through the wringer until it is completely penetrated by the solution.

9.2 After 30 ± 2 min, pass each test specimen assembly through the wringer with the multifiber stripes perpendicular to the length of the wringer rolls (all stripes go through the wringer at the same time). Weigh each test specimen to be sure it weighs 2.25 ± 0.05 times its original weight. Because certain fabrics may not be able to retain this amount of solution when passing through a wringer, such fabrics may be tested after blotting to the required wet pickup with White AATCC Textile Blotting Paper (see 13.4). To obtain consistent results all specimens of a given construction in a test series should have identical pickup, as the degree of staining increases with the amount of retained solution.

9.3 Place each test specimen assembly on an acrylic plate with the multifiber stripes running perpendicular to the long dimension of the plate (see Fig. 3).

9.4 Depending upon equipment available, use the following alternates:

9.4.1 Horizontal Perspiration Tester (see Fig. 1): Place the plates in the perspiration tester with the specimen assemblies evenly distributed between the 21 plates. Place all 21 plates into the unit regardless of the number of specimens. After placing the final plate in position (on top) set the dual plates with compensating springs in position, place the 3.63 kg (8.0 lb) weight on top making a total of 4.54 kg (10.0 lb) under the pressure plate, and lock the pressure plate in position by turning the thumb screws. Remove the weight and place the unit lying on its side in the oven so that the sides of the perspiration tester are parallel to the oven walls (see Fig. 4).

9.4.2 Vertical Perspiration Tester (See Fig. 2): Assemble the plates in the perspiration tester with the specimens evenly distributed between the 21 plates. Place all 21 plates into the unit regardless of the number of specimens. The plates are held in a vertical position between an indicating scale with a fixed metal plate at one end and an adjustable metal plate at the other end. Use the adjusting screw to exert a 4.54 kg (10.0 lb) force against the plates. Lock the specimen unit containing the test specimens with a set screw. Remove the pressure gauge unit from the specimen unit and place the specimen unit in the oven such that the side of the perspiration tester is parallel to the oven walls. Another specimen unit may be added to the pressure gauge unit and the loading procedure repeated.

9.5 Heat the loaded specimen unit in an oven at 38 ± 1°C (100 ± 2°F) for 6 h ± 5 min. Check the oven temperature periodically to be sure it remains at the specified temperature throughout the test.

9.6 Remove the tester from the oven and for each test specimen assembly, separate the multifiber fabric and, if used, the undyed adjacent fabric from the test fabric. Place the multifiber fabric and test fabric specimens separately on a wire screen in a conditioned atmosphere (21 ± 1°C [70 ± 2°F]) and 65 ± 2% relative humidity overnight.

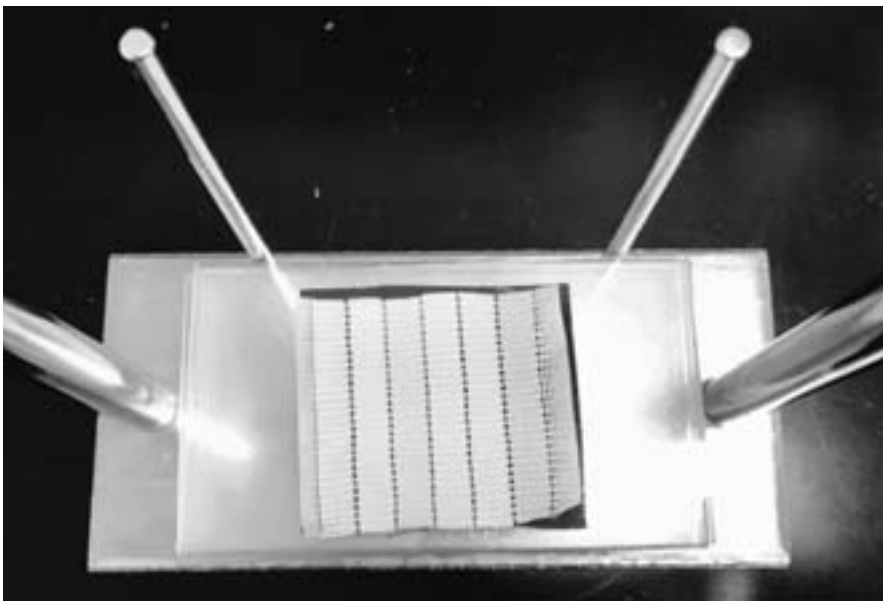

Fig. 3—Specimen in holder.