Colorfastness to Laundering: Accelerated

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1. Purpose and Scope

1.1 These accelerated laundering tests are to evaluate the colorfastness to laundering of textiles which are expected to withstand frequent laundering. The fabric color loss and surface changes resulting from detergent solution and abrasive action of five typical hand or home launderings, with or without chlorine, are roughly approximated by one 45 min test (see 9.2-9.6). However, the staining effect produced by five typical hand or home launderings cannot always be predicted by the 45 min test. Staining is a function of the ratio of colored to undyed fabrics, fiber content of fabrics in the wash load and other end-use conditions which are not always predictable.

1.2 When this test method was originally developed, various options of this method were intended to evaluate the color change and staining by five home or commercial launderings, on an accelerated basis. Throughout the years, commercial laundering procedures have changed and commercial cleaning today involves many different types of processes, dependent on the type of product being cleaned that cannot be duplicated by one accelerated laboratory procedure. In 2005, all references to commercial laundering were removed as it is not known if these procedures accurately replicate typical commercial laundering processes used today.

2. Principle

2.1 Specimens are tested under appropriate conditions of temperature, detergent solution, bleaching and abrasive action such that the color change is similar to that occurring in five hand or home launderings. The color change is obtained in a conveniently short time. The abrasive action is a result of the frictional effects of fabric against canister, the low liquor ratio and the impact of the steel balls on the fabric.

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 **laundering,** n.—*of textile materials,* a process intended to remove soils and/or stains by treatment (washing) with an aqueous detergent solution and normally including subsequent rinsing, extracting and drying.

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 the 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 All chemicals should be handled with care.

4.3 The 1993 AATCC Standard Reference Detergent WOB may cause irritation. Care should be taken to prevent exposure to skin and eyes.

4.4 An eyewash/safety shower should be located nearby for emergency use.

4.5 Manufacturer's safety recommendations should be followed when operating laboratory testing equipment.

5. Apparatus, Reagents and Materials

5.1 Launder-Ometer or other comparable equipment (see 12.1).

5.1.1 A laundering machine for rotating closed canisters in a thermostatically controlled water bath at 40 ± 2 rpm (see 12.1).

5.1.2 Stainless steel lever lock canisters Type 1 (see 12.1) 500 mL (1 pt), 75 × 125 mm (3.0 × 5.0 in.) for Test No. 1A.

5.1.3 Stainless steel lever lock canisters Type 2 (see 12.1) 1200 mL, 90 × 200 mm (3.5 × 8.0 in.) for Tests No. 2A, 3A, 4A and 5A.

5.1.4 Adapter plates for holding canisters (see 5.1.3) on laundering machine shaft (see 12.1).

5.1.5 Stainless steel balls, 6 mm (0.25 in.) in diameter (see 12.1).

5.1.6 Teflon fluorocarbon gaskets (see 7.4.2, 12.1 and 12.2).

5.1.7 Preheater/storage module (see 7.4, 12.1 and 12.3).

5.2 Scales for rating test results.

5.2.1 AATCC Chromatic Transference Scale (see 12.4).

5.2.2 Gray Scale for Color Change (see 12.4).

5.2.3 Gray Scale for Staining (see 12.4).

5.3 Reagents and materials.

5.3.1 Multifiber test fabrics No. 1 and FB (8 mm [0.33 in.] bands) contains bands of acetate, cotton, nylon, silk, viscose rayon and wool. Multifiber test fabrics No. 10, and FA (8 mm [0.33 in.] bands) and No. 10A and FAA (15 mm [0.6 in.] bands) contain bands of acetate, cotton, nylon, polyester, acrylic and wool (see 12.5).

5.3.2 Bleached cotton test fabric, 32 × 32 ends × picks/cm (80 × 80 ends × picks/in.) construction, 100 ± 3 g/m^2 (3.0 ± 0.1 oz/yd^2), desized without fluorescent whitening agent (see 12.5).

5.3.3 1993 AATCC Standard Reference Detergent WOB (without fluorescent whitening agent and without phosphate) (see 10.5 and 12.6).

5.3.4 1993 AATCC Standard Reference Detergent (with fluorescent whitening agent) (see 10.5 and 12.6).

5.3.5 Water, distilled or deionized (see 12.7).

5.3.6 Sodium hypochlorite (NaOCl) bleach (see 12.8).

5.3.7 Sodium carbonate (Na_2CO_3).

5.3.8 Sulfuric acid (H_2SO_4), 10% (see 12.8.1).

5.3.9 Potassium iodide (KI), 10% (see 12.8.1).

5.3.10 Sodium thiosulfate ($Na_2S_2O_3$), 0.1*N* (see 12.8.1).

5.3.11 Crockmeter test cloth cut in 50 mm (2 in.) squares (see 12.9).

5.3.12 White cards (specimen mounts) with *Y* tristimulus value at least 85%.

6. Test Specimens

6.1 The sizes of the specimens required for the various tests are as follows:

50 × 100 mm (2.0 × 4.0 in.) for Test No. 1A,

50 × 150 mm (2.0 × 6.0 in.) for Tests No. 2A, 3A, 4A and 5A.

6.2 Test only one specimen in each canister.

6.2.1 Test one specimen per laboratory sample. Replication may be advisable for

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improved precision.

6.3 To determine staining in Tests No. 1A and 2A, use multifiber test fabric. To determine staining in Test No. 3A, use either multifiber test fabric or bleached cotton test fabric. With respect to Test No. 3A, the use of multifiber test fabric is optional but the staining of acetate, nylon, polyester and acrylic is disregarded unless one of these fibers is present in the fabric being tested or known to be in the final garment. For Test 3A, multifiber test fabric with heat-sealed edges is recommended. Staining is not determined in Tests No. 4A and 5A (see 12.10 and 12.11).

6.4 Specimen preparation.

6.4.1 Preparation with multifiber test fabric with individual component bands 8 mm (0.33 in.) wide or with bleached cotton test fabric. Prepare pieces with a 50 mm (2.0 in.) square of multifiber test fabric cloth or bleached cotton test fabric (as required) sewn, stapled or suitably attached along one 50 mm (2.0 in.) edge of the test specimen and in contact with the face of the material. When multifiber test fabric is used, attach it so that each of the six fiber bands is along the 50 mm (2.0 in.) edge of the specimen with the wool on the right. The fiber bands in the multifiber test fabric will be parallel to the lengthwise direction of the test specimen.

6.4.2 Preparation with multifiber test fabric with individual component bands 15 mm (0.6 in.) wide. Prepare pieces with a 50 × 100 mm (2.0 × 4.0 in.) rectangle of multifiber test fabric sewn, stapled or suitably attached centered along one 100 mm (4.0 in.) or 150 mm (6.0 in.) edge of the test specimen and in contact with the face of the material. Attach it so that each of the six fiber bands will be parallel to the widthwise direction of the specimen. Attach and secure the wool band at the top of the specimen to avoid fiber loss.

6.4.3 It is recommended that knitted fabrics be sewn or stapled at the four edges to equivalent size pieces of bleached cotton test fabric to avoid rolled edges and to assist in obtaining a uniform test result over the entire surface. Attach the multifiber test fabric to the face of the knitted fabric.

6.4.4 For pile fabric specimens with a pile lay direction, attach the multifiber test fabric at the top of the specimen with the pile lay direction pointing away from the top of the specimen.

6.5 When the textile to be tested is yarn, specimens may be tested using Option 1 or Option 2.

6.5.1 Option 1. Knit yarn on an appropriate sample knitting machine. Prepare specimens and multifiber test fabrics according to 6.1-6.4.3. Keep one knitted specimen of each sample as an unwashed original.

6.5.2 Option 2. Prepare two 110 m (120 yd) skeins of each yarn. Fold the skein so that there is a uniform amount of yarn across a 50 mm (2 in.) width with a length appropriate for the procedure to be used. Keep one skein of each sample as an unwashed original. Sew or staple Crockmeter test cloth squares (see 12.9) or squares of bleached cotton test fabric having approximately the same weight folded over each end of the layered yarn specimen. Attach a multifiber test fabric according to 6.4.1 or 6.4.2.

7. Procedure

7.1 Table I summarizes the conditions of the tests.

7.2 Adjust the laundering machine to maintain the designated bath temperature. Prepare the required volume of wash liquor. Preheat this solution to the prescribed temperature.

7.3 Run Test No. 1A in 75 × 125 mm (3.0 × 5.0 in.) lever lock stainless steel canisters. Run Tests No. 2A, 3A, 4A and 5A in 90 × 200 mm (3.5 × 8.0 in.) lever lock stainless steel canisters.

7.3.1 For Tests No. 1A, 2A and 3A, add to the canister the amount of detergent solution designated in Table I.

7.3.2 For Test No. 4A, prepare a 1500 ppm available chlorine solution. For 1 L, determine the amount of stock sodium hypochlorite bleach solution (see 12.8) to dilute as follows:

$$159.4/\%\ \mathrm{NaOCl} = \mathrm{g\ to\ add}$$

Weigh the correct amount of bleach into a volumetric flask and dilute to 1 L. To each canister, add 5 mL of 1500 ppm available chlorine solution and 45 mL of detergent solution making a total volume of 50 mL.

7.3.3 For Test No. 5A, determine the amount of stock sodium hypochlorite bleach solution (see 12.8) to dilute as follows:

$$4.54/\%\ \mathrm{NaOCl} = \mathrm{g\ to\ add}$$

Weigh the correct amount of bleach into a graduated cylinder and add detergent solution to make a total volume of 150 mL. Prepare this solution separately for each canister.

7.3.4 For all the tests, add the designated number of stainless steel balls to each canister.

7.4 The two options for preheating the canisters to the test temperature are by use of the laundering machine or the preheater/storage unit. If the canisters are to be preheated in the laundering machine, proceed to 7.4.2.

7.4.1 Place the canisters in the preheater module at the prescribed test temperature. They are to remain in the module for at least 2 min. Enter a well crumpled test specimen into each canister.

7.4.2 Clamp the covers on the canisters. A Teflon fluorocarbon gasket (see 5.1.6) may be inserted between the neoprene gasket and the top of each canister to prevent contamination of the wash solution by the neoprene. Fasten the 75 × 125 mm (3.0 × 5.0 in.) lever lock canisters vertically and the 90 × 200 mm (3.5 × 8.0 in.) lever lock canisters horizontally in the adapters on the rotor of the laundering machine in such a manner that when the canisters rotate, the covers strike the water first. Place an equal number of canisters on each side of the shaft. For canisters preheated in the module, proceed to 7.7.

7.5 Start the rotor and run it for at least 2 min to preheat the canisters.

7.6 Stop the rotor and with a row of canisters in an upright position, unclamp the cover of one canister, enter a well crumpled test specimen into the solution and replace the cover, but do not clamp it. Repeat this operation until all the canisters in the row have been loaded. Then clamp the covers in the same order in which the canisters were loaded (delay clamping the covers to allow equalization of pressure). Repeat this operation until all rows of canisters have been loaded.

7.7 Start the laundering machine and run it at 40 ± 2 rpm for 45 min.

7.8 The rinsing, extracting and drying procedures are the same for all the tests. Stop the machine, remove the canisters and empty the contents into beakers, keeping each test specimen in a separate beaker. Rinse each test specimen three times, in beakers, in distilled or deionized water at 40 ± 3°C (105 ± 5°F) for 1 min periods with occasional stirring or hand squeezing. To remove excess water, centrifuge, blot or pass the test specimens through wringer rolls. Dry the specimens in an air circulating oven in which the

Table I—Test Conditions[a]

Test No.	Temp °C (± °2)	Temp °F(± °4)	Total Liquor Volume	Percent Detergent of Total Volume	Available Chlorine of Total Volume	No. Steel Balls	Time
1A	40	105	200 mL	0.37%	None	10	45 Min
2A	49	120	150	0.15	None	50	45
3A	71	160	50	0.15	None	100	45
4A	71	160	50	0.15	0.015%	100	45
5A	49	120	150	0.15	0.027	50	45

[a]Refer to Section 9 for objectives for each test method.

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