

Test Method for Colorfastness to Home Laundering with Activated Oxygen Bleach Detergent: Accelerated

Developed in 2001 by AATCC Committee RA60; reaffirmed 2002, 2003; reaffirmed and editorially revised 2008, 2016; revised 2010; editorially revised 2012, 2013, 2019. Partly equivalent to ISO 105-C09.

1. Purpose and Scope

1.1 This test method is a diagnostic test intended to screen dyed cotton textiles sensitive to oxygen bleach detergents. It provides an accelerated procedure to assess the shade changes of dyed textiles when exposed to activated oxygen bleach detergent (simulating multiple home launderings, typically 10 or more). This procedure is most appropriately used during the dye selection process, prior to the production of washable textiles.

1.2 This method does not reflect the contribution to shade change of optical brighteners, which are present in some commercial washing products, or finishes that may be applied to the textile during production.

2. Principle

2.1 A specimen of the dyed textile is laundered, rinsed, and dried. Specimens are tested under defined conditions of temperature, bleach concentration and time to assess whether fading will occur after multiple home launderings. The color difference between the test specimen and the original textile is assessed instrumentally or visually.

3. Terminology

3.1 **activated oxygen bleach**, *n.*—a bleaching system comprising an oxygen bleach and a bleach activator.

3.2 **bleach activator**, *n.*—a bleach agent precursor, which converts a less potent bleaching species into a more powerful one.

3.3 **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.

3.4 **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, ex-

tracting and drying.

3.5 **oxygen bleach**, *n.*—a bleach agent which can liberate hydrogen peroxide by hydrolysis upon dissolving in water.

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 and the 2003 AATCC Standard Reference Liquid Detergent WOB may cause irritation. Care should be taken to prevent exposure to skin and eyes.

4.4 Use suitable gloves when handling hot canisters.

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

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

5. Apparatus, Reagents and Materials (see 12.1)

5.1 Apparatus

5.1.1 An accelerated laundering machine used for rotating closed canisters in a thermostatically controlled ($\pm 2^\circ\text{C}$ [$\pm 4^\circ\text{F}$] of prescribed temperature) water bath at 40 ± 2 rpm.

5.1.2 Stainless steel lever lock canisters 550 ± 50 mL, 75×125 mm. For heavy weight fabrics, stainless steel lever lock canisters 1200 mL, 90×200 mm may be used.

5.1.3 Teflon fluorocarbon gaskets, optional (see 7.5.2 and 12.2).

5.1.4 Preheater/storage module, optional (see 7.5).

5.1.5 NOTE: Steel balls are NOT used in this testing.

5.2 Suitable colorimeter, spectrophotometer or Gray Scale for Color Change

(AATCC EP1) (see 12.4).

5.3 Reagents and Materials

5.3.1 1993 AATCC Standard Reference Detergent WOB (without optical brightener and without phosphate) or 2003 AATCC Standard Reference Liquid Detergent WOB (see 10.3 and 12.5).

5.3.2 Bleach activator (see 12.6).

5.3.3 Sodium perborate monohydrate (PB1) (see 12.4).

5.3.4 Water, distilled or deionized having <15 ppm hardness.

5.3.5 Balance, accurate to ± 0.01 g.

5.3.6 Electric or automatic stirrer.

5.3.7 Blotting paper (see 12.4).

5.3.8 Screen or drying rack.

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

6. Test Specimens

6.1 Prepare a 50×100 mm specimen of the sample being tested. Woven fabrics may be stitched around edges with colorfast (preferably white) thread to prevent raveling.

6.2 Yarn may be knit on an appropriate sample knitting machine.

6.3 Keep one specimen of each sample as an unwashed original.

6.4 Weigh the specimen using the balance (see 5.3.5) to aid in accurate liquor ratio volumes.

6.5 Test only one specimen in each canister.

6.6 Three replicates are advised for improved precision. Replicates should be tested in separate accelerated test cycles.

7. Procedure

7.1 Adjust the accelerated tester to maintain $20 \pm 2^\circ\text{C}$ ($68 \pm 4^\circ\text{F}$).

7.2 A minimum of 1 L detergent solution should be prepared and freshly made immediately prior to each accelerated test.

7.3 Prepare the wash liquor by dissolving 10 ± 0.3 g of the 1993 AATCC Standard Reference Detergent WOB powder or 15.2 ± 0.5 g of 2003 AATCC Standard Reference Liquid Detergent WOB (see 5.3.1) plus 4 g bleach activator (100% activity) (see 12.6) and 3 g sodium perborate monohydrate (PB1) per liter of water (see 5.3.4). Preheat this solution to $20 \pm 2^\circ\text{C}$ ($68 \pm 4^\circ\text{F}$) and stir with electric/automatic stirrer for 10 ± 1 min to ensure thorough dispersion of chemicals. The level of bleach activator

can vary according to identity and level of bleach activation desired.

7.4 Add to each accelerated test canister the appropriate volume of wash liquor to provide a liquor:specimen ratio of 100 mL wash liquor:1 g of fabric. (Test one specimen per accelerated test canister.)

7.5 Two options for preheating the canisters to the test temperature are acceptable. Use either the accelerated tester or the preheater/storage unit. If the canisters are to be preheated in accelerated tester, proceed to 7.5.2.

7.5.1 Place the canisters in the preheater module at $20 \pm 2^\circ\text{C}$ ($68 \pm 4^\circ\text{F}$). They are to remain in the module for at least 2 min. Enter a test specimen into each canister.

7.5.2 Clamp the covers on the canisters. A Teflon fluorocarbon gasket (see 5.1.3) 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 lever lock canisters in the adapters on the rotor of the accelerated tester. Place an equal number of canisters on each side of the shaft. For canisters preheated in the module, proceed to 7.8.

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

7.7 Stop the rotor and with a row of canisters in an upright position, unclamp the cover of one canister, enter a 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 without stopping until all rows of canisters have been loaded.

7.8 Close the container and commence rotation immediately after all canisters have been loaded.

7.9 Increase the temperature at a maximum of $2^\circ\text{C}/\text{min}$ ($35^\circ\text{F}/\text{min}$) to $60 \pm 2^\circ\text{C}$ ($140 \pm 4^\circ\text{F}$) and continue to run for a further 30 min at $60 \pm 2^\circ\text{C}$ ($140 \pm 4^\circ\text{F}$).

7.10 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 water (see 5.3.4) at $40 \pm 3^\circ\text{C}$ ($104 \pm 5^\circ\text{C}$) for 1 min periods with occasional stirring or hand squeezing.

7.11 Squeeze the test specimen by hand to remove the excess water.

7.12 Dry the specimen by hand pressing flat between blotting papers to remove excess water. Then lay the specimen flat on a drying rack or screen not exceeding 60°C (140°F).

7.13 Allow the specimens to condition at $65 \pm 5\%$ RH and $21 \pm 2^\circ\text{C}$ ($70 \pm 4^\circ\text{F}$) for 1 h before evaluating.

7.14 Prepare tested fabric specimens

for evaluation by trimming off raveled yarns and lightly brushing off any loose fiber and yarn on the fabric surfaces. Brush pile fabric specimens in required direction to restore them as nearly as possible to the same pile angle as the untreated specimens. Specimens should be hand smoothed or flattened if they are wrinkled due to washing and/or drying. Specimens may be mounted on cards to facilitate identification and handling in their evaluation. For consistency in backing material, use a white mounting card with Y tristimulus value of at least 85%. Mounting material must not be visible in the area to be viewed and must not interfere with rating as specified in AATCC EP7, Evaluation Procedure for Instrumental Assessment of the Change in Color of a Test Specimen.

8. Evaluation

8.1 Evaluation of color change.

8.1.1 Evaluate the test specimen for change in color by comparison with the Gray Scale for Color Change (AATCC EP1) or using AATCC EP7, Instrumental Assessment of the Change in Color of a Test Specimen, and record the numerical rating that corresponds to the appropriate one on the Gray Scale.

8.1.2 For improved precision and accuracy the specimens should be rated by more than one rater.

9. Interpretation of Results

9.1 Results from the test are intended to estimate the sensitivity of dyed textiles to activated oxygen bleach detergent. This is an accelerated test, and in obtaining the required degree of acceleration some of the conditions, such as temperature, were purposely exaggerated. Laundry detergents, washers and dryers, laundry practices and fabrics continue to

change (see AATCC M6, Standardization of Home Laundry Test Conditions at www.aatcc.org for latest version of the monograph). Consequently, caution in interpreting test results is advised.

10. Report

10.1 Report the color change results determined in 8.1.

10.2 State the evaluation method (see 8.1.1 and 8.1.2) and scale used (refer to AATCC EP7 and AATCC TM173, Test Method for CMC: Calculation of Small Color Differences for Acceptability).

10.3 Report the type and amount of detergent used (see 12.5).

10.4 Report which accelerated tester was used.

11. Precision and Bias

11.1 An interlaboratory test was conducted in 1999 to establish the precision of the test method. Testing was conducted under the normal atmospheric conditions of each laboratory. One operator at each of seven laboratories evaluated six dyed fabrics in three replications using the accelerated test method. Color change (CIELAB) was measured on a spectrophotometer using an aperture of 25.4 mm, illuminant $D_{65}/10^\circ$ observer. Components of variance and critical differences are outlined below of fabrics representing different sensitivities to activated oxygen bleach detergent.

11.2 Components of variance as standard deviations of $\Delta E^* \text{CIELAB}$ readings are given in Table I.

11.3 *Critical Differences*. For the component of variance in Table I for this interlaboratory test, two averages of observed value should be considered significantly different at the 95% probability level if the difference equals or exceeds the critical differences shown in Table II.

Table I—Components of Variance

Dyed Fabric	Average ΔE^*	Single-Operator Component	Between-Laboratory Component
#1	1.21	0.185	0.487
#2	6.13	0.222	1.055
#3	18.16	2.27	10.936

Table II—Critical Differences

Dyed Fabric	Average ΔE^*	No. of Observations	Single-Operator Component	Between-Laboratory Component
#1	1.21	3	0.696	2.074
#2	6.13	3	0.761	2.975
#3	18.16	3	2.436	9.574

