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 (with and without optical brighteners) and the 2003 AATCC Standard Reference Liquid Detergent (with and without optical brighteners) 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 (see 12.1)

5.1 Accelerated laundering machine.

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

5.1.2 Stainless steel lever lock canisters Type 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 1200 mL, 90 × 200 mm (3.5 × 8.0 in.) for Tests No. 1B, 2A, 3A, 4A and 5A.

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

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

5.1.6 White Synthetic (SBR) Rubber Balls 9-10 mm (3/8 in.) dia. 70 Durometer hardness for Test 1B (see 12.1)

5.1.7 Teflon fluorocarbon gaskets (see 7.4.2 and 12.2).

5.1.8 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 (8 mm [0.33 in.] bands) containing acetate, cotton, nylon, silk, viscose rayon and wool. Multifiber test fabrics (8 mm [0.33 in.] bands) and (15 mm [0.6 in.] bands) containing 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/m² (3.0 ± 0.1 oz/yd²), desized without optical brightener (see 12.5).

5.3.3 1993 AATCC Standard Reference Detergent WOB (without optical brightener and without phosphate) or 2003 AATCC Standard Reference Liquid Detergent WOB (without optical brighteners) (see 10.5 and 12.6).

5.3.4 1993 AATCC Standard Reference Detergent (with optical brighteners) or 2003 AATCC Standard Reference Liquid Detergent (with optical brighteners) (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 Sulfuric acid (H_2SO_4), 10% (see 12.8.1).

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

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

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

5.3.11 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. 1B, 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 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, 1B, 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:

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

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:

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

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 or white rubber 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

Table I—Test Conditions[a]

Test No.[b]	Temp °C (±°2)	Temp °F (±°4)	Total Liquor Volume (mL)	Percent Powder Detergent of Total Volume	Percent Liquid Detergent of Total Volume	Percent Available Chlorine of Total Volume	No. Steel Balls	No. of Rubber Balls	Time (Min)
1A	40	105	200	0.37	0.56	None	10	0	45
1B[c]	31	88	150	0.37	0.56	None	0	10	20
2A	49	120	150	0.15	0.23	None	50	0	45
3A	71	160	50	0.15	0.23	None	100	0	45
4A	71	160	50	0.15	0.23	0.015	100	0	45
5A	49	120	150	0.15	0.23	0.027	50	0	45

[a]Refer to Section 9 for objectives for each test method.
[b]All Tests include an alternate use for 2003 AATCC Standard Liquid Detergent.
[c]Test 1B provides for the use of White Rubber Balls instead of Stainless Steel Balls.

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 temperature does not exceed 71°C (160°F), or tumble dry in a nylon mesh bag in an automatic tumble dryer at normal cycle, which has an exhaust temperature of 60-71°C (140-160°F), or air dry.

7.9 Allow specimens to condition at 65 ± 2% relative humidity and 21 ± 1°C (70 ± 2°F) for 1 h before evaluating.

7.10 Prepare tested fabric specimens and adjacent fabrics 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 smoothed or flattened if they are wrinkled and messy 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 5.1 of both AATCC Evaluation Procedures 1 and 2 for the Gray Scale for Color Change and Gray Scale for Staining or instrumental assessment of color according to AATCC Evaluation Procedure 7, Instrumental Assessment of the Change in Color of a Test Specimen (see 12.4).

7.10.1 Yarn skein specimens should be combed and brushed for improved alignment of the yarns before comparison with the unwashed original. The original specimens may also need further combing and brushing for uniformity of appearance.

8. Evaluation

8.1 Evaluation of color change.

8.1.1 Evaluate the color change of the test specimens by comparison with the AATCC Gray Scale for Color Change (AATCC Evaluation Procedure 1), or using AATCC Evaluation Procedure 7, 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. For improved precision and accuracy the specimens should be rated by more than one rater.

8.2 Evaluation of staining.

8.2.1 Evaluate staining (see 12.10) by comparison with the AATCC Gray Scale for Staining (AATCC Evaluation Procedure 2), the AATCC 9-Step Chromatic Transference Scale (AATCC Evaluation Procedure 8), or Instrumental Assessment of Degree of Staining (AATCC Evaluation Procedure 12), and record the numerical rating that corresponds to the appropriate one on either of them. The scale used should be indicated when reporting the test results.

8.2.2 The color transferred to the multifiber test fabric or bleached cotton test fabric square of 6.4.1 can be quantitatively determined by measuring the color difference between a piece of the original material and the stained material. Multifiber test fabrics (15 mm [0.6 in.]) have filling bands of sufficient width to be within the aperture diameter capability of many colorimeters and spectrophotometers (see AATCC Evaluation Procedure 6, Instrumental Color Measurement and 12.14).

9. Interpretation of Results

9.1 Results from these tests are intended to approximate the color change effects (see 1.1) of five typical home launderings. These are accelerated tests, and in obtaining the required degree of acceleration some of the conditions, such as temperature, were purposely exaggerated. The tests have remained largely the same over many years while laundry detergents, washers and dryers, laundry practices and fabrics have changed (see AATCC monograph "*Standardization of Home Laundry Test Conditions,*" elsewhere in this TECHNICAL MANUAL). Consequently, caution in interpreting test results is advisable.

9.2 Test No. 1A—This test is for evaluating the colorfastness of textiles that are expected to withstand repeated hand laundering at low temperature. Specimens subjected to this test should show color change similar to that produced by five typical careful hand launderings at a temperature of 40 ± 3°C (105 ± 5°F).

9.3 Test No. 1B—This test is for evaluating the colorfastness of textiles that are expected to withstand repeated hand laundering at cool temperatures. Specimens subjected to this test should show color change similar to that produced by five typical careful hand launderings at a temperature of 27 ± 3°C (80 ± 5°F).

9.4 Test No. 2A—This test is for evaluating the colorfastness to washing of textiles that are expected to withstand repeated low temperature machine laundering in the home. Specimens subjected to this test should show color change similar to that produced by five home machine launderings at medium or warm setting in the temperature range of 38 ± 3°C (100 ± 5°F).

9.5 Test No. 3A—This test is for evaluating colorfastness to washing of textiles considered washable under vigorous conditions. Specimens subjected to this test should show color change similar to that produced by five home machine launderings at 60 ± 3°C (140 ± 5°F), without chlorine.

9.6 Test No. 4A—This test is for evaluating the colorfastness to washing of textiles laundered in the presence of available chlorine. Specimens subjected to this test should show color change similar to that produced by five home machine launderings at 63 ± 3°C (145 ± 5°F) with 3.74 g per L (0.50 oz/gal) of 5% available chlorine per 3.6 kg (8.0 lb) load.

9.7 Test No. 5A—This test is for evaluating the colorfastness to washing of textiles that may be laundered in the presence of available chlorine. Specimens subjected to this test should show color change similar to that produced by five home machine launderings at 49 ± 3°C (120 ± 5°F) with 200 ± 1 ppm available chlorine.

10. Report

10.1 Report the test number.

10.2 Report the grade number determined for color change in 8.1 and the staining grade numbers for the evaluated fibers in the multifiber test fabric and/or bleached cotton test fabric as determined in 8.2.

10.3 State which scale (Gray Scale for Staining or AATCC Chromatic Transference Scale) was used in evaluating staining (see 12.12).

10.4 Report the multifiber test fabric used and if bleached cotton test fabric was employed to avoid knit curling.

10.5 Report the detergent used with color change and staining results (see 12.6).

10.6 Report which laundering machine is used.

11. Precision and Bias (see 12.15)

11.1 Precision and bias statements have been developed for Tests No. 2A and 5A. Although correlation work has been done, no precision and bias statements have been developed for Tests No. 1A, 3A and 4A.

11.1.1 Because of changes in the detergents used in this method, these precision and bias statements may not apply to data or information obtained with the currently available detergents.

11.2 Test No. 2A.

11.2.1 *Summary.* An interlaboratory test was carried out in May 1985 to establish the precision of Test No. 2A. A part of the test was to determine if the wider 15 mm (0.6 in.) No. 10A multifiber test fabric could be substituted for the 8 mm (0.33 in.) wide No. 10. The complete test consisted of six laboratories evaluating

10 materials in duplicate by one operator using Test No. 2A.

11.2.2 *Color Change.* Three raters from six laboratories independently evaluated nine materials in duplicate using the Gray Scale for Color Change. The components of variance as standard deviations of the colorfastness grades (averages of variances for No. 10 and No. 10A multifiber test fabrics) were calculated as follows:

Single-Operator Component	0.29
Within-Laboratory Component	0.29
Between-Laboratory Component	0.29

11.2.3 *Critical Differences.* For the components of variance reported in 11.2.2, two averages of observed values should be considered significantly different at the 95% probability level if the difference is equal to or exceeds the critical differences shown in Table II.

Table II—Critical Differences, Grades, for the Condition Noted[a]

No. of Observations	Single-Operator Precision	Within-Lab Precision	Between-Lab Precision
1	0.80	1.12	1.37
3	0.46	0.92	1.21
5	0.36	0.87	1.18

[a]The critical differences were calculated using t = 1.950 which is based on infinite degrees of freedom.

11.2.4 *Staining.* Three raters independently rated the six fibers of the multifiber test fabric (No. 10 and No. 10A) for 10 materials at six laboratories using the Gray Scale for Staining. Of the 60 possible fiber/fabric combinations, only 51 could be used. The components of variance were averaged for the No. 10 and No. 10A multifiber test fabrics and appear below as standard deviations of staining ratings:

Single Operator Component	0.27
Within-Laboratory Component	0.34
Between-Laboratory Component	0.25

11.2.5 *Critical Differences.* For the components of variance reported in 11.2.4, two averages of observed values should be considered significantly different at the 95% probability level if the difference equals or exceeds the critical differences shown in Table III.

11.2.6 *Bias.* Tests comparing five home launderings at 40°C (105°F) with one Launder-Ometer Test No. 2A indicate there is no bias between the two methods for the colorfastness and staining levels evaluated.

Table III—Critical Differences, Grades, for the Condition Noted[a]

No. of Observations	Single-Operator Precision	Within-Lab Precision	Between-Lab Precision
1	0.75	1.20	1.39
3	0.43	1.03	1.25
5	0.33	1.00	1.22

[a]The critical differences were calculated using t = 1.950 which is based on infinite degrees of freedom.

11.3 Test No. 5A, Chlorine Bleach.

11.3.1 *Summary.* An interlaboratory test was carried out in 1984 to establish the precision of Test No. 5A for determining the effect of chlorine bleach on the colorfastness of fabrics. All specimens were laundered in a Launder-Ometer by one operator. Color change in Test No. 5A was determined both visually and instrumentally. Details of the statistical analysis of the data can be found in the report, Third Interlaboratory Study of Proposed Launder-Ometer Test for Colorfastness of Fabrics to Chlorine and Non-Chlorine Bleaches, October 21, 1985, by J. W. Whitworth, Milliken Research Corp., Spartanburg, SC.

11.3.2 *Visual Assessment.* Four materials were tested at each of five laboratories. Three raters visually assessed the color change of four specimens. The components of variance as standard deviations of colorfastness grades were calculated as follows:

Single Operator Component	0.38
Within-Laboratory Component	0.28
Between-Laboratory Component	0.27

11.3.3 *Critical Differences.* For the components of variance in 11.3.2, two averages of observed values should be considered significantly different at the 95% probability level if the difference equals or exceeds the critical differences shown in Table IV.

Table IV—Critical Differences, Grades, for the Condition Noted[a]

No. of Observations	Single-Operator Precision	Within-Lab Precision	Between-Lab Precision
1	1.03	1.29	1.49
3	0.59	0.98	1.23
5	0.46	0.91	1.17

[a]The critical differences were calculated using t = 1.950 which is based on infinite degrees of freedom.

11.3.4 *Instrumental Assessment.* Color change as total color difference (CIELAB) was measured on a spectrophotometer or colorimeter using apertures ranging in size from 13-51 mm (0.5-2.0 in.) in diameter, illuminant D_{65}/10° observer or illuminant C/2° observer. Six materials were tested at each of six laboratories. One operator in each laboratory tested four specimens of each fabric. The components of variance for ΔE^* expressed as coefficients of variation were calculated to be:

Single-Operator Component	6.8%
Between-Laboratory Component	11.2%

11.3.5 *Critical Differences.* For the components of variance reported in 11.3.4, two averages of observed values should be considered significantly different at the 95% probability level if the difference equals or exceeds the critical differences shown in Table V.

Table V—Critical Differences, Percent of Grand Average for the Conditions Noted[a,b]

No. of Observations in Each Average	Single-Operator Precision	Between-Laboratory Precision
1	18.7	36.2
3	10.8	32.8
5	8.4	32.1

[a]The critical differences were calculated using t = 1.950 which is based on infinite degrees of freedom. [b]To convert the values of the critical differences to units of measure, multiply the critical differences by the average of the two specific sets of data being compared and then divide by 100.

11.3.6 *Bias.* Tests comparing five home launderings at 49°C (120°F) with one Launder-Ometer Test No. 5A indicate there is no bias between the two methods for the colorfastness levels evaluated (see 12.13).

12. Notes

12.1 For potential equipment information pertaining to this test method, please visit the online *AATCC Buyer's Guide* at http://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.

12.2 Teflon is a registered trademark of the DuPont Co., Wilmington DE 19898.

12.3 The preheater/storage unit may be a side unit to the laundering machine or a separate module with its individual electric heater and thermostat to control water bath temperatures for heating containers and solutions prior to loading the laundering machine.

12.4 Available from AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org; web site: www.aatcc.org.

12.5 Bleached cotton test fabric in 32 × 32 ends × picks/cm (80 × 80 ends × picks/in.) construction, 100 ± 3 g/m² and without optical brightener should be used.

12.6 The 1993 AATCC Standard Reference Detergent WOB (without optical brightener), a compact formulation, is the primary detergent to be used in this test method. Where the effect of an optical brightener is to be evaluated, 1993 AATCC Standard Reference Detergent (with optical brightener) should be used. The 2003 AATCC Standard Reference Liquid Detergent WOB (without optical brightener) is a liquid detergent that has been approved as an alternate to the 1993 AATCC Standard Reference Detergent WOB. All detergents are available from AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org; web site: www.aatcc.org.

12.7 Use distilled water or deionized water of not more than 15 ppm hardness to dissolve the detergent and for the test solutions.

12.8 Use sodium hypochlorite bleach purchased within the last six months for a stock solution.

12.8.1 To confirm the stock solution's hypochlorite activity, weigh 2.00 g liquid sodium hypochlorite into an Erlenmeyer flask and dilute with 50 mL of deionized water. Add 10 mL of 10% sulfuric acid and 10 mL of 10% potassium iodide. Titrate with 0.1*N* sodium thiosulfate until colorless.

Calculation:

% sodium hypochlorite

$$= \frac{(\text{mL } Na_2S_2O_3)(0.1N)(0.03722)}{(2.00 \text{ g NaOCl})} \times 100$$

The factor 0.03722 is derived by multiplying the molecular weight of NaOCl (74.45 g/mol) by 0.001 (mL to L conversion) and dividing by 2 (mols of thiosulfate per hypochlorite).

12.8.2 Oxidizing power of sodium hypochlorite is typically expressed in terms of available chlorine, the equivalent amount of diatomic chlorine present. A 5.25% NaOCl solution contains 50,000 ppm available chlorine.

12.9 Crockmeter test cloth, 32 × 33 ends × picks/cm (80 × 84 ends × picks/cm) combed cotton, desized, bleached (no optical brightener or finishing material present) should be used.

12.10 If staining evaluations are needed for Tests No. 4A and 5A, they may be carried out using the corresponding Tests No. 2A or 3A, which use no bleach. Test No. 2A is the no-bleach alternate for Test No. 5A, and Test No. 3A is the no-bleach alternate for Test No. 4A.

12.11 If multifiber test fabric is used in conjunction with Tests 4A or 5A, the wool can absorb the chlorine leaving very little for bleaching action. The wool may be removed from the multifiber test fabric before testing to eliminate this effect.

12.12 For very critical evaluations and in cases of arbitration, grades must be based on the geometric Gray Scale for Staining.

12.13 For additional information pertaining to the bias between Test No. 5A and five home washes, refer to Fig. 1 in Interlaboratory Study of Proposed Launder-Ometer Test for Colorfastness of Fabrics to Chlorine and Non-Chlorine Bleaches, Report to AATCC Committee RA60, Colorfastness to Washing Test Methods, November 1984, New York NY by L. B. Farmer and J. W. Whitworth of Milliken Research Corp., Spartanburg SC, and J. G. Tew, AATCC Technical Center, Research Triangle Park NC.

12.14 AATCC Evaluation Procedure 7 gives a method for computing Gray Scale grades from color measurement data.

12.15 The precision of this test method is dependent on the combined variability of the material being tested, the test method itself, and the evaluation procedure utilized.

12.15.1 The precision statement in Section 11 was developed from results obtained by visual evaluation (EP 1 and EP 2).

12.15.2 It is expected that the use of instrumental evaluation procedures (EP 7 and EP 12) will result in greater precision than that obtained from visual evaluations.