

Colorfastness to Drycleaning

Developed in 1969 by AATCC Committee RA43. Supersedes AATCC 85-1968; re-affirmed 1973, 1976, 1979, 1989, 1998, 2003; editorially revised 1981, 1986, 1990, 1995, 2001, 2002; editorially revised and reaffirmed 1985; revised 1993, 2004. Technically equivalent to ISO 105-D01.

1. Purpose and Scope

1.1 This test method is intended for determining the colorfastness of textiles to all kinds to drycleaning.

1.2 The test method is neither suitable for the evaluation of the durability of textile finishes, nor is it intended for use in evaluating the resistance of colors to spot and stain removal procedures used by the drycleaner (see 11.1).

1.3 This test method gives an indication of results to be obtained from three commercial drycleanings.

2. Principle

2.1 A specimen of the textile in contact with cotton fabric, multifiber swatch and noncorrodible steel discs is agitated in perchloroethylene (see 11.2) and then dried in air. Any change in color of the specimen is then assessed with the standard Gray Scale for Color Change.

2.2 Any staining is assessed by using the Gray Scale for Staining or the Chromatic Transference Scale.

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 **drycleaning**, n.—the cleaning of fabrics with organic solvents such as petroleum solvent, perchloroethylene or fluorocarbon.

NOTE: The process also includes adding detergent and moisture to the solvent, up to 75% RH, and hot tumble drying to 71°C (160°F).

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 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 Perchloroethylene is toxic by inhalation, by repeated contact with the skin and by ingestion; it should be used only in a well vented atmosphere. Toxicology studies with laboratory animals have shown evidence of cancer in rats and mice exposed to perchloroethylene vapors at 100-400 ppm concentrations for prolonged times. Fabric saturated with this solvent should be dried in an adequately ventilated hood. Use chemical goggles or face shield, impervious gloves and an impervious apron when handling perchloroethylene.

4.4 An eyewash/safety shower should be located nearby and an organic vapor respirator should be readily available for emergency use.

4.5 Exposure to chemicals used in this procedure must be controlled at or below levels set by governmental authorities (e.g., Occupational Safety and Health Administration's [OSHA] permissible exposure limits [PEL] as found in 29 CFR 1910.1000 of January 1, 1989). In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) comprised of time weighted averages (TLV-TWA), short term exposure limits (TLV-STEL) and ceiling limits (TLV-C) are recommended as a general guide for air contaminant exposure which should be met (see 11.3).

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

4.7 Any perchloroethylene residue must be sent to a permitted waste management facility. Any disposal must be in compliance with federal, state or local regulations.

5. Apparatus and Materials

5.1 Launder-Ometer (see 11.4).

5.2 Standard stainless-steel containers, 7.5 cm diam × 12.5 cm (3 in. diam × 5 in.), of approximately 500 mL (1 pt) capacity, which can be closed using solvent-resistant gaskets (see 11.4).

5.3 Noncorrodible steel discs, 30.0 ± 2.0 mm (1.18 ± 0.08 in.) diam × 3.0 ± 0.5 mm (0.12 ± 0.02 in.) smooth and free from rough edges, weight 20.0 ± 2.0 g (0.7 ± 0.07 oz) (see 11.4).

5.4 Undyed cotton twill cloth weighing 270 ± 70 g/m² (8 ± 2 oz/yd²), free from finishes and cut into swatches 12.0 × 12.0 cm (4.75 × 4.75 in.) (see 11.5).

5.5 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 11.6).

5.6 Perchloroethylene, commercial drycleaning grade.

5.7 Gray Scale for Color Change (see 11.7).

5.8 Gray Scale for Staining or AATCC Chromatic Transference Scale (see 11.7).

5.9 Colorimeter or spectrophotometer.

5.10 Crockmeter Test Cloth (see 11.5).

5.11 Detergent, Perk-Sheen (see 11.8).

6. Specimens

6.1 If the textile to be tested is fabric, use three specimens, each 10 × 5 cm (4 × 2 in.) with the longer dimension parallel to the warp or wale direction of the fabric.

6.2 If the textile to be tested is a yarn, knit it into a fabric and use three specimens 10 × 5 cm (4 × 2 in.) with the longer dimension parallel to the wale direction of the fabric.

6.3 Sample preparation.

6.3.1 White cotton fabric, multifiber No. 1, No. 10, FA or FB. Prepare pieces with a 5 cm (2 in.) square of multifiber cloth or white cotton fabric (as required) sewn, stapled or suitably attached along one 5 cm (2 in.) edge of the test specimen and in contact with the face of the material. When multifiber test cloth is used, attach it so that each of the six fiber stripes is along the 5 cm (2 in.) edge of the specimen with wool on the right. The fiber stripes in the multifiber fabric will be parallel to the lengthwise direction of the test specimen.

6.3.2 Multifiber No. 10A or FAA. Prepare pieces with a 5 × 10 cm (2 × 4 in.) rectangle of multifiber cloth sewn, stapled or suitably attached centered along a 10 cm (4 in.) edge of the test specimen and in contact with the face of the material. Attach it so that each of the six fiber stripes will be parallel to the widthwise direction of the specimen. Attach and se-

cure the wool stripe at the top of the specimen to avoid fiber loss.

6.3.3 It is recommended that knitted fabrics be sewn or stapled at the four edges to equivalent size pieces of 80 × 80 cm bleached cotton fabric to avoid rolled edges and to assist in obtaining a uniform test result over the entire surface.

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

6.3.5 When the textile to be tested is yarn, specimens may be tested in one of two ways.

6.3.5.1 Option 1. Knit yarn on an appropriate sample knitting machine. Prepare specimens and multifiber test fabrics according to 6.1-6.3. Keep one knitted specimen of each sample as an original.

6.3.5.2 Option 2. Prepare four 120-yd skeins of each yarn. Fold the skeins so that there is a uniform amount of yarn across a 2 in. width with a length appropriate for the procedure to be used. Keep one skein of each sample as an original. Sew or staple crock squares folded over each end of the layered yarn specimen. Attach a multifiber test fabric to one end.

7. Procedure

7.1 Prepare a bag for each specimen with inside dimensions of 10 × 10 cm (4 × 4 in.) using the undyed cotton twill cloth (see 5.4) by sewing together two squares of this cloth around three sides. Place the specimen and 12 steel discs inside the bag (see 5.3). Close the bag by any convenient means, such as sewing.

7.2 In a hood, prepare the perchloroethylene/detergent solution. To a 1000 mL volumetric flask filled partially with perchloroethylene, add 10 mL of detergent, (Perk Sheen 324). Shake or stir. Add perchloroethylene until the total volume equals 1000 mL. Add 0.6 mL water. Shake or stir until the solution is no longer cloudy. This mixture produces a 1% charge volume/volume at 75% RH.

7.3 In a hood, place the bag containing the specimen and the steel discs in the standard 500 mL (1 pt) stainless steel container and add 200 mL perchloroethylene detergent solution at $30 \pm 2^\circ\text{C}$ ($86 \pm 4^\circ\text{F}$). Close the container and agitate the specimen for 30 min at $30 \pm 2^\circ\text{C}$ ($86 \pm 4^\circ\text{F}$) in the specified equipment (see 11.4).

7.4 Place the container in an adequately ventilated hood. Remove the bag from the container, withdraw the specimen and place the specimen between layers of absorbent paper or cloth to remove surplus solvent. Air dry the specimen in a hood. Air at a temperature not exceeding 65°C (149°F).

7.5 Allow specimens to condition at $65 \pm 2\%$ RH and $20 \pm 1^\circ\text{C}$ ($68 \pm 2^\circ\text{F}$) for 1 h

before evaluating.

7.6 Prepare the tested specimens and staining fabric 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 there are wrinkles. Specimens may be mounted on cards to facilitate identification and handling in their evaluation. Mounting must not interfere with rating as specified in AATCC Evaluation Procedures 1 (Gray Scale for Color Change), 2 (Gray Scale for Staining), and 3 (AATCC Chromatic Transference Scale). For consistency in backing material, use a white mounting card with Y tristimulus value of at least 85%.

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

8. Evaluation and Calculation

8.1 Evaluation of Color Change.

8.1.1 Rate the color change of the test specimens using the Gray Scale for Color Change. (Usage of the scale is discussed in Evaluation Procedure 1.) For improved precision and accuracy, the specimens should be rated by more than one rater.

Grade 5—negligible or no change as shown in Gray Scale Step 5.

Grade 4.5—change in color equivalent to Gray Scale Step 4-5.

Grade 4—change in color equivalent to Gray Scale Step 4.

Grade 3.5—change in color equivalent to Gray Scale Step 3-4.

Grade 3—change in color equivalent to Gray Scale Step 3.

Grade 2.5—change in color equivalent to Gray Scale Step 2-3.

Grade 2—change in color equivalent to Gray Scale Step 2.

Grade 1.5—change in color equivalent to Gray Scale Step 1-2.

Grade 1—change in color equivalent to Gray Scale Step 1.

8.1.2 The color change can be quantitatively determined between the original sample and a test specimen using a suitable colorimeter or spectrophotometer (see AATCC Evaluation Procedure 7, Instrumental Assessment of the Change in Color of a Test Specimen).

8.2 Evaluation of Staining.

8.2.1 Rate staining by using the Gray Scale for Staining or the AATCC Chromatic Transference Scale. (Usage of the scales is discussed in Evaluation Procedures 2 and 8.) The scale used should be indicated when reporting the test results

as follows:

Grade 5—negligible or no color transfer. Grade 4.5—color transfer equivalent to Step 4-5 on the Gray Scale for Staining or Row 4.5 on the 9-step AATCC Chromatic Transference Scale.

Grade 4—color transfer equivalent to Step 4 on the Gray Scale for Staining or Row 4 on the 9-step AATCC Chromatic Transference Scale.

Grade 3.5—color transfer equivalent to Step 3-4 on the Gray Scale for Staining or Row 3.5 on the 9-step AATCC Chromatic Transference Scale.

Grade 3—color transfer equivalent to Step 3 on the Gray Scale for Staining or Row 3 on the 9-step AATCC Chromatic Transference Scale.

Grade 2.5—color transfer equivalent to Step 2-3 on the Gray Scale for Staining or Row 2.5 on the 9-step AATCC Chromatic Transference Scale.

Grade 2—color transfer equivalent to Step 2 on the Gray Scale for Staining or Row 2 on the 9-step AATCC Chromatic Transference Scale.

Grade 1.5—color transfer equivalent to Step 1-2 on the Gray Scale for Staining or Row 1.5 on the 9-step AATCC Chromatic Transference Scale.

Grade 1—color transfer equivalent to Step 1 on the Gray Scale for Staining or Row 1 on the 9-step AATCC Chromatic Transference Scale.

8.2.2 The color transferred to the multifiber fabric or white cotton square of 6.3.1 can be quantitatively determined by measuring the color difference between a piece of the original material and the stained material. Using a suitable colorimeter or spectrophotometer, the No. 10A multifiber material has sufficient width to be within the aperture diameter capability of many instruments.

8.3 Calculation.

8.3.1 Average the observations made on each sample (means of judgement of 3 specimens).

9. Calculating and Reporting Results

9.1 Average the number of observations made on each sample (means of judgments on each of 3 specimens). Report the average to the nearest tenth of a grade point.

9.2 Report the test method number.

9.3 Report the grade number determined for color change in 9.1 and the staining grade number for the evaluated fibers in the multifiber test fabric and/or staining fabric as determined in 9.2.

9.4 State which scale (Gray Scale for Staining or AATCC Chromatic Transference Scale) was used in evaluating staining (see 11.9).

9.5 State whether multifiber No. 1, No. 10 or No. 10A was used, and if the cotton print cloth was employed to avoid knit curling.

10. Precision and Bias

10.1 *Precision.* On one fabric, three specimens were tested by each of two operators in three trials. The specimens were rated by two evaluators. The average grade for the two raters and three specimens was determined. This was considered the unit of measure of this test.

10.2 The components of variance as standard deviations of the color change grades were calculated to be as follows:

Single operator	0.03
Within laboratory	0.11

10.3 *Bias.* The true value of the color change can only be defined in terms of the test method. Within this limitation, the test method has no known bias.

11. Notes

11.1 This test method covers colorfastness to drycleaning only; it does not cover the ef-

fects of water spotting, solvent spotting and steam pressing which are normally involved in commercial drycleaning practice. For testing the durability of applied designs and finishes see AATCC Method 86, Durability of Applied Designs and Finishes to Drycleaning.

11.2 Perchloroethylene is used in this test because (a) it is the most used solvent in commercial drycleaning in the USA, and (b) it is slightly more severe in solvent action than petroleum. A color which is not affected by perchloroethylene will not be affected by petroleum solvents, whereas the converse is not always true.

11.3 Available from Publications Office, ACGIH, Kemper Woods Center, 1330 Kemper Meadow Dr., Cincinnati OH 45240; tel: 513/742-2020.

11.4 Available from SDL Atlas L.L.C., 1813A Associate Lane, Charlotte NC 28217; tel: 704/329-0911; fax: 704/329-0914; e-mail: info@sdlatlas.com.

11.5 Available from Testfabrics Inc., P.O. Box 26, 415 Delaware St., W. Pittston PA 18643; tel: 570/603-0432; fax: 570/603-0433; e-mail: testfabric@aol.com.

11.6 Multifiber test fabrics No. 1, No. 10 and No. 10A are available from Testfabrics Inc., P.O. Box 26, 415 Delaware St., W. Pittston PA 18643; tel: 570/603-0432; fax: 570/603-0433; e-mail: testfabric@aol.com. Multifiber test fabrics FA, FB and FAA are available from Textile Innovators Corp., div. of SDL Atlas L.L.C., P.O. Box 8, 101 Forest St., Windsor NC; tel: 252/794-9703; fax: 252/794-9704; e-mail: tic@sdlatlas.com. Bleached cotton test fabric in 32 × 32 ends × picks/cm (80 × 80 ends × picks/in.) construction, 136 ± 10 g/m² (4.0 ± 0.3 oz/yd²) and without fluorescent whitening agent is available from both suppliers.

11.7 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.

11.8 Available from Adco Inc., 900 W. Main St., P.O. Box 999, Sedalia MO 65301; tel: 660/826-3300 or 800/821-7556; fax: 660/826-1361; e-mail: sales@adco-inc.com.

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