

Soil Redeposition: Launder-Ometer Method

Developed in 1977 in AATCC Committee RA56; reaffirmed 1980, 2003; editorially revised and reaffirmed 1985, 1990; editorially revised 1986, 1991, 1995, 2004; revised (with title change) 1998.

1. Purpose and Scope

1.1 This laboratory test method measures the degree of soil redeposition which may occur on a fabric during the laundering process and is applicable to any light-colored fabric.

1.2 The test method includes two means of demonstrating the soil redeposition performance of most fabrics. In the past, a single 30 min cycle produced a level of soil redeposition that correlated well with 100 home launderings (see 12.1). Three 10 min cycles can be used to produce an exaggerated soil level for a quick and effective way to demonstrate differences between fabrics.

2. Principle

2.1 Test specimens are exposed to a soiling medium in a Launder-Ometer canister under specified conditions and its change in *Y* value (CIE standard illuminant D_{65} and 1964 10° observer) is measured using a spectrophotometer or colorimeter. AATCC Evaluation Procedure 6, Instrumental Color Measurement, can be used for reference.

3. Terminology

3.1 **soil affinity**, *n.*—the reduction in *Y* value between new and soiled fabrics.

3.2 **soil redeposition**, *n.*—the soiling of clean or relatively clean fabric during the laundering process by soil which has been removed from another fabric.

3.3 **wet soiling**, *n.*—the application of soil from a liquid medium.

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

4.4 Perchloroethylene is toxic by inhalation, by repeated contact with 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.

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

4.6 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 12.2).

5. Apparatus and Materials

5.1 Launder-Ometer (see 12.3).

5.2 Canisters, stainless steel, 80 × 130 ± 5 mm (3 × 5 ± 0.2 in.), with solvent resistant seals (see 12.3).

5.3 Balls, stainless steel, 6 mm (0.25 in.) diameter (see 12.3).

5.4 Colorimeter or spectrophotometer (see 12.4).

5.5 Automatic home dryer (see 12.5).

5.6 Particulate soil.

5.6.1 Bandy Black clay (see 12.6).

5.6.2 Vacuum cleaner dirt (see 12.7).

5.7 Beakers, glass, 50 mL, 1500 mL and 4000 mL.

5.8 Tweezers, 250-300 mm (10-12 in.) in length.

5.9 Syringe, 1 mL tuberculin.

5.10 Cotton swatches, bleached sheeting cut into at least 50 × 50 mm (2 × 2 in.) (see 12.8).

5.11 Screen, 150 mesh (Tyler equivalent).

6. Reagents

6.1 Water with a hardness of 150 ± 5 ppm (9 gr) (see 12.9). The use of deionized or distilled water is preferred.

6.2 Hardness concentrate for artificially hardening the water (see 12.10).

6.3 1993 AATCC Standard Reference Detergent (see 12.11).

6.4 Triolein, technical oil ($C_{57}H_{104}O_6$, FW 885.46) (see 12.12).

6.5 Mineral oil, Saybolt Viscosity 180-190 (see 12.13).

6.6 Perchloroethylene ($CHCl_2CHCl_2$).

6.7 Magnesium chloride, hexahydrate ($MgCl_2 \cdot 6H_2O$).

6.8 Calcium chloride, anhydrous ($CaCl_2$).

7. Preparation of Oil-Soiled Swatches

7.1 Preparation of oily soil.

7.1.1 Weigh 6.25 ± 0.5 g of triolein and 6.25 ± 0.5 g of mineral oil.

7.1.2 Dilute with 50 ± 2 mL of perchloroethylene. Oily soil will remain stable under refrigeration at 4°C (40°F).

7.2 Place each of the four 50 × 50 mm (2 × 2 in.) cotton swatches over the mouth of small glass beakers.

7.3 Apply 0.2 mL of the oily soil prepared in 7.1 to the center of each swatch using a 1 mL tuberculin syringe.

7.4 Dry swatches flat to avoid dripping and uneven distributions of the oil into the swatches. Allow swatches to condition for 1 h in ambient conditions prior to use.

7.5 Prepare fresh oily soiled swatches daily.

8. Test Specimens

8.1 Cut four specimens from each fabric to be tested into 100 × 200 mm (4 × 8 in.) swatches. The 100 mm (4 in.) dimension is the length and the 200 mm (8 in.) dimension is the width of the fabric. Do not have same lengthwise or widthwise yarns in any two specimens. Do not take specimens within 10% of the selvage of the fabric. Pre-washing or stripping the specimens before testing is recommended.

9. Procedures

9.1 Initial *Y* Value (Tristimulus Re-

flectance).

9.1.1 Fold each specimen with the face side out, to obtain a 100 mm (4 in.) square.

9.1.2 Stack the four folded test specimens to obtain eight thicknesses.

9.1.3 Using a calibrated colorimeter or spectrophotometer, make a total of 16 readings, presenting the specimen stack as directed in 9.1.3.1-9.1.3.3.

9.1.3.1 Read and record the Y value of the top and bottom of the specimen stack to the nearest 0.1.

9.1.3.2 Move specimen one to the bottom of the stack. Read the Y value of the top and bottom of the new stack, continue moving the top specimen to the bottom of the stack and reading the Y value of the top and the bottom of the stack until specimen four is at the top of the stack and 8 Y value readings have been taken.

9.1.3.3 Rotate the specimens 90° and repeat the readings as in 9.1.3.2 for eight more Y value readings.

9.1.3.4 Calculate the average of the 16 readings to the nearest 0.1 and record as the initial Y value (Y_i).

9.2 Soiling treatment.

9.2.1 Pre-heat the Launder-Ometer to $54 \pm 2^\circ\text{C}$ ($130 \pm 5^\circ\text{F}$).

9.2.2 Place 30 steel balls in each of the 20 stainless steel canisters.

9.2.3 Measure 4 L of soft water at $54 \pm 2^\circ\text{C}$ ($130 \pm 5^\circ\text{F}$) into a beaker.

9.2.4 Transfer 70 ± 0.15 mL of hardness concentrate into the beaker and stir for 30 s.

9.2.5 Add 200 ± 0.4 mL of the hard water (150 ± 5 ppm) to each of the stainless steel canisters.

9.2.6 Add 0.20 ± 0.01 g of 1993 AATCC Standard Reference Detergent into each of the stainless steel canisters.

9.2.7 Add 0.25 ± 0.01 g each of the two particulate soils, Bandy Black clay and vacuum cleaner dirt, to each canister.

9.2.8 Add two oily soiled carrier cotton swatches to each canister.

9.2.9 Add one test specimen to each canister. Close the canisters. Be sure to use solvent resistant seals. Place canisters into the Launder-Ometer.

9.3 Running time.

9.3.1 Choose one of the three run cycles as described below:

9.3.1.1 For Option 1, run one cycle for 10 min in the Launder-Ometer at $54 \pm 2^\circ\text{C}$ ($130 \pm 5^\circ\text{F}$).

9.3.1.2 For Option 2, run the 10 min cycle for a total of three times for the exaggerated soil level.

9.3.1.3 For Option 3, run a 30 min cycle in the Launder-Ometer at $54 \pm 2^\circ\text{C}$ ($130 \pm 5^\circ\text{F}$) for the level of soil that correlated best with 100 home launderings (see 12.1).

9.4 Rinsing and drying.

9.4.1 Remove a test specimen with tweezers. Rinse the specimen by dipping it ten times in each of three successive beakers of soft water at $20 \pm 5^\circ\text{C}$ ($70 \pm 10^\circ\text{F}$) for a total of 30 dips. Replace the rinse water after the four replicates of each test fabric are rinsed. Repeat for each of the remaining specimens of the sample.

9.4.2 Squeeze excess water from specimens by hand and tumble dry on the normal setting.

9.5 Fold, stack and read the Y values of the soiled test specimens as directed in 9.1.3. Calculate the average of the 16 readings to the nearest 0.1 and record as the soiled Y value (Y_f).

10. Calculation and Report

10.1 Calculate the soiling affinity using the following equation:

$$S = Y_i - Y_f$$

where:

S = Soiling affinity

Y_i = Initial, or unsoiled, Y value reading

Y_f = Final, or soiled, Y value reading

10.2 Report the following:

10.2.1 Description of the material tested.

10.2.2 Run cycle option used.

10.2.3 Water hardness.

10.2.4 Soiling affinity for each sample.

11. Precision and Bias

11.1 Precision.

11.1.1 The precision of this test method has not been established. Until a precision statement is generated, use standard statistical techniques in making any comparisons of test results for either *within-laboratory* or *between-laboratory* averages.

11.2 Bias.

11.2.1 There is no independent referee test method for measuring the true value of soil redeposition to determine any bias in this test method. There is no known bias.

12. Notes

12.1 The correlation tests referred to have utilized the AATCC approved washer (contact AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org, for the list of approved washers), Permanent Press or Durable Press Cycle, 37°C (100°F) wash temperature, 100 g of detergent, 64.6 L (17 gal) water, 120 ppm water hardness, 2.7 kg (6.0 lb) of test fabrics [0.68 kg (1.5 lb) clean fabric and 2.0 kg (4.5 lb) naturally soiled dirty clothes]. The items were tumble dried after each wash cycle and cold rinse. Instrumental readings were taken after 25, 50 and 100 cycles. A test fabric specimen of 350×350 mm

(14×14 in.) was used.

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

12.3 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.

12.4 Suitable apparatus: Hunterlab Model D25 (A, M or L) Colorimeter (gives Y values) available from the Hunter Associates Laboratory Inc., 11491 Sunset Hills Rd., Reston VA 20190; tel: 703/471-6870. Other instruments may be used as long as the values reported are Y values (See AATCC Evaluation Procedure 6).

12.5 Contact AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org, for model number(s) and source(s) of approved dryers. Any other dryer which is known to give comparable results can be used.

12.6 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.

12.7 Vacuum cleaner dirt can be obtained from domestic or office locations. Before use, screen the dirt through a 150-mesh (Tyler equivalent) screen to remove lint, trash and coarse particles. It can also be purchased 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.

12.8 A bleached cotton sheeting is suggested for the oily soiled swatches. A suitable fabric identified as Style 405 is 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, and 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.

12.9 In special circumstances, water with a 0 ppm and 300 ppm hardness may be used to simulate an unusual situation.

12.10 Make hardness concentrate as follows:

12.10.1 Chemicals. Magnesium chloride hexahydrate ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$); calcium chloride, anhydrous, (CaCl_2); softened water.

12.10.2 Procedure. In a glass container mix 13.114 ± 0.001 g magnesium chloride hexahydrate with 1 L of soft water with constant stirring. Add 2.356 ± 0.001 g of calcium chloride, anhydrous, slowly to keep heat generation to a minimum. Agitate a total of 30 min. The concentrate strength is equal to 34 ppm/mL or 2 gr/mL water hardness.

12.11 The 1993 AATCC Standard Reference Detergent is 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.

12.12 Triolein technical oil ($\text{C}_{57}\text{H}_{104}\text{O}_6$, FW 885.46) is available from Sigma Chemical Co., P.O. Box 14508, St. Louis MO 63178. The practical grade is catalog no. T7752.

12.13 Mineral oil is available from any division of The Standard Oil Co. Identify it as white mineral oil, USP 185.