Fabric Soil-Removal Test Method
For additional copies of this publication, write:

Department of Apparel, Interiors, Housing and Merchandising
Oregon State University
224 Milam Hall
Corvallis, OR 97331-5101
Fabric Soil-Removal Test Method

Hsiou-Lien Chen
Assistant Professor
and
Sally K. Francis
Professor and Head
Department of Apparel, Interiors, Housing and Merchandising
Oregon State University
Corvallis, Oregon
1. Purpose

1.1 This method determines the effect of two water temperatures and the presence of selected laundry aids on soil removal from two selected test fabrics.

1.2 Seven variables can affect the performance of laundering aids on soil removal and must be considered in designing tests for their evaluation:

a. Fiber content (e.g., cotton, polyester, nylon, blend, etc.) and fabric construction (e.g., weave structure, knit structure, etc.);
b. Kind and level of soil or stain;
c. Size of laundry load (4-8 pounds);
d. Temperature of wash water;
e. Presence of laundering aids (e.g., detergent, bleach, etc.);
f. Type of agitation; and
g. Wash time (i.e., length of laundry cycle).

2. Referenced Documents

This test method adapts and revises three standard methods:

2.1 ASTM D2960-89,
2.2 AHAM HLW-1-1987, and
2.3 CSMA Designation DCC-14-1991.

3. Materials and Apparatus

3.1 Test Fabrics. To control the types of soils, degrees of soiling, and the fabrics used in this test, purchase Clay and Dust-Sebum soiled test fabrics (Scientific Services S/D, Inc., 41 Main Street, P.O. Box 778, Sparrow Bush, N.Y. 12780). Obtain test fabrics comprised of two fiber types: a 100 percent cotton and a 65/35 percent polyester cotton blend. Select fabrics with plain weave construction.

3.2 Laundry Aids. Use the following four laundry aids in this test:

a. Water
b. Water + one Alternative Laundry Device
c. Water + one dummy Alternative Laundry Device
d. Water + AATCC WOB Standard Reference detergent
3.3 **Ballast or Dummy Load.** Add ballast of 36 inches x 36 inches hemmed pieces of bleached 100 percent cotton sheeting with the test fabrics to total 4 pounds per laundry load.

3.4 **Laundry Load.** Use a standard laundry load of 4 pounds in this test. Various committees dealing with laundering tests recommend this load size because the 4-pound load is much less than the load capacity of a standard washing machine. Consequently, specimens move relatively freely during agitation (Merkel 1991).

3.5 **Detergent.** Add AATCC WOB Standard Reference detergent (AATCC, P.O. Box 2215, Research Triangle Park, NC 27709) instead of commercial detergent. Use 100 grams of AATCC detergent for each full water level load (18 gallons). The major ingredients of AATCC WOB Standard Reference detergent are sodium salt, sodium aluminosilicate, sodium carbonate, sodium sulfate, moisture, sodium polyacrylate, polyethylene glycol, sodium silicate, and miscellaneous ingredients.

3.6 **Washer and Dryer.** Use a standard capacity household automatic washer and dryer (e.g., Kenmore, Fridgidaire). Conduct a thorough maintenance check of the washer and dryer before testing to ensure that the washer and dryer are in good working condition.

3.7 **Hunter Lab Spectrophotometer.** To collect data, use an upgraded LabScan 5000/.5100/5200 to LS600 w/Universal spectrophotometer by Hunter Lab, Reston, VA 22090. It provides SIU in lieu of processor, universal software, replacement of circular variable filter, and sensory recalibration. The SpecWare provides complete color quality-control capabilities. Color and spectral information can be displayed numerically or graphically as absolute numbers or as differences versus target values. Standard and sample storage and data can be transferred to spreadsheets and databases.

4. **Test Procedure**

4.1 **Pre-test Data Collection.**

a. Take a reading from the center of 15 unsoiled test fabrics of each fabric type using a Hunter Lab spectrophotometer.

b. Mark the test fabrics with a permanent laundry marker on the upper right hand corner before the laundering procedure to indicate the type of laundry aid used, water temperature, and soil type. Take a reading from the center of each of the un laundered 15 test fabrics using the Hunter Lab spectrophotometer before the laundering procedure.

4.2 **Preconditioning Washer.** Before the test of each laundering aid, rinse the washer with water once (i.e., run the machine through a complete washing cycle once without laundry aids or test fabrics) using the same water temperature that will be used in the ensuing test. Take a water
sample from the drain after the cycle and measure pH to ensure that there is no residue remaining in the machine from the previous testing condition.

4.3 Laundry load. Each laundry load should include one of the laundry aids listed in 3.2, following the sequence listed in order from a to d, 15 pieces of soiled test fabric (containing only 1 soil type, i.e., either Clay or Dust-Sebum soil), and ballast to total 4 pounds.

4.4 Washing Machine Settings. For each testing condition, use the following washing machine settings:

a. Washing water temperature. Use one of two water temperature conditions for each laundry aid: hot (130 °F or above) or warm (approx. 100 °F). Use a warm water temperature for all rinse cycles.

b. Water level. Use a full level of 18 gallons of water in the test for each laundry aid to ensure that items in the load move and turn over freely.

c. Machine cycle. Use a "normal" cycle for all test procedures. The normal cycle includes 16 minutes of washing, 10 minutes for the first rinse and 6 minutes for the second rinse. The agitator speed should be 68 spins per minute and the washer spin speed should be 500 rotations per minute for a normal wash cycle.

4.5 Order of Addition.

a. Weigh 15 test fabrics and ballast to total 4 pounds;

b. Add 18 gallons of water, set the washer for the desired washing condition, set agitator in motion;

c. Add one laundry aid;

d. Add test fabrics (add one at a time); and

e. Add ballast.

4.6 Dryer Condition. At the end of the second rinse, transport 15 test fabrics plus the ballast to a dryer for drying with heat for 40 minutes using the "regular fabrics" setting.

4.7 A complete testing cycle for each laundry aid consists of washing (washing once and rinsing twice) and drying once with conditions specified in 4.2-4.6. Repeat steps 4.2-4.6 for each laundry aid washing condition for the first test fabric type.

4.8 Repeat the laundering procedure (4.2-4.7) for all laundry aids for the second test fabric type.

4.9 Repeat the laundering procedure (4.2-4.7) for the second test soil type.

4.10 Repeat steps 4.2-4.9 for each laundry aid and water temperature condition.
4.11 Post-test Data Collection.

a. After laundering, take a reading again from the center of the laundered 15 test fabrics. Repeat this procedure for each of the laundering conditions.
b. Data analysis procedures follow the guidelines listed on #3 and #5 on CSMA Designation DCC-14.

5. Statistical Analysis

5.1 Questions.

a. For each soil type, are there statistically significant differences in soil removal among the 8 laundering conditions for the two test fabrics? In other words, are there significant differences between any of the 16 laundry conditions (i.e., 4 laundry aids x 2 water temperatures x 2 fabric types) when compared to any other tested condition? Is this true for each soil type?
b. For each soil type, if there are statistically significant differences among the 8 laundering conditions for the two test fabrics (question a), is there a statistically significant difference in soil removal for each test fabric under each of the 8 laundry conditions compared to a new unsoiled specimen of the test fabric? In other words, do any of the 16 laundry conditions have an effect on soil removal when compared to new unsoiled fabric? Is this true for each soil type?

5.2 Experimental Design. Conduct two sets of experiments: one for clay-soiled and one for Dust-Sebum soiled test fabrics. For each experiment the same 4x2x2 factorial experimental design is used. The dependent variable is soil removal. The independent variables are laundry aid, water temperature, and fabric type. The 3 independent variables result in a total of 16 treatment conditions.
Laundry aid comprises 4 levels:
1. Water
2. Water + one Alternative Laundry Device
3. Water + one dummy Alternative Laundry Device
4. Water + AATCC WOB Standard Reference detergent

Water temperature comprises 2 levels:
1. Warm (approx. 100° F)
2. Hot (130° F or above)

Fabric type comprises 2 levels:
1. 100 percent cotton
2. 65 percent/35 percent polyester/cotton plain weave

Figure 1. Experimental design of the fabric soil-removal test method.

5.3 **Statistical Tests.** Use three-way analysis of variance (ANOVA) to test for statistically significant effects of the 3 independent variables (laundry aid, water temperature, fabric type) and all possible interactions among them. ANOVA is a statistical test that detects differences in soil removal as a result of the effects of the three independent variables (laundry aid, water temperature, fabric type). Also, two- and three-way interactions among combinations of the three independent variables (e.g., laundry aid + water temperature) may be analyzed. An alpha level of .05 should be used to determine statistical significance.

Significant differences found as a result of the ANOVA should be followed up with t-tests to test for statistically significant differences between the new unsoiled test fabrics and each of the 8 laundry treatment conditions. Use an alpha level of .05 to determine statistical significance.

5.4 **Final Report.** Prepare a final report to summarize research findings. The report should include a narrative description of the methods, findings, raw data, statistical analyses, and interpretation of results.
6.0 References


