Designation: D3050 – 07 (Reapproved 2015)

Standard Guide for Measuring Soil Removal from Artificially Soiled Fabrics (Not Suitable for Detergent Ranking)[1]

This standard is issued under the fixed designation D3050; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This is a guide for measuring the ability of detergents to remove artificially applied soils from fabrics. It is intended as a laboratory screening test to aid in the formulation of detergent products, for quality control and as a basis between the purchaser and seller in standardizing specific products' performance.

1.2 The relative ranking of detergent products will vary greatly depending on the type of soiled fabrics used in the test. Therefore, selection of the standard soiled fabric to be used in a test shall be made by agreement between the interested parties on the basis of experience.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1193 Specification for Reagent Water

D2960 Guide for Controlled Laundering Test Using Naturally Soiled Fabrics and Household Appliances (Withdrawn 2013)[3]

3. Summary of Guide

3.1 Soiled fabric swatches are washed in a laboratory washer using the products being tested and the change in reflectance is measured.

4. Significance and Use

4.1 The guide, as now constituted, is not suitable for ranking of detergent products since no basis is available at this time for correlation of the detergency performance of any particular soiled cloth or clothes with detergency of naturally soiled articles.

4.2 A suggested procedure for comparing the performance of any two laundry detergents on naturally soiled family items in home laundry equipment under controlled conditions on a paired comparison basis is described in Method D2960.

5. Apparatus

5.1 *Laboratory Washer*—A laboratory scale agitator-type washing machine.[4]

5.2 *Reflectometer,* calibrated by means of standard vitreous enamel plaques having reflectances in the range of the fabric or swatch samples being measured.

6. Reagents and Materials

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[5] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean Type IV reagent water conforming to Specification D1193.

6.3 *Hard Water Stock Solution*—Prepare a hard water stock solution by dissolving 2.940 ± 0.002 g of calcium chloride dihydrate ($CaCl_2 \cdot 2H_2O$) and 2.033 ± 0.002 g of magnesium

[1] This guide is under the jurisdiction of ASTM Committee D12 on Soaps and Other Detergents and is the responsibility of Subcommittee D12.15 on Physical Testing.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] The Terg-o-tometer, obtainable from the United States Testing Co., 1415 Park Ave., Hoboken, NJ, or its equivalent, has been found satisfactory for this purpose.

[5] *Reagent Chemicals, American Chemical Society Specifications* , American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

chloride hexahydrate ($MgCl_2 \cdot 6H_2O$) in about 300 mL of water. Dilute to a volume of 1 L with additional water. This solution contains 3000 ppm hardness (expressed as calcium carbonate) with a Ca:Mg molar ratio of 2:1. Other ratios may be used.

6.4 *Reference Detergent*—A comparison detergent suitable to the fabric and conditions shall be included in each run.

6.5 *Standard Soiled Fabrics.*

NOTE 1—Most commercially available soiled swatches are based on particulate component such as clay, iron oxide, carbon black, vacuum cleaner dust, air-conditioner filter dust or other particulate, inorganic or organic matter, with or without one or more oily components such as synthetic sebum, oil, or grease.

7. Procedure

7.1 Operate the washer at a suitable fixed speed (90 cycles/min is suggested). Maintain the water bath at a temperature suitable to the fabric, detergent, and conditions of the test. Prepare duplicate solutions of the test product and the reference detergent in 1000 mL of water at the desired concentration, temperature, and water hardness. It is recommended that concentrations of 0.1, 0.15, 0.2 and 0.25 %, temperature of 60, 90, and 120°F (16, 35, and 49°C) and water hardnesses of 35, 150, and 300 ppm be included. Transfer the solutions to the buckets of the washer. Add to each bucket in rapid succession the selected soiled swatches and wash for 10 min. Then remove the swatches, squeeze them by hand and transfer to a bucket containing 1000 mL of water of the same hardness at the same temperature and rinse 3 min. Then damp dry the swatches between clean toweling and air or tumble dry. Determine the reflectances of the washed and dried swatches. Replicate the above tests a sufficient number of times for statistical significance.

NOTE 2—If only one test is to be made, water hardness of 150 ppm is suggested since approximately 80 % of the families in the United States have this level of hardness or below. It should also be noted that while natural soils add hardness to the wash bath, artificial soils may not; therefore a hardness of 75 ppm may be more realistic for the lower hardness level.

NOTE 3—To avoid discoloration or change, or both, in the structure of the swatch surfaces do not use a photographic print dryer, hand iron, or mangle to dry the swatches.

8. Instrumental Evaluations and Calculations

8.1 Measure the reflectance, L, and both parameters "a" and "b" of the residual soils relative to the unsoiled fabric with a photoelectric colorimeter.

8.1.1 Carefully present each swatch to the instrument with the same orientation, for example, long direction perpendicular to operator. Back each swatch with the other replicate specimens (usually five) representing the same treatment variable.

8.1.2 Read swatches with no ultraviolet light. Standard filter for eliminating ultraviolet from light source should be used.

8.2 Measure the reflectance of the unsoiled washed reference as described in 8.1.

8.3 Calculate the soil removal index (SRI) for each test specimen using the following formula:

$$\mathrm{SRI} = 100 - \left[(L_c - L_w)^2 + (a_c - a_w)^2 + (b_c - b_w)^2\right]^{1/2} \quad (1)$$

where:

L = reflectance (white/black),
a = redness/greenness,
b = yellowness/blueness,
c = unsoiled fabric, washed in the treatment conditions, and
w = soiled fabric.

8.4 *Improvement in Reflectance*—Calculate the improvement in reflectance as follows:

$$\%\ \text{improvement in reflectance} = \left[(A - B)/(C_0 - B)\right] \times 100 \quad (2)$$

where:

A = average reflectance of the soiled swatches after washing,
B = average reflectance of the soiled swatches before washing, and
C_0 = average reflectance of the unsoiled swatches before washing.

NOTE 4—If unsoiled swatches of the type used to make the soiled fabrics are not available, calculate the improvement in reflectance as follows:

$$\text{Improvement in reflectance } (\Delta Rd) = A - B \quad (3)$$