Designation: D5548 – 13

Standard Guide for Evaluating Color Transfer or Color Loss of Dyed Fabrics in Laundering (Not Suitable for Detergent or Washing Machine Rankings)[1]

This standard is issued under the fixed designation D5548; 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 guide covers the evaluation of the effect of dyestuff color transfer or color loss from dyed fabrics. It is designed as a laboratory screening test to aid in the formulation of detergent products or the comparison of two or more detergents.

1.2 There is no single assessment that will give the overall performance of a laundry product. A single test can only suggest how a formulation performs under the particular conditions chosen for the evaluation and cannot be expected to reflect comparative product performance under the many other possible conditions of use. A series of assessments is always necessary in order to evaluate the many aspects of product performance. It is necessary to conduct confirming tests under controlled but practical home-laundering conditions to simulate consumer experience.

1.3 The values stated in either inch-pound or SI units are to be regarded separately as the standard. The values given in parentheses are for information only.

1.4 *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]

D459 Terminology Relating to Soaps and Other Detergents

D1776 Practice for Conditioning and Testing Textiles

E179 Guide for Selection of Geometric Conditions for Measurement of Reflection and Transmission Properties of Materials

E1347 Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

2.2 *AATCC Methods:*

Evaluation Procedure 6 Instrumental Color Measurement[3]

Evaluation Procedure 7 Instrumental Assessment of the Change in Color of a Test Specimen[3]

3. Terminology

3.1 *Definitions:*

3.1.1 See Terminology D459.

3.1.2 *laundering, n*—a process intended to remove soils or stains, or both, by treatment (washing) with an aqueous detergent solution and normally including subsequent rinsing, extraction, and drying.

3.1.3 *rinse, v* or *n*—a process or treatment in an aqueous medium for the purpose of removing extraneous matter from textile materials.

4. Summary of Guide

4.1 Three fabrics are chosen that exhibit varying degrees of color loss or transfer. A nylon fabric is dyed with a heavy concentration of a red dye that will exhibit the greatest amount of color loss or transfer. Two cotton fabrics are dyed with blue dyes, which provide a light and intermediate level of color loss and transfer. A bleached undyed cotton fabric is washed in the same bucket as the dyed fabrics to act as a receptacle for the fugitive dyestuff.

4.2 The evaluation is performed in a laboratory washer under standardized conditions. It is possible to rank one or more detergents using instrumental readings and determining the ΔE^* values.

[1] This guide is under the jurisdiction of ASTM Committee D12 on Soaps and Other Detergents and is the direct responsibility of Subcommittee D12.25 on Consumer Standards.

Current edition approved June 1, 2013. Published July 2013. Originally approved in 1994. Last previous edition approved in 2011 as D5548 – 05$^{\varepsilon 2}$. DOI: 10.1520/D5548-13.

[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] Available from American Association of Textile Chemists and Colorists (AATCC), P.O. Box 12215, Research Triangle Park, NC 27709.

5. Apparatus

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

5.2 *Photoelectric Colorimeter.*

5.3 *Fabrics:*

5.3.1 Spun nylon 6.6 fabric dyed with Acid Red 151 at 2.5 %.

5.3.2 Cotton print cloth dyed with Direct Blue 71 at 0.4 %.

5.3.3 Cotton print cloth dyed with Direct Blue 90 at 0.75 %.

5.3.4 Bleached cotton print cloth (undyed).

6. Materials

6.1 *One Swatch*—4½ by 6 in. (114 by 152 mm) spun nylon 6.6 fabric dyed Acid Red 151 for each detergent being evaluated.

6.2 *Three Swatches*—4½ by 6 in. (114 by 152 mm) cotton print cloth dyed Direct Blue 90 for each detergent being evaluated.

6.3 *Three Swatches*—4½ by 6 in. (114 by 152 mm) cotton print cloth dyed Direct Blue 71 for each detergent being evaluated.

6.4 *One Swatch*—4½ by 6 in. (114 by 152 mm) bleached cotton print cloth for each detergent being evaluated.

6.5 *Detergent(s) Being Evaluated.*

6.6 *Laundry Additive(s) Being Evaluated (Optional).*

6.7 *Hard-Water Stock Solution*—Prepare a hard-water stock solution by dissolving 3.3075 ± 0.002 g of calcium chloride dihydrate ($CaCl_2 \cdot 2H_2O$) and 1.525 ± 0.002 g of magnesium 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 3:1.

7. Instrumental Reading of Undyed Fabric

7.1 Carefully present each swatch to a photoelectric colorimeter with the same orientation (for example, long direction perpendicular to operator). Back each swatch with the same color specimens.

7.2 Read swatches with no ultraviolet light. Standard filters for eliminating ultraviolet from the light source should be used.

7.3 Measure the reflectance of the undyed fabric with a photoelectric colorimeter. (See Practice D1776, Test Method E1347, Guide E179, and AATCC Procedures 6 and 7.)

7.4 Measure the reflectance of the dyed fabrics with a photoelectric colorimeter. (See Practice D1776, Test Method E1347, Guide E179, and AATCC Procedures 6 and 7.)

8. Procedure for Color Transfer in One Wash

8.1 Wash swatches in laboratory washer.

8.1.1 *Water*—1000 mL water hardened to 110 ppm with a 3:1 mixture of Ca:Mg.

8.1.2 *Water Temperature*—32°C (±1°C).

8.1.3 *Detergent*—0.2 % concentration or manufacturer's use level.

8.1.4 *Laundry Additives (Optional)*—Manufacturer's recommended concentration.

8.1.5 *Agitation Rate*—60 cycles per min.

8.1.6 *Time*—15 min.

8.1.7 Use the appropriate number of swatch(s) (one color), depending on which dye cloth is being used, per bucket for each detergent being evaluated.

8.1.8 Use one swatch of undyed fabric per bucket for each detergent being evaluated.

8.1.9 Rinse at 20°C (±3°C) for 3 min in 1000 mL of 110 ppm water with agitation.

8.1.10 Air dry without heat.

8.1.11 Repeat instrumental readings as per Section 7.

NOTE 1—It has been demonstrated that color transfer occurs in one wash using the specified dyed fabrics in 5.3 of this guide.

9. Procedure for Color Loss in Three Washes

9.1 Wash swatches in laboratory washer.

9.1.1 *Water*—1000 mL distilled water per bucket, hardened to 110 ppm.

9.1.2 *Water Temperature*—32°C (±1°C).

9.1.3 *Detergent*—0.2 % concentration or manufacturer's recommended use level.

9.1.4 *Laundry Additives (Optional)*—Manufacturer's recommended use level.

9.1.5 *Agitation Rate*—60 cycles per min.

9.1.6 *Time*—15 min.

9.1.7 Use the appropriate number of dyed fabric swatches (one color) per bucket for each detergent being evaluated.

9.1.8 Rinse at 20°C (±3°C) for 3 min in 110 ppm water with agitation.

9.1.9 Air dry without heat.

9.1.10 Repeat instrumental readings as per Section 7.

9.2 Repeat steps in 9.1 for a total of three washes.

NOTE 2—It has been demonstrated that color loss occurs over repeated washings. Three washings using the specified fabrics in 5.3 of this guide will demonstrate color loss for practical purposes.

10. Calculations

10.1 Calculate ΔE^*ab values using the following equation:

$$\Delta E^*ab = \sqrt{(L_2^* - L_1^*)^2 + (a_2^* - a_1^*)^2 + (b_2^* - b_1^*)^2} \quad (1)$$

where: ΔE^*ab is also referred to as dE^*, dE, or Delta E

L^* = reflectance,
a^* = redness/greenness,
b^* = yellowness/blueness,
2 = fabric after washing, and
1 = fabric before washing.

11. Report

11.1 Report the following information:

11.1.1 Details of any optional or additional requirements that have been met,

[4] The sole source of supply of the laboratory washer known to the committee at this time is the Terg-O-Tometer, available from SGSUS Testing, 291 Fairfield Ave., Fairfield, NJ 07004, U.S.A. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

11.1.2 Whether the procedure in Section 8 or 9 was used, and

11.1.3 The results obtained according to Section 10.

12. Keywords

12.1 colorfastness; dye fading; dye transfer; fabrics