

Test Method for Transfer of Acid and Premetallized Acid Dyes on Nylon

Developed in 1979 by AATCC Committee RA87; editorially revised and reaffirmed 1984, 1989 (title change), 1994, 1999; editorially revised 1985, 1987, 1997, 2004, 2010, 2019; reaffirmed 2006; revised 2011, 2017.

1. Purpose and Scope

1.1 This test method evaluates the transfer of an acid (anionic) or premetallized dye from a dyed to an undyed nylon substrate under mock dyebath conditions. A general method of dyeing acid dyes on nylon is included for uniformity of dyeing procedure.

2. Principle

2.1 A test specimen of nylon fabric is dyed to 1/1 standard depth with the dye to be evaluated. Part of the dyed fabric together with an equal weight of undyed fabric is subjected to transfer in a mock dyebath.

2.2 Transfer is made at pH 4.5, 6.0 and 7.5, and at a temperature of 95°C.

3. Terminology

3.1 **acid dye**, n.—an anionic dye having substantivity for fibers which contain cationic groups usually in acidic or neutral aqueous dyebaths.

3.2 **premetallized acid dye**, n.—an acid dye manufactured by reacting an equivalent of a suitable metal ion with one equivalent of a dye (1:1 premetallized acid dye), or with two equivalents of the same or different dyes (1:2 premetallized acid dyes), capable of chelating the metal.

3.3 **transfer**, n.—in textile processing, testing, storage and use, movement of a chemical, dye or pigment between fibers within a substrate or between substrates (see also *migration*, *leveling*).

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 Good laboratory practices should be followed. Wear safety glasses in all

laboratory areas and a single-use dust respirator while handling powder dyes.

4.2 All chemicals should be handled with care. Use chemical goggles or face shield, impervious gloves and an impervious apron when dispensing concentrated acids and sodium hydroxide.

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

4.4 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; see web site: www.osha.gov for latest version). 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 9.1).

5. Apparatus and Materials

- 5.1 Dyed nylon.
- 5.2 Undyed nylon (from same piece as dyed sample).
- 5.3 Nonionic surfactant.
- 5.4 Sodium carbonate (Na_2CO_3).
- 5.5 Phosphoric acid (usually 85%) (H_3PO_4).
- 5.6 Acetic acid, glacial (CH_3COOH).
- 5.7 Boric acid (H_3BO_3).
- 5.8 Sodium hydroxide (NaOH).
- 5.9 Acetic acid, 56% (CH_3COOH).
- 5.10 EDTA (ethylenediaminetetraacetic acid, tetrasodium salt, 100% powder).
- 5.11 Means of evaluating color change of specimen.
 - 5.11.1 Gray Scale for Color Change (AATCC EP1) (see 9.2), or
 - 5.11.2 Spectrophotometer meeting any one of the geometric definitions described in CIE publication 15.2, subclause 1.4 (see 9.3).
 - 5.12 Means of evaluating color staining on specimen
 - 5.12.1 Gray Scale for Staining (AATCC EP2) (see 9.2), or
 - 5.12.2 AATCC 9-Step Chromatic Transference Scale (AATCC EP8) (see 9.2), or
 - 5.12.3 Spectrophotometer meeting any one of the geometric definitions described in CIE publication 15.2, subclause 1.4 (see 9.3).

6. Procedure

- 6.1 Fabric Preparation.
 - 6.1.1 Scour undyed fabric in a bath containing 1.5 g/L nonionic surfactant (5.3) and 1.5 g/L sodium carbonate for 30 min at 50–60°C.
 - 6.1.2 Rinse thoroughly in water.
 - 6.1.3 Neutralize with acetic acid, 1 mL/L 56% acetic acid.
 - 6.1.4 Final rinse in water.
 - 6.1.5 Air dry.
- 6.2 Dyeing Procedure.
 - 6.2.1 Set 30:1 bath at 38°C (100°F); X.XX% dye; 0.25% EDTA sequestrant (omit for neutral premetallized dyes; and 2.00% acetic acid [56%]).
 - 6.2.2 Enter nylon substrate (cloth, yarn, stock) at 38–48°C.
 - 6.2.3 Raise temperature to boil at 1.5°C/min.
 - 6.2.4 Dye at or near boil for 45 min.
 - 6.2.5 If necessary, add an additional 1.0% acetic acid (56%) to exhaust dye.
 - 6.2.6 Run an additional 15 min.
 - 6.2.7 Rinse in hot 80–90°C water, then in 38°C water.
 - 6.2.8 Air dry.
- 6.3 Transfer Bath Preparation (see Appendix I).
 - 6.3.1 Prepare 200 mL mock dyebaths (one for each dye to be tested) for pH 4.5, 6.0 and 7.5 as described in Appendix I.
 - 6.3.2 Add one 5 g piece of dyed fabric and one 5 g piece of undyed fabric to each mock dyebath; B/F = 20/1.
 - 6.3.3 It has been shown that the degree of agitation is a contributing factor affecting the rate of diffusion of dyes into and out of a substrate. Agitation should be the same for all comparative experiments.
 - 6.3.4 Raise temperature at 2°C/min to 95°C/min (5°F/min to 203°F/min) and run with agitation for 50 min. Save the bath (see 6.3.6).
 - 6.3.5 Remove both pieces of fabric. Rinse with water and air dry.
 - 6.3.6 Measure pHs of part of the transfer baths at room temperature and record in the table attached.
 - 6.3.7 Add a piece of undyed nylon to the transfer bath and exhaust using the conditions outlined in 6.3.4. Adjust pH to 4.5 to accomplish. Record pH in table.

7. Evaluation and Reporting

- 7.1 Comparison of Dyes at pH 4.5.
 - 7.1.1 For best observations, samples should be butted together on white board as shown in Fig. 1.
 - 7.1.2 Mount pH 6.0 and 7.5 samples similarly.

Transfer pH 4.5				
	Original	From	To	Exhaust
Dye A				
Dye B				
Dye C				

Fig. 1—Mounting for comparison of dyes at pH 4.5.

<u>Transfer of Dye A</u>					
	Original	From	To	Exhaust	
					pH 4.5
					pH 6.0
					pH 7.5

Fig. 2—Mounting for comparison of Dye A at pH 4.5, 6.0, and 7.5.

7.2 Comparison of Dye A at pH 4.5, 6.0 and 7.5.

7.2.1 Mount samples on white board as shown in Fig. 2.

7.2.2 Mount Dye B and Dye C samples similarly.

7.3 Comparison of Shade.

7.3.1 Rate the degree of color difference between “to” and “from” samples using the Gray Scale for Color Change (AATCC EP1) or AATCC EP7, Instrumental Assessment of the Change in Color of a Test Specimen (see 9.2). Record the appropriate rating.

7.4 Exhaust Example Evaluation.

7.4.1 Rate the degree of staining on the “Exhaust” sample using the Gray Scale for Staining (AATCC EP2) or AATCC 9-Step Chromatic Transference Scale (AATCC EP8) or AATCC EP12, Instrumental Assessment of Degree of Staining (see 9.2). Record the appropriate numerical rating.

7.5 Record type of nylon and manufacturer on all test boards.

8. Precision and Bias

8.1 *Precision.* Precision for this test

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

8.2 *Bias.* The transfer of acid and pre-metalized acid dyes on nylon can be defined only in terms of a test method. There is no independent method for determining the true value. As a means of estimating this property, the method has no known bias.

9. Notes

9.1 Available from Publications Office, ACGIH, Kemper Woods Center, 1330 Kemper Meadow Dr., Cincinnati OH 45240; tel: +1.513.742.2020; web site: www.acgih.org.

9.2 Available from AATCC Technical Center, P.O. Box 12215, Research Triangle Park NC 27709; tel: +1.919.549.8141; fax: +1.919.549.8933; e-mail: ordering@aatcc.org; web site: www.aatcc.org.

9.3 CIE Publication 15:2004 Colorimetry, 3rd Edition. Available through the US National Committee of the CIE or via the CIE webshop (www.techstreet.com/cie/).

Appendix I

Preparation of Buffered Mock Dyebaths

A1. Prepare two solutions as follows using distilled water (tap water can be used if distilled water is not available):

SOLUTION A—5 g phosphoric acid (100%); 2.4 g acetic acid (100%); and 1.76 g boric acid (HBO₂ 100%). Make to 1L of solution.

SOLUTION B—8 g sodium hydroxide. Make to 1L of solution.

A1.1 Prepare mock dyebaths as shown in Table I using a pH meter. The amount of Solution B required to obtain the desired pH may vary slightly. Add Solution B to Solution A, checking end point with pH meter. Dilute to 600 mL with deionized water. This is sufficient for three mock dyebaths at each pH value.

Table I—Preparation of Mock Dyebaths

	Solution A	Solution B	Solution C
pH 4.5	100 mL	ca. 35 mL	600 mL
pH 6.0	100 mL	ca. 50 mL	600 mL
pH 7.5	100 mL	ca. 10 mL	600 mL