Evaluation Procedure for Gray Scale for Color Change

Foreword

This procedure is used to standardize visual evaluation of color change due to colorfastness tests. It is not intended for use in the color approval (lab dip) process. For instrumental assessment of color change, refer to AATCC EP7, Evaluation Procedure for Instrumental Assessment of the Change in Color of a Test Specimen. The colors of AATCC Gray Scale color chips are the same as those specified in ISO 105-A02.

1. Scope

1.1 This evaluation procedure describes the use of a Gray Scale for visually evaluating overall color change resulting from colorfastness tests. Individual color difference components of lightness, chroma and hue may be noted, but are not quantified by this procedure. To determine if a Gray Scale is still suitable for use, see Appendix A.

1.2 Color change due to any colorfastness test may be evaluated.

2. Principle

2.1 The result of a colorfastness test is evaluated by visually comparing the difference in color between the original (untested) and tested specimens with the differences represented by the Gray Scale for Color Change. The color change grade is equal to that of the Gray Scale pair that is judged to have the same color difference. Results are reported as a Gray Scale for Color Change grade of 5 to 1, with 5 representing no color change and 1 representing the most color change.

3. Terminology

3.1 **color change,** n.—a change in color of any kind whether in lightness, hue or chroma, or any combination of these, discernible by comparing the test specimen with a corresponding untested specimen.

3.2 **colorfastness,** n.—the resistance of a material to change in any of its color characteristics, to transfer of its colorant(s) to adjacent materials or both, as a result of the exposure of the material to any environment that might be encountered during the processing, testing, storage or use of the material.

3.3 **grade,** n.—the number assigned to a test specimen resulting from comparison to a scale.

3.4 **Gray Scale,** n.—a scale consisting of pairs of standard gray chips, the pairs representing progressive differences in color corresponding to numerical colorfastness grades.

NOTE: Gray Scale grades are expressed as half-steps in decimal form (e.g., 1 or 1.5). Dashed form is also acceptable (e.g., 1 or 1-2).

4. Materials

4.1 Gray Scale for Color Change, including gray mask with *Y* tristimulus of 63 ± 2 (see 8.1 and 8.2).

4.2 White backing material (cardstock or other), *Y* tristimulus value of at least 85 (see 8.3), no optical brightener. Small pieces (approximately the same size as specimens) may be used for evaluation only, or larger pieces may be used for permanent mounting of specimens.

4.3 Illumination and viewing environment as described in AATCC EP9, Evaluation Procedure for Visual Assessment of Color Difference of Textiles (see 8.1).

5. Description of the Scale

5.1 Color change grade 5 is represented on the scale by two neutral gray reference chips mounted side by side, having a *Y* tristimulus value of 12 ± 1. This pair has no perceptible color difference (see Appendix A).

5.2 Color change grades 4.5 (or 4-5) to 1, inclusive, are represented by reference chips like those used in grade 5, paired with lighter neutral gray chips of similar dimensions and gloss. The visual differences in the whole-grade pairs—grades 4, 3, 2 and 1—are in geometric progression of color difference. The differences in the half-grade pairs—4.5, 3.5, 2.5 and 1.5 (or 4-5, 3-4, 2-3 and 1-2)—are intermediate between the whole-grade pairs (see 8.2 and Fig. 1).

6. Procedure

6.1 Place an original (untested) specimen and its corresponding tested specimen side by side, edges touching, in the same plane and oriented in the same direction. Take special care to create a sharp junction between the two specimens. Trim loose threads as needed.

6.2 Place the specimens, both the original and tested, over a piece of white backing material. Any means of attachment (staples, etc.) must not be in the area viewed. If necessary, place two or more layers of the original textile under both original and tested specimens to create opacity.

Fig. 1—Gray Scale for Color Change.

6.3 Place the Gray Scale along the specimen edges, with the junctions of the specimens and the Gray Scale pair aligned.

6.4 Place the mask provided with the scale over the specimens and the scale to eliminate any influence from the surrounding areas (see Fig. 2).

6.5 Illuminate the surfaces and use viewing conditions as described in AATCC EP9, with preference to Option A (45°/0°).

6.6 Compare the perceived visual difference between original and tested specimens with the differences represented by the Gray Scale pairs. The grade is that of the Gray Scale pair whose color difference corresponds most closely to the color difference between the original and tested specimens.

6.6.1 A grade of 5 is given only when there is no perceived difference in color between the original and tested specimens.

6.6.2 A grade of 0 may be given when the perceived difference in color between the original and tested specimens is decidedly greater than a grade of 1.

6.7 The cleanliness and physical condition of the Gray Scale is extremely important in obtaining consistent results (see 8.4).

6.8 When several assessments have been made, it is very useful to compare all the pairs of original and tested specimens which have been given the same numerical grade. This gives a good indication of the consistency of the grades, since any errors become prominent. Pairs that do not appear to have the same degree of color difference as others with the same grade should be re-checked against the Gray Scale and, if necessary, the grades should be changed.

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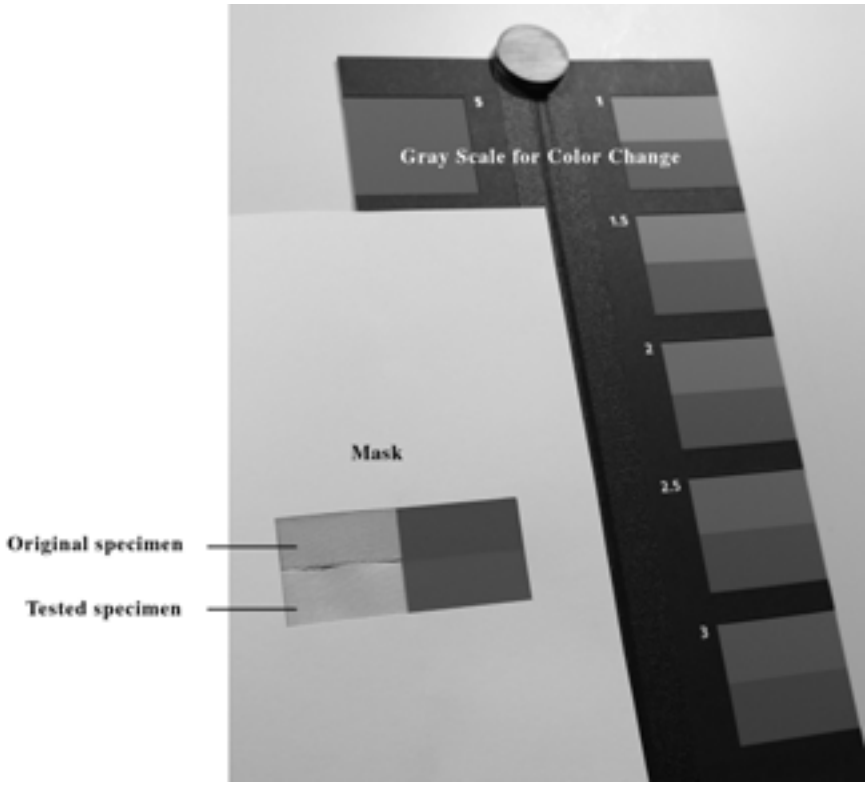

Fig. 2—Illustration of how to use scale.

7. Report

7.1 Report the grade assigned to each specimen pair as directed in the relevant colorfastness test method. The Gray Scale grade is an evaluation of the overall, total color difference between the original and tested specimens.

7.2 This procedure is not used to evaluate the changes in the individual components of lightness, chroma and hue. If a description of these component changes is required, the observer may add appropriate qualitative terms to the numerical grade, as listed in Table I.

8. Notes

8.1 Available from AATCC, P.O. Box 12215, Research Triangle Park NC 27709; +1.919.549.8141; ordering@aatcc.org; www.aatcc.org.

8.2 The grades of the Gray Scale pairs, and the corresponding total color differences and tolerances, determined by the CIE 1976 L*a*b* (CIELAB) formula, are given in Table II. Colorimetric data is calculated using the CIE 1964 10° observer data for Illuminant D_{65}.

Table I—Color Difference Direction Descriptors

Lightness	Lighter, Darker
Chroma	More (or higher) chroma and Less (or lower) chroma
Hue	Redder, Greener, Yellower, Bluer

8.3 Colorimetric data is calculated using the CIE 1964 10° observer data for Illuminant D_{65}.

8.4 The Gray Scale should be inspected frequently for fingerprints and any other marks. If the marks interfere with the evaluation process, the scale should be replaced immediately. The scale can also be physically damaged through handling. To minimize damage, do not place the mask in the folded scale. If the physical damage to the Scale interferes with the evaluation process, it should be replaced immediately. The scale should be measured quarterly on a spectrophotometer or colorimeter (see Appendix A) to ensure that the total color differences are within specification as shown in Table II. If not within specification, the scale should be replaced. If the Scale is not measured on a spectrophotometer or colorimeter, replace within 1 year of initial use. Keep the scale in its sleeve when it is not in use.

Table II—Color Differences for Gray Scale for Color Change Chip Pairs

Grade	ΔE_{CIELAB}	Tolerance
5	0.0	+ 0.2
4.5	0.8	± 0.2
4	1.7	± 0.3
3.5	2.5	± 0.3
3	3.4	± 0.4
2.5	4.8	± 0.5
2	6.8	± 0.6
1.5	9.6	± 0.7
1	13.6	± 1.0

9. History

9.1 Revised to include Gray Scale maintenance and replacement instructions approved by the committee in 2018, but omitted from the previous published version.

9.2 Revised 2018, 2012, 2002, 1987, 1979. Editorially revised 2011, 2009, 1991. Editorially revised and reaffirmed 1992. Reaffirmed 2007.

9.3 Technically equivalent to ISO 105-A02. Adopted in 1954 by AATCC; under jurisdiction of AATCC Committee RA36.

Appendix A

A.1 Table II provides the color difference values in CIE 1976 L*a*b* (CIELAB) units for each pair of chips on the Gray Scale for Color Change, calculated using the CIE 1964 10° observer data for Illuminant D_{65}.This table is for instrumental measurement and confirmation that a Gray Scale is within tolerance, only. Table II is NOT to be used for assigning a Gray Scale grade based on instrumental measurement of two specimens (see AATCC EP7).

A.2 The reference for each of the color pairs must be the reference for *that pair* (not the grade 5 reference). Each color difference measurement is the difference between the bottom section of a pair and the top section of the same pair.

To check a Gray Scale for compliance, spectrophotometric measurements may be made under the following conditions:

A.1.1 di:8° (diffuse, specular included/8 degree) sphere instrument.

A.1.2 Small area of view, approximately 10-mm diameter.

A.1.3 Specular component included.

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