

Compatibility of Basic Dyes for Acrylic Fibers

Developed in 1974 by AATCC Committee RA87 (see 10.1); reaffirmed 1976, 1977, 1980, 1989; revised 1984; editorially revised 1985, 1988; editorially revised and reaffirmed 1987, 1994, 1999, 2004. Technically equivalent to ISO 105-Z03.

1. Purpose and Scope

1.1 In the dyeing of acrylic fibers with basic dyes, the classic parameters—e.g., the time of half-dyeing—of individual dyes do not give a true indication of their dyeing behavior in admixture with other basic dyes.

1.1.1 Since basic dyes show virtually no migration in acrylic fibers under normal dyeing conditions, compatibility is of major importance in selecting dye combinations with optimum level dyeing behavior (see 10.2).

1.2 This test method is intended to determine the behavior of a dye in relation to its compatibility when applied to acrylics (see 10.3, 10.4 and 10.5).

2. Principle

2.1 Compatibility is assessed against one of two defined five-step scales, a yellow scale and a blue scale. The assessment should be made using the scale showing the greatest difference in hue from that of the dye under test.

2.1.1 The compatibility value of the dye is assessed by determining its dyeing behavior in combination with each of the standard dyes in the relevant scale.

2.1.2 The recommended standard dyes have been chosen because: (a) they form two series encompassing the compatibility behavior of nearly all basic dyes recommended for acrylic fibers; (b) the dyes in a series are spaced to produce approximately equal visual effects; and (c) the corresponding standard dyes from both scales are compatible (see 10.4).

3. Terminology

3.1 **basic dye, n.**—a dye that dissociates in an aqueous medium to give a positively charged colored ion (cation) with affinity for fibers containing acidic groups.

3.2 **compatibility, n.**—in textile dyeing, propensity of individual dye components in a combination shade to exhaust at similar rates resulting in a buildup of shade that is constant, or nearly constant, in hue throughout the dyeing process.

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.

4.3 Use chemical goggles or face shield, impervious gloves and an impervious apron during handling of concentrated acetic acid.

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

4.5 The basic dyes listed in this method belong to the following classes:

C.I. Basic Orange 42—Azo-methineazo
C.I. Basic Yellow 29—Methine
C.I. Basic Yellow 28—Monoazo
C.I. Basic Yellow 15—Monoazo
C.I. Basic Orange 48—Azo
C.I. Basic Blue 69—Methine
C.I. Basic Blue 45—Anthraquinone
C.I. Basic Blue 47—Anthraquinone
C.I. Basic Blue 22—Anthraquinone
C.I. Basic Blue 77—Triarylmethane

4.6 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 of January 1, 1989). 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 10.9).

5. Standard Dyes (see 10.6)

5.1 The constitution of the scales, and recommended amounts of standard dyes, to be used in the test, are as shown in Table I.

Table I

Amount of Standard Dye (% owf) ¹	C.I. Basic	Compatibility Value
Yellow		
0.45	Orange 42	1.0
0.25	Yellow 29 (200%)*	2.0
0.15	Yellow 28 (200%)*	3.0
0.75	Yellow 15	4.0
0.65	Orange 48	5.0
Blue		
0.55	Blue 69	1.0
2.7	Blue 45	2.0
0.6	Blue 47 (200%)*	3.0
0.6	Blue 77	4.0
1.2	Blue 22 (200%)	5.0

¹Note: (owf) means "on weight of fabric" and dyes marked with an (*) are 200% (see 10.8)

The percentages given produce dyeings approximately 1/2 of 1/1 standard depth of many acrylic fibers (see 10.7).

6. Apparatus and Materials

6.1 Thirty samples (pieces of skeins) of equal weight of acrylic fiber.

6.2 Any apparatus that can be used for dyeing at a 40:1 liquor:goods ratio at the required constant temperature.

6.3 A supply of the standard dyes.

6.4 Acetic acid (glacial).

6.5 Sodium acetate crystals ($\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$).

6.6 A supply of deionized or distilled water, which does not change significantly in pH on boiling.

7. Procedure

7.1 Pretreat the samples of material to be used in the test for 10 min at approximately 95°C in a solution containing 1% (owf) acetic acid (glacial) and 1% (owf) sodium acetate crystals ($\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$) [to give pH 4.5 (± 0.2)] at a liquor to goods ratio of 40:1. Then lightly squeeze the material and keep it wet ready for use.

7.2 Set five dyebaths, one for each of the standard dyes, at 95°C, a liquor to goods ratio of 40:1 and a pH value of 4.5 ± 0.2 with:

X% Standard dye (blue or yellow)

Y% Dye under test

1% Acetic acid (glacial)

1% Sodium acetate crystals

($\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$)

Y% corresponds to the amount of dye under test required to give a dyeing approximately 1/2 of 1/1 standard depth on the acrylic fiber chosen. X% is as given in 5.1.

7.2.1 These percentages and the liquor: goods ratio refer to the weight of an individual sample; i.e., to one skein or piece as defined and not to the combined weight of the six samples required for each of the series of dyeings.

7.3 Four to six samples of material are needed for each dyebath. Proceed with each of the prepared dyebaths as follows:

Enter the first sample of material into the dyebath at the required temperature (see 10.2) for the required time at this temperature. Remove this sample and replace it by the second sample of material and dye as before. Repeat this procedure with the remaining two to four samples, except that the last sample is dyed to complete exhaustion.

7.4 Rinse and dry each sample immediately after it is removed from the dyebath. Mount the samples in the sequence in which they were dyed.

8. Assessment

8.1 The compatibility value assigned to the dye under test is that of the standard dye with which it gives on-tone dyeings throughout the sequence. A typical example of the results obtained in assessing a blue dye could be as shown in Table II.

8.2 It is possible for the compatibility value of a dye to lie between two adjacent standards; e.g., to be 1.5, 2.5, 3.5 or 4.5. In these instances a series of on-tone dyeings will not be obtained with any of the standard dyes.

8.3 If a dye is found which lies outside the scale as defined, then a value of less than 1, or greater than 5, whichever is appropriate, should be assigned.

Table II

Compatibility Value of Yellow Standard	Appearance of Sequence of Samples
1.0	Progressively much bluer
2.0	Progressively bluer
3.0	On-tone
4.0	Progressively yellower
5.0	Progressively much yellower

The compatibility value of the blue dye is 3.0.

9. Precision and Bias

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

9.2 *Bias.* The compatibility of basic dyes for acrylic fibers 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.

10. Notes

10.1 This test method corresponds to a Proposed Method of the Society of Dyers and Colourists, *JSDC*, Vol. 88, June 1972, pp. 220-222.

10.2 Acrylic fibers can vary widely in their dyeing characteristics. The test is to be conducted in such a manner that all available dye is exhausted in approximately equal portions onto the number of fiber samples used. In order to accomplish this, it may be necessary to adjust the dyeing temperature within a range of 90-100°C and/or the dyeing time for each sample in the range of 5-10 min. Suggested times and temperatures for some typical fibers are:

Acrilan 16—93°C, 5 min intervals

Acrilan SEF—96°C, 5 min intervals (except for blue C-1 and yellow C-2 standard, use 93°C)

Orlon 75—96°C, 10 min intervals (except for C-1 standard, use 5 min)

Creslan—88°C, 5 min intervals

10.3 The test is valid only under the conditions defined. Compatibility values may be affected by the presence of anionic substances—e.g., anionic surfactants or anionic dyes—in the dyebath.

10.4 The yellow and blue standard dyes of compatibility value 2.0 are not fully compatible when applied in combination. The differences observed are exaggerated if wet-spun acrylic fibers are used.

10.5 It should be clearly understood that the test is one for compatibility and not a measure of the extent to which incompatibility may lead to unevenness when combinations of basic dyes are applied to acrylic fibers.

10.6 Sets of 10 basic dyes (5 blue and 5 yellow) packaged 50 g per bottle may be ordered from AATCC Technical Center, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org.

10.7 For ease in visual assessment, it is recommended to use the dyes under test and the standard dyes in a concentration which produces approximately 1/2 of 1/1 standard depth when dyed on most acrylic fibers. Booklets illustrating 1/1 standard depth as well as other levels of standard depth for 18 hues are available from AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: 919/549-8141; fax: 919/549-8933; e-mail: orders@aatcc.org. It should be understood, however, that it is not critical that the compatibility is assessed at standard depth, since identical values are obtained at other depths and in other ratios of standard and test dye.

10.8 The strength of dyes indicated above as 200% were changed in strength in August 1984. The (% owf) is therefore 1/2 of that used in previous years. For example, C. I. Basic Yellow 29 (200%) at 0.25% would be 0.50% of C. I. Basic Yellow 29 (100%).

10.9 Available from Publications Office, ACGIH, Kemper Woods Center, 1330 Kemper Meadow Dr., Cincinnati OH 45240; tel: 513/742-2020.