



Designation: D4838 – 88 (Reapproved 2003)

# Standard Test Method for Determining the Relative Tinting Strength of Chromatic Paints<sup>1</sup>

This standard is issued under the fixed designation D4838; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method describes the determination of the absorption tinting strength of a chromatic test paint relative to that of a standard or reference paint of the same chemical type. The procedures are based on dilution of the paints with a standard mixing white paint, followed by instrumental measurement and calculation. Provision is made for correcting the results for small differences in hue or chroma, or both, between the test and reference chromatic paints.

1.2 This test method is intended for the comparison of paints containing the same type of vehicle (acrylic, alkyd, or oil) and single-pigment colorants of the same Colour Index<sup>2</sup> name and number. The amounts of the pigment and of the other components of the paint need not be known.

1.3 The values stated in SI units are to be regarded 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:<sup>3</sup>

**D1640** Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature

**D4303** Test Methods for Lightfastness of Colorants Used in Artists' Materials

**E284** Terminology of Appearance

**E308** Practice for Computing the Colors of Objects by Using the CIE System

**E1164** Practice for Obtaining Spectrometric Data for Object-Color Evaluation

## 3. Terminology

### 3.1 Definitions:

3.1.1 *tinting strength*—measure of the effectiveness with which a unit quantity of a colorant alters the color of a material. For scattering and absorbing colorants (pigments), both absorption and scattering tinting strength must be specified.

3.1.2 *tinting strength, absorption*—relative change in the absorption properties of a standard white material when a specified amount of an absorbing pigment, black or chromatic, is added to it.

3.1.2.1 *Discussion*—This is the common definition of tinting strength; however, this definition of the term can be misleading. For example, the tinting strength of a yellow colorant depends on its scattering as well as its absorption. Its tinting strength as determined from a mixture with white provides no information about its behavior when mixed with low-scattering colorants, such as a black.

3.1.3 *tinting strength, scattering*—relative change in the scattering properties of a standard black material (with no white pigment present) when a specified amount of a white or chromatic scattering pigment is added to it.

3.1.4 For other definitions, see Terminology **E284**.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *drawdown*—a layer of paint deposited on a substrate by use of a drawdown bar to evaluate the characteristics of the paint.

3.2.2 *drawdown bar*—a bar designed to deposit a specified thickness of wet paint film uniformly on a specified test panel or other substrate.

## 4. Summary of Test Method

4.1 Chromatic paints are diluted with white paint to obtain mixtures that will produce a drawdown having 35 to 45 % reflectance factor at the wavelength of maximum absorption.

4.2 Drawdowns of these mixture paints are produced at complete hiding.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee **D01** on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee **D01.57** on Artist Paints and Related Materials.

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<sup>2</sup> *Colour Index*, The Society of Dyers and Colourists, London, 1987. Available from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

<sup>3</sup> 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.

4.3 The drawdowns are measured to obtain tristimulus filter readings  $R$ ,  $G$ ,  $B$  either directly or by computation from CIE tristimulus values  $X$ ,  $Y$ ,  $Z$ .

4.4 One of the samples is designated the standard, and the percents of tinting strength, %  $TS$ , of the others are calculated relative to that of the standard. Provision is made for correcting this tinting strength for small differences in hue, chroma, or both, between the standard and the test specimen, and for obtaining an average tinting strength and a range.

## 5. Significance and Use

5.1 Tinting strength may be one factor in judging the relative economic value of paints, since pigment concentration contributes to strength in a major way; other factors are formulation and color development in grinding. The user may also select products for other properties, such as transparency, that are accompanied by different tinting strengths. The results of this test method may be used for production control or quality comparisons.

5.2 The product with the greatest or the least tinting strength may not be the most desirable for a given artistic use. For example, low tinting strength may lead to the need to use an excessively high pigment concentration to obtain a desired color effect, and this may lead to defects in the dry paint film.

5.3 This test method applies only to single-pigment paints. The tinting strength of paints that contain two or more chromatic pigments with different optical properties cannot be evaluated by this test method.

5.4 The term “similar chemical type” used in 1.1 does not limit the ingredients in the paints to identity, but refers to compatibility in the case of vehicles and to similarity in the case of pigment types.

5.5 While the instrumental evaluation of tinting strength is described, visual comparisons can also be used, with lower precision, and should be made to provide confirmation of the instrumental and computational results.

5.6 If the sample and standard are widely different in appearance when prepared at the same ratio of chromatic to white paint, another sample should be prepared to bring the two closer in appearance, to obtain the most accurate results.

5.7 The quantities of chromatic and white paints mixed must be accurately known, on either a weight or a volume basis, but the concentration of pigment in the chromatic paint need not be known.

5.8 When the paints being compared have the same vehicle and pigment (same Colour Index name and number) the values of uncorrected tinting strength from 9.1 and corrected tinting strength from 9.2 should be nearly the same. If they are not, an average of the two tinting strengths is recommended as the best estimate of the true value, and a range provides a measure of the magnitude of the uncertainty, which is due to differences in hue or chroma, or both, between the paints.

5.9 Strictly speaking, the Kubelka-Munk-type analysis of this test method should not be applied to the tristimulus filter readings used, but only to spectral data. For the purposes of the relative comparisons of this test method, however, the errors introduced by the calculations used cancel to an adequate degree.

## 6. Apparatus and Materials

6.1 *Laboratory Balance*, top-loading, having a sensitivity of 0.01 g.

6.2 *Drawdown bars*, capable of producing smooth paint films with wet-film thicknesses between 0.075 and 0.25 mm (0.003 and 0.010 in.).

6.3 *Opacity charts*, sealed-paper type with black and white areas.

6.4 *Color-Measuring Instrument*, either a spectrophotometer providing 1931 CIE tristimulus values  $X$ ,  $Y$ ,  $Z$  for CIE standard illuminant  $C$ , or a tristimulus colorimeter providing either such tristimulus values or colorimeter readings  $R$ ,  $G$ ,  $B$ .

6.5 *Mixing White Paint*, prepared as described in the Specimen Preparation, Mixing Whites for Dilution of Colors section of Test Methods D4303. Alternatively, a commercial titanium-dioxide white artists' paint may be used. The mixing white paint must be made with the same vehicle type (acrylic, alkyd, or oil) as the paints to be tested.

## 7. Specimen Preparation

7.1 Obtain representative samples of the chromatic paints to be tested. For tube paints, expel the entire contents of the tube and mix thoroughly before sampling.

7.2 Determine the approximate amount of chromatic paint to be added to 20 g of mixing white paint to obtain a drawdown with 35 to 45 % reflectance factor at the wavelength of maximum absorption. If the amount of chromatic paint is not known in advance, consult the tables in Appendix X1. For pigments other than those listed, use as the general guideline the addition of 5 g of chromatic paint containing an inorganic pigment or 1 g of chromatic paint containing an organic pigment to the 20 g of mixing white paint.

NOTE 1—Appendix X1 of Test Methods D4303 describes a method for computing the necessary adjustments in quantities required if additional trials are needed to obtain the desired level of reflectance factor.

7.3 Weigh out the chromatic and mixing white paints to the nearest 0.01 g, and mix thoroughly.

7.4 Prepare drawdowns by placing the paint mixture at one end of an opacity chart and pulling the drawdown bar smoothly through the paint and across the chart. Paste paints should be spread with a spatula or palette knife over the entire chart area to be covered before pulling the bar down the chart.

7.5 Allow the drawdowns to reach the dry-to-touch time as described in the Procedure section of Test Methods D1640. Acrylic paints should dry in air overnight. Alkyd paints may require 5 days to dry. Oil paints may require 2 months to dry.

7.6 Determine whether each drawdown is at complete hiding by measuring the portions of it over the black and over the white areas of the chart to determine tristimulus value  $Y$  or colorimeter reading  $G$ . If the quotient  $Y_B/Y_W$  or  $G_B/G_W$ , where the subscripts refer to measurements over black and white, respectively, is greater than 0.98, the drawdown can be considered at complete hiding. If the drawdown is not at complete hiding, prepare a thicker drawdown or a drawdown made with multiple coats of paint, one over another.

NOTE 2—At the required dilution with white, a drawdown bar with an aperture of 0.15 mm (0.006 in.) will usually make a drawdown at complete hiding. In the cases of some acrylic paints and a few oil paints