Designation: D5326 – 94a (Reapproved 2013)

Standard Test Method for Color Development in Tinted Latex Paints[1]

This standard is issued under the fixed designation D5326; 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 test method covers a procedure for measuring color development in tinted latex paints, for the purpose of determining the efficiency of colorants, the tintability of base paints and the potential for poor color uniformity of applied paint films.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *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]

D16 Terminology for Paint, Related Coatings, Materials, and Applications

D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

D3924 Specification for Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials

D3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings

E284 Terminology of Appearance

E1164 Practice for Obtaining Spectrometric Data for Object-Color Evaluation

E1331 Test Method for Reflectance Factor and Color by Spectrophotometry Using Hemispherical Geometry

E1345 Practice for Reducing the Effect of Variability of Color Measurement by Use of Multiple Measurements

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

E1349 Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional (45°:0° or 0°:45°) Geometry

3. Terminology

3.1 *Definitions:*

3.1.1 *color development, n*—the extent to which the colorant has achieved its full tinting potential, as evidenced by the color change or lack thereof, when the tinted paint is subjected to very strong shear stress.

3.1.2 *tintability, n*—the capability of a white or tint base paint to accept various colorants, as evidenced by the color development in the mixture.

3.1.2.1 *Discussion*—Sometimes called "color acceptance."

3.2 See Terminology D16, E284, and the *Paint/Coatings Dictionary*[3] for definitions of other terms used in this test method.

4. Summary of Test Method

4.1 The test paint is applied by drawing it down on a striped black and white sealed chart, at a film thickness sufficient to obtain full hiding.

4.2 A portion of the drawdown is subjected to strong shearing forces in a prescribed brushing procedure.

4.3 The CIELAB color difference between the drawdown and sheared areas after drying, is reported as a measure of deficiency in the color development of the test paint.

5. Significance and Use

5.1 A colorant sometimes fails to disperse completely in a base paint due to poor compatibility, which can be the fault of the colorant, the paint, or both. This will result in poor color development, which is readily manifested by the common procedure of applying the paint with a doctor blade and subjecting the drawdown to high shear stress by finger-rubbing a small area of the partially dry film. This tends to disperse

[1] 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 D01.42 on Architectural Coatings.

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[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 Federation of Societies for Coatings Technology (FSCT), 492 Norristown Rd., Blue Bell, PA 19422-2350, http://www.coatingstech.org.

undeveloped colorant, if any, and produces a color variation between the unsheared and sheared areas of the paint film. The variation can be measured colorimetrically to give a numerical color difference value that is a measure of the color development of the original paint, the smaller the difference the better the color development and vice versa. Color difference values obtained by finger-rubbing were found to vary widely for the same as well as among different operators. This test method establishes a controlled shear-stress procedure analogous to the finger rub-up test, but with far better reproducibility.

5.2 Poor color development can be a problem in the production of paints, and in their performance in the field. In production it causes a loss of colorant monetary value, and unpredictable tinting results. In field performance it results in color variations in the applied paint film due to the varying shear forces to which the paint is subjected at different stages or by different modes of application.

5.3 Although poor color development is primarily and most often related to the colorant portion of a tinted paint, the white pigment in the base paint can also be poorly developed due to flocculation or other causes. In the latter case, shear dispersion can make the paint film lighter and less colorful, rather than the reverse. Then too, the colorant and the white might both be poorly developed, and the color change due to shear stress would then be the combined effect of both.

5.4 In any case, color development is an important paint property, for the measurement of which this test method is intended to provide a generally accepted and reproducible test method.

6. Apparatus

6.1 *Film Applicator,* 6-in. (150-mm) wide with a clearance of 10 mils (250 µm).[4]

6.2 *Drawdown Plate*—A vacuum plate or thick plate glass are both satisfactory.

6.3 *Test Charts,* black and white striped, with a sealed surface, and overall size approximately 8½ by 11 in. (245 by 280 mm) having a test area of 0.538 ft^2 (500 cm^2).[5]

6.4 *Paint Brush,* 2-in. (50-mm) polyester filaments, 2¾-in. (70-mm) length out, 9⁄16-in. (15-mm) thick, with chisel tip.[6]

6.5 *Syringe,* 20 mL, plastic disposable type.

6.6 *Force-Draft Oven,* maintained at 120 ± 2°F (50 ± 1°C).

6.7 *Reflectometer,* using CIE Illuminant C, specular reflection excluded, and capable of measuring CIELAB color coordinates as defined in Practice D2244 and Terminology E284.[7]

7. Sampling and Conditioning

7.1 Take a pint (500 mL) sample of the material in accordance with Practice D3925.

7.2 Adjust or allow the sample to come to room temperature as defined in Specification D3924 (65 to 85°F, 18 to 29.5°C).

8. Procedure

8.1 Stir the test paint thoroughly by hand, making sure that it is completely uniform with no trace of sediment or otherwise undispersed material. If necessary filter to remove persistent large agregates.

8.2 Clean the drawdown plate thoroughly and place the test chart on it with the applicator close to the top edge of the chart.

8.3 Fill the syringe to the 17-mL mark and from it distribute 10 mL of test coating evenly onto the chart in front of and close to the applicator, then draw down with a uniform motion.

8.4 Without delay cut an approximately 3-in. (75-mm) wide paint strip from the bottom end of the chart and set it aside.

8.5 Tape one edge of the remaining portion of the chart onto a flat support surface and distribute an additional 7 mL of test paint from the syringe evenly over the test area.

8.6 Dampen a clean paint brush, shake out the moisture vigorously, then dip the brush to ⅔ of its filament length into the test paint in a ¾-filled pint container. Remove the brush, wipe the tip against the edge of the container to remove the surplus, then spread the paint evenly over the test area of the chart and allow to dry for 15 ± 1 min under room temperature conditions.

8.7 During this drying period keep the wet paint brush wrapped in plastic film to prevent it from drying out.

8.8 After the specified drying period, brush over the painted area repeatedly for 2 min ± 10 s. Make sure that each brush stroke fully traverses the painted area and is at a uniform speed such that there will be 150 ± 5 strokes during the stated brushing period. Cover the entire area with six successive parallel strokes in alternate opposite directions followed by the same in the direction perpendicular to the preceding six, alternating in this way until the specified brushing time is completed. During each stroke press the brush down so that a third of the filament length is pressed against the surface of the

[4] A Bird type film applicator, obtainable from most suppliers of paint test equipment, has been found satisfactory for this purpose. Other suitable applicators may be used.

[5] Leneta Form 8K-BW; obtainable from The Leneta Company; 15 Whitney Road; Mahwah, NJ 07430, was used in the round robins for this standard and found satisfactory. An equivalent may be used.

[6] The E-Z Paintr "ONE-V20-90 ONE COATER BRISTLENE" brush has been found satisfactory. Available from E-Z Paintr, 4051 S. Iowa Ave., Milwaukee, WI 53207.

[7] Any reflectometer that measures the CIE tristimulus values of opaque surfaces will be found suitable. Types that provide a direct read-out of color difference ΔE^*_{ab} are available, and are particularly desirable for this test method. The following standards are applicable to this measurement, depending on instrumentation and other factors: Practice E1164, Test Method E1331, Practice E1345, Test Methods E1347, E1349.

chart. Manipulate the brush so as to maintain a uniform spreading rate as much as possible during this operation. Complete the brushout by sweeping the tip of the brush over the painted area to smooth and eliminate brushmarks, and to completely obscure the black and white substrate pattern.

8.9 Place the completed brushout section along with the drawdown section of the chart in the force-draft oven for one h ± 2 min.

8.10 Remove the two sections from the oven and tape them together at the original cut.

8.11 Measure the CIELAB color difference ΔE^*_{ab} between the drawdown and the brushout, avoiding measurements on show-through areas that might have occurred due to persistent deep brush marks or other deficiency in spreading rate uniformity. To obtain ΔE^*_{ab} determine CIELAB color coordinates L*a*b *, and from them calculate ΔE^*_{ab} in accordance with Sections 8 and 9 of Practice D2244. Modern color difference meters give ΔE^*_{ab} directly without need for calculations.

9. Report

9.1 Report the following information:

9.1.1 CIELAB Color difference ΔE^*_{ab}, between drawdown and brushout,

9.1.2 A general description of the color and the type of paint being tested, and

9.1.3 Specific names and sources of commercial products being tested, paints or colorants or both.

10. Precision and Bias

10.1 *Experimental*—In an interlaboratory study[8] of this test method one operator in each of five laboratories tested eight latex paints that varied widely in color and color development, by applying them with a clearance-type drawdown applicator and then subjecting a portion of the drawdown to very high shear stress using a paint brush (see Note 1).

10.2 *Precision*—The interlaboratory pooled standard deviation, after discarding several outliers (see Note 2), was found to be 0.43 ΔE^*_{ab} with 21 df. Based on this standard deviation the following criteria should be used for judging, at the 95 % confidence level, the acceptability of results:

10.2.1 *Reproducibility*—Two single results obtained by operators in different laboratories should be considered suspect if they differ by more than 1.3 ΔE^*_{ab}.

NOTE 1—In the interlaboratory study the test applications were air dried, but it was established that there is essentially perfect correlation between color difference measurements made on air-dried and force-dried panels.[8]

NOTE 2—Results from one laboratory for three of the paints and one result from another for one of the same paints were discarded because they differed significantly from other results for the same materials or because the laboratory mean differed significantly from means of all the other laboratories.

NOTE 3—The measurement or determination of tristimulus values using modern spectrocolorimeters has been shown to not follow normal Gaussian statistics. Additionally, the calculation of color differences (ΔE) involves the positive square root of the sum of the squares of the tristimulus differences. The ΔE values are distributed more like a CHI-squared variable than a normal variable. As a result, statistical inferences based on either the normal distribution or the Student's *t* distribution may underestimate the probabilities of repeating or reproducing a given value.

10.2.2 *Repeatability*—Insufficient data was obtained to directly establish the repeatability of this test, but it should be at least equal to the reproducibility stated in 10.2.

10.3 *Bias*—The concept of bias is inapplicable to this test method, because there are no independent authoritative values.

11. Keywords

11.1 color; color development; color uniformity; colorants; tintability

[8] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D01-1079.