



Designation: D344 – 11

Standard Test Method for Relative Hiding Power of Paints by the Visual Evaluation of Brushouts¹

This standard is issued under the fixed designation D344; 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 provides for the qualitative and quantitative visual determination of the hiding power of a test paint relative to that of a comparison paint.

1.2 This test method describes only a brushout application procedure in specific detail, but its concepts are valid for other methods of application as well.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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:*²

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

D1475 Test Method For Density of Liquid Coatings, Inks, and Related Products

D1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials

D2805 Test Method for Hiding Power of Paints by Reflectometry

D5068 Practice for Preparation of Paint Brushes for Evaluation

E1247 Practice for Detecting Fluorescence in Object-Color Specimens by Spectrophotometry

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

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 D01.26 on Optical Properties.

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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.

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

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology **D16** and the *Paint/Coatings Dictionary*.³

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *relative hiding power, qualitative, n*—the characterization of a test paint as being better, equal, or poorer in hiding power than a comparison paint.

3.2.2 *relative hiding power, quantitative, n*—the spreading rate of a paint expressed as a percent of the spreading rate of a comparison paint at equal hiding.

4. Summary of Test Method

4.1 *Qualitative*—The test and comparison paints are brushed out uniformly at the same spreading rate on black and white hiding power charts. After drying the brushouts are compared visually to see which paint has been most effective in reducing the substrate contrast.

4.2 *Quantitative*—Additional brushouts are made with the comparison paint, if and as necessary, to determine the spreading rate at which it matches the hiding of the test paint brushout.

5. Significance and Use

5.1 This test method evaluates the hiding power of a test paint relative to a comparison paint. The results have significance only within that relationship. It may be used for production control or quality comparisons.

5.2 When a paint is applied by brush or any other practical method, the opacity of the film is affected by variations in film thickness related to the application procedure and to the application characteristics of the paint. Two paints that hide equally well by this method might therefore differ considerably when applied with a doctor blade, since the latter method gives

³ Available from Federation of Societies for Coatings Technology (FSCT), 492 Norristown Rd., Blue Bell, PA 19422-2350, <http://www.coatingstech.org>.

essentially perfect leveling. Different brushes or surface application conditions can likewise give different results.

NOTE 1—Test Method **D2805** describes an instrumental method for quantitatively determining hiding power without reference to a material paint standard. The paint film is applied at a uniform thickness (for example, with a doctor blade), the film thickness is measured rigorously, and the opacity is evaluated photometrically. Hiding power is thereby determined with a high degree of precision.

5.3 Test Method **D344** is less precise than Test Method **D2805**, but is more practical because it is responsive to the application characteristics of paints, and is simpler in concept and execution.

6. Apparatus

6.1 *Balance*, top-loading laboratory balance having a capacity of 100 g and sensitivity of 0.1 g.

6.2 *Syringe*, 10-mL capacity.

6.3 *Paint Brush*, ferrule 50 mm wide and 14 mm thick, tapered polyester filaments 70 mm long with flagged chisel trim tip.⁴

6.4 *Container*, 250-mL beaker.

6.5 *Test Surface*, a smooth-surfaced paper chart having adjacent black and white areas and coated with a suitable varnish or lacquer so as to render the surface impervious to paint liquids. The black and white areas of the chart shall have luminous reflectance factors of 1 % maximum and 75 % minimum, respectively, when tested in accordance with Test Methods **E1347** or **E1349**. The white areas of the charts used in any one testing program shall not differ in their reflectance factors by more than 1 %, and shall be nonfluorescent.⁵ Any suitable regular design of contrasting areas may be used. The chart shall have a defined test area of 0.1 m². Larger test areas may be used if available, with appropriate modification of the indicated calculations.

6.6 *Illumination*, a light source providing diffuse light of reasonable intensity, preferably northern sky light or an approximation of same. (See Practice **D1729**).

7. Preparation of Brushouts

7.1 Select a convenient and suitable spreading rate, mutually agreeable to all parties involved in the testing program, and preferably in the range from 9.8 to 19.6 m²/L. In any case, the spreading rate shall not be so low that the substrate contrast is difficult to see, nor so high that it is difficult to apply the paint at a reasonably uniform film thickness.

7.2 Determine the density *D* in grams per millilitre of the comparisons and test paints, in accordance with Test Method **D1475**.

⁴ Describes the brush used by the round-robin participants. Other 50-mm brushes of equivalent quality may be used, no doubt with similar results. Ideally, the same type of brush should be used within a comparison set, and among correspondent laboratories.

⁵ As observed visually under ultraviolet illumination or determined in accordance with Practice **E1247**.

7.3 Calculate to three significant figures the volume *V* in millilitres to apply for the selected spreading rate *SR* as follows:

$$V(\text{mL}) = \frac{100}{SR(\text{m}^2/\text{L})} \quad (1)$$

7.4 Calculate to three significant figures, the weight *W* in grams corresponding to the volume *V*(mL) as follows:

$$W(\text{g}) = V(\text{mL}) \times D(\text{g/mL})$$

7.5 To prepare a brushout, first stir the paint well. Then precondition the brush by dipping it into the paint and working it out on a smooth, nonporous surface as described in Practice **D5068**. Take up the desired volume of paint in the syringe and weigh it with the brush in the empty container. Place the test chart on a level bench top, distribute the paint evenly over the test area of the chart, then brush the paint out uniformly within the test area. Set the brushout aside to dry in a horizontal position, protected adequately from dust and under normal room conditions of ventilation and temperature. Reweigh the empty syringe with the brush and container. The loss of weight represents the actual weight of paint applied to the test surface as opposed to the intended weight calculated from 7.3 and 7.4. If there is a discrepancy do not attempt to correct it by removing or applying paint since this would disturb the leveling of the brushout. Instead, calculate the actual spreading rate as follows:

$$SR_A = \frac{B}{A} \times SR_B \quad (2)$$

where:

SR_A = actual spreading rate,
B = intended weight,
A = actual weight, and
SR_B = intended spreading rate.

8. Evaluation Procedure

8.1 *Viewing conditions*—When the test and comparison paint brushouts are thoroughly dry, place them vertically side by side against a flat surface and view them from a distance of 1.5 to 3 m under illumination conditions as described in 6.6.

8.2 Qualitative Evaluation:

8.2.1 If the contrast between the black and white areas of the test paint brushout is adjudged less than, equal to, or more than that of the comparison paint brushout, then the hiding power of the test paint is considered as better than, equal to, or poorer than that of the comparison paint.

8.2.2 If the actual spreading rate of the lower contrast paint-out is lower than that of the other paint-out by more than 3 %, prepare a second brushout with either paint so as to eliminate the difference, then compare again to confirm or revise the previous estimation of relative hiding power.

8.3 Quantitative Evaluation:

8.3.1 If the hiding of the test paint brushout does not match that of the comparison paint at the same spreading rate, make a series of additional comparison paint brushouts at several other spreading rates, differing in steps of approximately 15 % and providing contrasts above and below that of the test paint brushout. Refer to these and to the original comparison paint

brushout as standards. If the standards are prepared correctly, each increase in spreading rate will correspond to a perceptible increase in contrast. Compare the standards under the viewing conditions described in 8.1 to assure that this is the case.

8.3.2 Compare the brushout of the test paint with the standards under the specified viewing conditions to determine which standard it matches in contrast, or if none to which pair of successive standards it is intermediate. In the latter case view the test paint brushout with the two standards on either side and rate the contrast of the test paint brushout by estimating the contrast difference between it and the lower spreading rate (lower contrast) standard, as a fraction of the contrast difference between the two standards to the nearest fourth. Keeping the test paint brushout in the middle, reverse the position of the two standards and rate the test paint brushout again in the same way. The final rating is the mean of the two to the nearest eighth.

8.3.3 Calculate the spreading rate (SR_C) of the comparison paint at which it is estimated to match the hiding of the test paint brushout as follows:

$$SR_C = SR_1 + X(SR_2 - SR_1) \quad (3)$$

where:

SR_1 = spreading rate of the lower spreading rate (lower contrast) standard,

SR_2 = spreading rate of the higher spreading rate (higher contrast) standard, and

X = fractional contrast rating of the test paint brushout.

8.3.4 Calculate the relative hiding power of the test paint in accordance with the definition in 3.2.2 as follows:

$$HP_t = \frac{SR_t}{SR_c} \times 100 \quad (4)$$

where:

HP_t = relative hiding power of the test paint,

SR_t = spreading rate of the test paint, and

SR_c = spreading rate of the comparison paint at equal hiding, as determined by an actual match with one of the standards or by estimation between two standards as described and calculated in 8.3.2 and 8.3.3.

9. Report

9.1 *Qualitative* (see 8.2)—Report the relative hiding power of the test paint as better than, equal to, or poorer than the comparison paint. The report may be amplified by such terms as exactly, slightly, moderately, considerably, etc., as may seem appropriate.

9.2 *Quantitative* (see 8.3)—Report the relative hiding power of the test coating to the nearest whole number. This is a purely numerical value. Physical units such as square feet per gallon or square metres per litre are not applicable.

TABLE 1 Round Robin Results of Relative Hiding Power of Four White Paints versus a Comparison White Paint

Method	Paint	Laboratory 1		Laboratory 2	Laboratory 3
		Trial 1	Trial 2		
Qualitative	V1	A	A	A	A
	V2 ^B				
	V3	C	C	C	C
	V4	C	C	C	C
	V5	A	C	C	C
Quantitative	V1	125	117	115	120
	V2 ^B	100	100	100	100
	V3	85	93	62	96
	V4	66	82	60	67
	V5	102	90	83	95

^A Indicates that the test paint hides better than the comparison paint.

^B Comparison paint, relative hiding power equals 100.

^C Indicates that the test paint hides poorer than the comparison paint.

10. Precision

10.1 *Qualitative*—Four test paints were rated versus a comparison paint by three laboratories, twice each by one laboratory and once each by the other two, for a total of 16 trials. There was only one discrepancy, which occurred with a paint that was apparently very similar in hiding power to the comparison paint. These results indicate that the method is effective, but more results would be required to develop a more detailed precision statement. Table 1 gives the results of these tests.

10.2 *Quantitative*—In an interlaboratory study of this method, four coatings were evaluated for hiding power against a fifth coating taken as the standard. In one laboratory each material was tested twice, but only once in the other two laboratories. Statistical analysis of the results revealed that the two results for each coating from the one laboratory were as variable as those from the other two. Consequently, the two results were treated as being individual results and the interlaboratory standard deviation was found to be 10 % with 12 df. Based on this standard deviation, the following criterion should be used for judging the acceptability of results at the 95 % confidence level:

10.2.1 *Reproducibility*—Two single results obtained by operators in different laboratories should be considered suspect if they differ in relative hiding power by more than 32 % of their mean.

10.2.2 *Repeatability*—A reasonable estimate of intralaboratory precision could not be obtained because only one laboratory repeated the test.

10.3 *Bias*—The concept of bias is not applicable to this test method because its measurements are comparative, and there is no objective true reference value.

11. Keywords

11.1 hiding power; opacity; relative hiding



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