



Standard Test Method for Determining Enamel Holdout ¹

This standard is issued under the fixed designation D7786; 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 standard provides a method for determining the holdout characteristics of a primer and topcoat coating application. A standard topcoat is used to determine the absorption characteristics of a primer. Enamel holdout can be measured as a difference in observed gloss of the topcoat over a primer, relative to the gloss of the same topcoat over a non-porous smooth surface.

1.2 The standard is written in the context that the user will be evaluating the enamel holdout characteristics of a primer. Alternatively, the standard may be used as a method to evaluate the enamel holdout characteristics of primer/topcoat system where the primer is constant and different topcoats are used as test paints.

1.3 This standard may also be used for evaluation of paints other than primers as the first coat. In this alteration the user can test the enamel holdout characteristics of a self primed topcoat, or use of any other type of paint as the primer followed by the use of a standard topcoat.

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

1.5 *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

D523 Test Method for Specular Gloss

D823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels

D1640 Test Methods for Drying, Curing, or Film Formation

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.

of Organic Coatings at Room Temperature

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 Definitions:

3.1.1 *enamel holdout, n*—the ability of a primer/topcoat system to retain gloss of the topcoat relative to gloss of the topcoat over a non-porous smooth surface.

3.1.2 *primer, n*—an undercoat of paint applied to prepare a surface for final painting.

3.1.3 *topcoat, n*—a coating, intended as the final coat of a finished system, which has the desired appearance and resistance properties as specified by the end user.

4. Summary of Test Method

4.1 A substrate, preferably a non-porous smooth drawdown card, is coated using a test primer and allowed to dry. The primer-coated substrate is then coated with the standard topcoat and allowed to dry (primed topcoat).

4.2 A non-porous smooth substrate is coated using only the standard topcoat and allowed to dry (unprimed topcoat).

4.3 Gloss measurements are taken over the primed topcoat and also over the unprimed topcoat. The difference in the gloss reading between the primed topcoat system and unprimed topcoat system is an indication of enamel holdout. Smaller differences indicate better enamel holdout.

5. Significance and Use

5.1 This standard may be used by paint companies and raw material suppliers to assess the interactions of primers and topcoats with respect to their ability to provide good enamel holdout. Primer/topcoat systems with the best enamel holdout will result in desirable gloss in the first coat of topcoat application.

6. Apparatus

6.1 *Film Applicator*, preferably a drawdown bar, capable of applying wet-film thickness of approximately 0.075 mm (3.0 mils).

6.2 If preferred, brush, roller or spray applicators can be substituted for the drawdown applicators.

6.3 *Gloss Meter* capable of measuring 20 and 60° gloss.

7. Reagents and Materials

7.1 *Substrate Desired for Testing*—The preferred substrate should have a uniform flat surface to enable paint films to be applied with the preferred drawdown bar applicator. Unless otherwise agreed upon, a non-porous smooth drawdown card is used. Other commonly used substrates include: gypsum panel, wood or drawdown cards with non-porous and porous sections. The choice to use an alternative substrate often necessitates the choice of an alternate applicator such as brush, roller or spray.

7.2 *Standard Paints*—The topcoat will be a mutually agreed upon standard topcoat. Unless otherwise agreed, use a commercially available latex topcoat which yields a gloss between 40 and 55 when applied in accordance with 9.2.

8. Hazards

8.1 The user of this test method should refer to appropriate MSDS for hazards associated with handling and disposal of paint samples or other laboratory items used as specified in this standard.

9. Procedure

9.1 Application of primer (or other primary coating) and topcoat.

9.1.1 Apply the primer onto the selected substrate using the film applicator across the full length of the drawdown card or alternative substrate. Refer to Practices D823, for the procedure and information related to the application of films with uniform thickness.

9.1.2 Allow the primer to dry in a controlled environment for an appropriate period of time for the primer that has been applied. Refer to Test Methods D1640 for the procedure and information related to drying, curing, or film formation of organic coatings at room temperature. Report the environmental condition (°C, %RH) and dry time interval.

9.1.3 Using a film applicator capable of applying a wet film thickness of approximately 0.075 mm (3 mils), apply the standard topcoat on top of the dried primer coat from step 9.1.1. Casting the topcoat in a direction perpendicular to the primer coat will allow the use of a single drawdown bar for both primer and topcoat application while ensuring that the drawdown bar can travel a uniform path across the primer coat (Fig. 1).

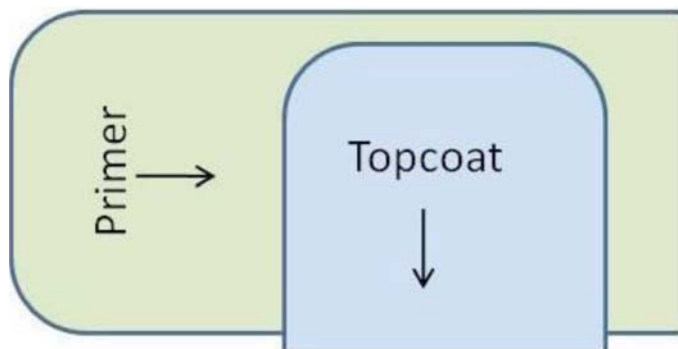


FIG. 1 Diagram of Perpendicular Drawdown Technique

9.1.4 Allow the topcoat to dry in a controlled environment for an appropriate period of time for the topcoat that has been applied. Report the environmental condition (°C, %RH) and dry time interval.

9.2 Application of standard topcoat to non-porous smooth surface:

9.2.1 Apply the standard topcoat to the non-porous smooth substrate using the same film applicator as in section 9.1.3 across the full length of the drawdown card. This application should be made at a similar time as the topcoat in step 9.1.3.

9.2.2 Allow the topcoat from step 9.2.1 to dry in a controlled environment for an appropriate period of time for the topcoat that has been applied. This environment and dry time should be the same as in step 9.1.4. Report the environmental condition (°C, %RH) and dry time interval.

9.3 Gloss measurement:

9.3.1 Measure the gloss of the topcoat on both the primer/topcoat card and the unprimed card. Refer to Test Method D523 for the procedure and information related to measuring gloss.

9.3.2 Record the average of three readings from each chart. If the 60° gloss of the unprimed topcoat is greater than 80 gloss units, use the 20° gloss reading; otherwise use the 60° gloss reading.

10. Calculation or Interpretation of Results

10.1 *Variable Definitions*:

$$\text{Enamel Holdout (\%retained)} = 100 \cdot G_P / G_U$$

$$\text{Enamel Holdout (\%difference)} = 100 \cdot (G_U - G_P) / G_U$$

$$\text{Enamel Holdout (difference)} = G_U - G_P$$

where:

G_P = Gloss of primed topcoat

G_U = Gloss of unprimed topcoat

10.2 Users may choose which calculation to use for reporting enamel holdout, though percent retained is the preferred method.

11. Report

11.1 Substrate system, applicator choice and application method for primers and topcoats.

11.2 Number of coats of topcoat.

11.3 Whether test paints are used as primer or topcoat.

11.4 Identification of standard topcoat or standard primer.

11.5 Environmental conditions and dry time intervals.

11.6 Angle of gloss measurements (20°, 60°).

11.7 Gloss value of unprimed topcoat.

11.8 Calculation method and enamel holdout result.

12. Precision and Bias ³

12.1 The precision of this test method is based on a single-laboratory study of Test Method D7786, Test Method for Determining Enamel Holdout, conducted in 2011. The laboratory tested three different primers, paired with a single semigloss topcoat. Every “test result” reported represents the average of three individual determinations. Five test results

³ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D01-1161.

TABLE 1 60° Gloss — 7 Day (Gloss Units)

Test Primer	Standard Topcoat	Average	Repeatability Standard Deviation	Repeatability Limit
		$\bar{x}$	Sr	r
None	Semigloss Topcoat ^A	51.88	0.51	1.43
Flat Topcoat ^B	Semigloss Topcoat	37.76	0.57	1.59
Primer A ^C	Semigloss Topcoat	50.72	0.83	2.33
Primer B ^D	Semigloss Topcoat	49.16	0.86	2.41

^A Commercially available water-based acrylic interior semigloss topcoat.

^B Commercially available water-based acrylic interior flat topcoat.

^C Commercially available water-based styrene acrylic interior primer-sealer.

^D Commercially available water-based styrene acrylic interior-exterior primer-sealer.

TABLE 2 Enamel Holdout — 7 Day, 60° Gloss Retained

Test Primer	Standard Topcoat	Average	Repeatability Standard Deviation	Repeatability Limit
		$\bar{x}$	Sr	r
None	Semigloss Topcoat	100.00	0.99	2.76
Flat Topcoat	Semigloss Topcoat	72.78	1.09	3.06
Primer A	Semigloss Topcoat	97.76	1.60	4.49
Primer B	Semigloss Topcoat	94.76	1.66	4.66

were reported for each material combination. Except for the use of only a single laboratory, Practice E691 was followed for the design and analysis of the data; the details are given in ASTM Research Report No. D01-1161.

12.1.1 *Repeatability Limit (r)*—Two test results obtained within one laboratory shall be judged not equivalent if they differ by more than the “*r*” value for that material; “*r*” is the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory.

12.1.1.1 Repeatability limits are listed in Table 1 and Table 2.

12.1.2 *Reproducibility Limit (R)*—Two test results shall be judged not equivalent if they differ by more than the “*R*” value for that material; “*R*” is the interval representing the critical difference between two test results for the same material, obtained by different operators using different equipment in different laboratories.

12.1.2.1 Reproducibility limits cannot be determined from a single-laboratory study.

12.1.3 The above terms (repeatability limit and reproducibility limit) are used as specified in Practice E177.

12.1.4 Any judgment in accordance with statements 12.1.1 and 12.1.2 would normally have an approximate 95 % probability of being correct, however the precision statistics obtained in this ILS must not be treated as exact mathematical quantities which are applicable to all circumstances and uses. The limited number of materials tested and the use of data from just a single reporting laboratory results guarantees that there will be times when differences greater than predicted by the ILS results will arise, sometimes with considerably greater or small frequency than the 95 % probability limit would imply. The repeatability limit and the reproducibility limit should be considered as general guides, and the associated probability of 95 % as only a rough indicator of what can be expected.

12.2 *Bias*—At the time of the study, there was no accepted reference material suitable for determining the bias for this test method, therefore no statement on bias is being made.

12.3 The precision statement was determined through statistical examination of 40 results from one laboratory; three primers coated with the same semigloss topcoat compared against the semigloss topcoat on a nonporous substrate without primer.

12.3.1 To judge the equivalency of two test results, it is recommended to choose the material closest in characteristics to the test material.

12.4 The following test method details are reported for the single-laboratory study.

12.4.1 All films were cast using a 3 mil Bird drawdown applicator on smooth nonporous drawdown cards (Leneta Form WB). A vacuum plate was used to secure the drawdown charts.

12.4.2 One coat of topcoat was applied.

12.4.3 The test paints are identified as Test Primer.

12.4.4 The standard topcoat is identified as Semigloss Topcoat.

12.4.5 All coatings were applied in a constant temperature room with set point conditions of 25°C and 50%RH. Primer coats were dried 2 h. Topcoat dry time interval is seven days.

13. Keywords

13.1 absorption; enamel holdout; primer; sealer; under-coater

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