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Standard Guide for Evaluation of Coatings Applied to Plastics¹

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1. Scope

1.1 This guide is intended for the evaluation of clear and pigmented coatings designed for use on rigid or semirigid plastic substrates. Coated film and sheeting are not covered by this guide.

1.2 *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

- D 522 Test Methods for Mandrel Bend Test of Attached Organic Coatings
- D 523 Test Method for Specular Gloss
- D 658 Test Method for Abrasion Resistance of Organic Coatings by Air Blast Abrasive³
- D 822 Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
- D 870 Practice for Testing Water Resistance of Coatings Using Water Immersion
- D 968 Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
- D 1308 Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- D 1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials
- D 2199 Test Method for Measurement of Plasticizer Migration From Vinyl Fabrics to Lacquers
- D 2244 Practice for Calculation of Color Tolerances and

Color Differences from Instrumentally Measured Color Coordinates

- D 2246 Method of Testing Finishes on Primed Metallic Substrates for Humidity-Thermal Cycle Cracking³
- D 2247 Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
- D 3170 Test Method for Chipping Resistance of Coatings
- D 3359 Test Methods for Measuring Adhesion by Tape Test
- D 3361 Practice for Unfiltered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
- D 3363 Test Method for Film Hardness by Pencil Test
- D 4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
- D 4141 Practice for Conducting Black Box and Solar Concentrating Exposures of Coatings
- D 4587 Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
- D 5031 Practice for Enclosed Carbon-Arc Exposure Tests of Paint and Related Coatings
- D 5179 Test Method for Measuring Adhesion of Organic Coatings to Plastic Substrates by Direct Tensile Testing
- D 6695 Practice for Xenon-Arc Exposures of Paint and Related Coatings
- G 99 Test Method for Wear Testing with a Pin-on-Disk Apparatus

3. Significance and Use

3.1 This guide is designed to set up a series of screening tests that will indicate the performance level to be expected of a coating or coating system on a given plastic substrate.

3.2 Plastic substrates vary widely in their acceptance characteristics for a given coating.

NOTE 1—Not all tests apply to all plastics.

3.3 Surface cleaning or preparation prior to application of the coating can be critical to the proper performance of the coating.

4. Test Panels and Panel Preparation

4.1 Unless directed otherwise, conduct performance tests on coatings of specified thickness applied to a normally molded sample of the designated plastic.

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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 Withdrawn.

4.2 Preparation of test samples shall include any cleaning, metallizing, or priming operations agreed upon between the producer and the user.

4.3 Air-dry or bake the system according to the established schedule and aged as agreed upon between the producer and the user.

5. Effect on Substrates

5.1 Determine the physical properties of the substrate such as hardness, tensile strength, flexibility, or surface smoothness before and after applying the coating under test. Select the appropriate tests for the substrate from the appropriate volumes of the *Annual Book of ASTM Standards*.

6. Physical Properties—Coating Film⁴

6.1 Color:

6.1.1 *Pigmented (on Dry Film)*—Evaluate color differences visually in accordance with Practice D 1729 and instrumentally in accordance with Practice D 2244.

6.2 Gloss:

6.2.1 Test in accordance with Test Method D 523.

6.3 Hardness:

6.3.1 Test in accordance with Test Method D 3363 (determining film hardness using pencil test).

6.4 Adhesion:

6.4.1 Test in accordance with Test Methods D 3359 for tape adhesion.

Note 2—Test Methods D 3359 may be used to test the adhesion of organic coatings on plastic substrates. However, read Peel Adhesion Testing on Plastic Substrates in the Appendix Commentary at the end of Test Methods D 3359 and Reference 7 for precautions to observe.

6.4.2 Test in accordance with Test Method D 5179 direct for tensile adhesion.

6.5 Abrasion Resistance:

6.5.1 Test in accordance with Test Method D 658 for air blast abrasion resistance.

6.5.2 Test in accordance with Test Methods D 968 for falling (abrasive) resistance.

6.5.3 Test in accordance with Test Method D 4060 for Taber abrasion resistance.

6.5.4 Test in accordance with Test Method G 99 for Pin-on-Disk abrasion resistance.

6.6 Resistance to Chipping:

6.6.1 Test in accordance with Test Method D 3170 for chipping resistance.

6.7 Flexibility and Elasticity:

6.7.1 Test in accordance with Test Methods D 522 for mandrel bend flexibility.

7. Durability/Environmental Properties⁴

7.1 Resistance to Plasticizer Migration:

7.1.1 Test in accordance with Test Method D 2199 for plasticizer migration.

7.1.2 Time and temperature may be varied as agreed upon between the producer and the user.

7.1.3 If migration from a plastic substrate into a coating is being determined, the vinyl contact pad should be omitted.

7.2 Resistance to Temperature-Humidity Cycling:

7.2.1 Test in accordance with Method D 2246 for humidity-thermal cycle cracking.

7.3 Humidity Resistance:

7.3.1 Test in accordance with Practice D 2247 for humidity resistance.

7.4 Water Immersion:

7.4.1 Test in accordance with Practice D 870 for water immersion resistance.

7.5 Resistance to Household Chemicals:

7.5.1 Test in accordance with Test Method D 1308.

7.6 Weather Resistance:

7.6.1 For outdoor exposure testing, expose in accordance with Practice D 4141. The type of exposure (Procedure A or Procedure B), duration of test and maximum acceptable appearance change shall be agreed upon between the producer and the user.

7.6.2 For accelerated weather testing, expose in accordance with either Practice D 822, D 3361, D 4587, D 5031, or D 6695. The practice to be used, duration of test and maximum acceptable appearance shall be agreed upon between the producer and the user. Because of differences in the spectral distributions of the exposure sources (xenon arc, fluorescent UV lamps, enclosed carbon arc and open flame carbon arc), as well as other conditions used in these types of laboratory weathering tests, these procedures may not result in the same performance ranking or types of failure modes of coatings, and different exposure durations may be required for detection of failure in the materials tested. Comparisons shall not be made of the relative stability of coatings exposed in the different types of apparatus.

8. Report

8.1 Report the appropriate results for each test as specified by the appropriate test method.

9. Precision

9.1 The precision of this guide is as specified in the individual test methods cited.

10. Keywords

10.1 coatings for plastics; plastic substrates

⁴ In cases where alternate test methods (that is, A, B, C, etc.) are listed, use the appropriate test method for the application.



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