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Standard Test Method for Evaluating Adhesion by Knife¹

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1. Scope

1.1 This test method covers the procedure for assessing the adhesion of coating films to substrate by using a knife.

1.2 This test method is used to establish whether the adhesion of a coating to a substrate or to another coating (in multi-coat systems) is at a generally adequate level.

NOTE 1—The term “substrate” relates to the basic surface on which a coating adheres (may be steel, concrete, etc. or other coating).

1.3 This method can be used in the laboratory and field.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[D2197 Test Method for Adhesion of Organic Coatings by Scrape Adhesion](#)

[D3359 Test Methods for Rating Adhesion by Tape Test](#)

[D4138 Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means](#)

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 D01.46 on Industrial Protective 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.

[D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers](#)

[D6132 Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Coating Thickness Gage](#)

[D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals](#)

[D7234 Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers](#)

3. Summary of Test Method

3.1 Adhesion is determined by scribing an “X” into the coating film to the substrate and by lifting the coating with the point of a utility knife. Adhesion is evaluated qualitatively on a 0 to 10 scale.

4. Significance and Use

4.1 Coatings, to perform satisfactorily, must adhere to the substrates on which they are applied. This test method has been found useful as a simple means of assessing the adhesion of coatings. Although this method is a qualitative (subjective) test it has been used in industry for many years and can provide valuable information.

4.2 Other adhesion test methods may be useful in obtaining quantitative results. See Test Methods [D2197](#), [D3359](#), [D4541](#), and [D7234](#).

4.3 The Performance Evaluation Scale (see [Table 1](#)) is based on both the degree of difficulty to remove the coating from the substrate and the size of removed coating chip.

4.4 This test method does not have a known correlation to other adhesion test methods (pull-off, tape, etc.).

4.5 A coating that has a high degree of cohesive strength may appear to have worse adhesion than one that is brittle and hence fractures easily when probed.

4.6 This method is not to be used on overly thick coatings, that is, those which cannot be cut to the substrate with a utility knife in one stroke.

5. Apparatus and Materials

5.1 *Cutting Tool*—Sharp utility knife.

TABLE 1 Rating System

Rating	Description
10	Coating is extremely difficult to remove; fragments no larger than approximately 0.8 mm by 0.8 mm ($\frac{1}{32}$ in. by $\frac{1}{32}$ in.) removed with great difficulty.
8	Coating is difficult to remove; chips ranging from approximately 1.6 mm by 1.6 mm ($\frac{1}{16}$ in. by $\frac{1}{16}$ in.) to 3.2 mm by 3.2 mm ($\frac{1}{8}$ in. by $\frac{1}{8}$ in.) can be removed with difficulty.
6	Coating is somewhat difficult to remove; chips ranging from approximately 3.2 mm by 3.2 mm ($\frac{1}{8}$ in. by $\frac{1}{8}$ in.) to 6.3 mm by 6.3 mm ($\frac{1}{4}$ in. by $\frac{1}{4}$ in.) can be removed with slight difficulty.
4	Coating is somewhat difficult to remove; chips in excess of 6.3 mm by 6.3 mm ($\frac{1}{4}$ in. by $\frac{1}{4}$ in.) can be removed by exerting light pressure with the knife blade.
2	Coating is easily removed; once started with the knife blade, the coating can be grasped with ones fingers and easily peeled to a length of at least 6.3 mm ($\frac{1}{4}$ in.).
0	Coating can be easily peeled from the substrate to a length greater than 6.3 mm ($\frac{1}{4}$ in.).

5.2 *Cutting Guide*—Steel or other hard metal straight edge to ensure straight cuts.

5.3 *Dry Film Thickness Gage*.

6. Test Specimen

6.1 When this test method is used in the field, the specimen is the coated substrate on which the adhesion is to be evaluated.

6.2 For laboratory use, apply the materials to be tested to panels of the composition and surface conditions on which it is desired to determine adhesion.

NOTE 2—If desired or specified, the coated test panels may be subjected to a preliminary exposure such as water immersion, salt spray, or high humidity before conducting the knife adhesion test.

7. Procedure

7.1 Select an area free of blemishes and surface imperfections.

7.2 Measure the dry film thickness at, or near, the location where adhesion assessment will be performed. Appropriate procedures are found in Practices **D4138**, Test Method **D6132**, or Practice **D7091**.

7.3 Using a sharp knife and cutting guide, make two cuts into the coating with a 30° to 45° angle between legs and down to the substrate which intersects to form an “X.” Make each leg of the angle a minimum of 38.1 mm ($1\frac{1}{2}$ in.) in length. Disregard coating removed during cutting process.

7.4 Employing the point of the knife and beginning at the vertex of the angle, attempt to lift up the coating from the substrate or from the coating below. Rate according to **Table 1**.

7.5 Repeat the test in two other locations on each test panel. For large structures make sufficient tests to ensure that the adhesion evaluation is representative of the whole surface.

7.6 After making several cuts examine the cutting edge and, if necessary, replace the blade.

8. Report

8.1 Report the following information:

8.1.1 The number of tests,

8.1.2 The mean and range of the tests,

8.1.3 Where the failure (if any) occurred (between first coat and substrate, between first and second coat, or within the coating, etc., and

8.1.4 The coating dry film thickness.

8.1.5 For field test, report:

8.1.5.1 The structure or article tested,
8.1.5.2 The location on the article where the test(s) were performed, and

8.1.5.3 The environmental conditions at the time of testing.

8.1.6 For test panels, report:

8.1.6.1 The substrate employed,

8.1.6.2 The type of coatings,

8.1.6.3 The dry film thickness and cure of each coat, and

8.1.6.4 The environmental conditions at the time of testing.

9. Precision and Bias

9.1 No precision statement has been established for this test method due to its subjective character.

10. Keywords

10.1 adhesion; coating; intercoat adhesion; knife adhesion; paint; wet adhesion

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