



Designation: D3359 – 23

Standard Test Methods for Rating Adhesion by Tape Test¹

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1. Scope

1.1 These test methods cover procedures for assessing the adhesion of relatively ductile coating films to metallic substrates by applying and removing pressure-sensitive tape over cuts made in the film.

1.2 Test Method A is primarily intended to rate the adhesion of coatings and coating systems greater than 125 μm (5 mils) in total thickness, while Test Method B is primarily intended to rate the adhesion of coatings and coating systems less than 125 μm (5 mils) in total thickness. Test Method B is not considered suitable for films thicker than 125 μm (5 mils) unless wider spaced cuts are employed and there is an explicit agreement between the purchaser and seller. If the thickness of the coating or coating system has not been predetermined, employ the use of a standard such as Practice D7091 or other appropriate standard agreed upon by interested parties prior to proceeding.

1.3 These test methods are used to evaluate whether the adhesion of a coating to a substrate is adequate for the user's application. They do not distinguish between higher levels of adhesion for which more sophisticated methods of measurement are required.

1.4 This test method is similar in content (but not technically equivalent) to ISO 2409.

1.5 In multicoat systems adhesion failure may occur between coats so that the adhesion of the coating system to the substrate is not determined.

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

1.7 *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 These test methods are under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and are the direct responsibility of Subcommittee D01.23 on Physical Properties of Applied Paint Films.

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1.8 *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

D609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products

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

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

D1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting

D2092 Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting (Withdrawn 2008)³

D2370 Test Method for Tensile Properties of Organic Coatings

D3330/D3330M Test Method for Peel Adhesion of Pressure-Sensitive Tape

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

D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

2.2 Other Standards:

ISO 2409 Paint and Varnishes — Cross-cut test⁴

PSTC 101 International Standard for Peel Adhesion of

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 The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

Pressure Sensitive Tape⁵

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *adhesion, n*—the molecular attraction and mechanical bonds between a coating and its substrate.

3.1.2 *batch, n*—as it pertains to tape, a unique production run during manufacturing.

3.1.3 *blemish, n*—an obvious surface flaw, such as cracking or discoloration of the coating.

3.1.4 *environmental conditions, n*—the characteristics of the immediate surroundings during the tests, such as temperature, and relative humidity.

3.1.5 *immersion conditions, n*—the characteristics of the fluid to which the test specimen was exposed, such as type of fluid, temperature of fluid and duration of immersion.

3.1.6 *lap, n*—one complete turn of the tape on a roll; the outer exposed layer of tape.

3.1.7 *lattice pattern, n*—one series of parallel lines intersected by another set of parallel lines that are at 90° to and centered on the first set.

3.1.8 *mean, n*—the classification rating that is obtained by adding together the digits of the classification ratings of the tests performed and dividing by the number of tests, frequently rounded to the nearest whole number classification rating.

3.1.9 *pressure-sensitive tape, n*—tape with an adhesive that requires some degree of pressure, and only pressure, to adequately bond to a surface.

3.1.10 *range, n*—the span of classification ratings for a set of tests, from minimum classification rating to maximum classification rating.

3.1.11 *solvent, n*—a liquid agent capable of dissolving or dispersing contaminants from the surface of the coating or film.

3.1.12 *substrate, n*—the structural foundation beneath the coating or film being tested.

3.1.13 *template, n*—a thin, rigid plate containing evenly distributed, parallel slits for use as a guide in generating the lattice pattern when accompanied by a single-blade cutting tool.

3.1.14 *test specimen, n*—the object whose coatings adhesion is of interest.

4. Summary of Test Methods

4.1 *Test Method A*—An X-cut is made through the film to the substrate, pressure-sensitive tape is applied over the cut and then removed, and adhesion is assessed qualitatively on a 0 to 5 scale.

4.2 *Test Method B*—A lattice pattern with either six or eleven cuts in each direction is made through the film to the substrate, pressure-sensitive tape is applied over the lattice pattern and then removed, and adhesion is assessed qualitatively on a 0 to 5 scale.

4.2.1 Subject to agreement between the purchaser and the seller, Test Method B can be used for films thicker than 125 µm (5 mils) if wider spaced cuts are employed.

5. Significance and Use

5.1 In order for a coating is to fulfill its function of protecting or decorating a substrate, the coating must remain adhered to the substrate. Because the substrate and its surface preparation (or lack thereof) have a drastic effect on the adhesion of coatings, a method to evaluate adhesion of a coating to different substrates or surface treatments, or of different coatings to the same substrate, is of considerable usefulness in the industry.

5.2 This test method is limited to evaluating lower levels of adhesion (see 1.3). The intra- and inter-laboratory precision of this test method is similar to other test methods for coated substrates (for example, Test Method D2370 and Test Method D4060), and is insensitive to all but large differences in adhesion. Limiting the range of rankings from 0 to 5 reflects the inability of this test method to make fine distinctions between levels of adhesion. Users shall not use intermediate values for ranking adhesion tests within this method.

5.3 Extremes in temperatures or relative humidity may affect the adhesion of the tape or the coating.

5.4 A given tape may not adhere equally well to different coatings due to several factors, including differences in coating composition and topology. As such, no single tape is likely to be suitable for testing all coatings. Furthermore, these test methods do not give an absolute value for the force required for bond rupture, but serves only as an indicator that some minimum value for bond strength was met or exceeded (1, 2).⁶

5.5 Operators performing these test methods must be trained and practiced in order to obtain consistent results. The accuracy and precision of the test result obtained by using these methods depends largely upon the skill of the operator and the operator's ability to perform the test in a consistent manner. Key steps that directly reflect the importance of operator skill include the angle and rate of tape removal and the visual assessment of the tested sample. It is not unexpected that different operators might obtain different results (1, 2).

5.6 The standard requires that the free end of the tape be removed rapidly at as close to a 180° angle as possible. When the peel angle and rate vary, the force required to remove the tape can change dramatically due to the rheological properties of the backing and adhesive. Variation in pull rate and peel angle can effect large differences in test values and must be minimized to assure reproducibility (3).

NOTE 1—These test methods have been reported being used to measure adhesion of organic coatings on non-metallic substrates (for example, wood and plastic), although related precision and bias data is lacking. If testing coatings on non-metallic substrates, either Test Method A or Test Method B may be more appropriate and the method employed should be discussed by interested parties. Issues with plastic substrates are noted in Appendix X1. A similar test method, ISO 2409, permits tests on non-metallic substrates (for example, wood and plaster). Precision and

⁵ Available from the Pressure Sensitive Tape Council (PSTC), 1833 Centre Point Circle, Suite 123, Naperville, IL 60563, <http://www.pstc.org>.

⁶ The boldface numbers in parentheses refer to the list of references at the end of this test method.