



Designation: D3330/D3330M – 04

Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape ¹

This standard is issued under the fixed designation D3330/D3330M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 These test methods cover the measurement of the peel adhesion of pressure-sensitive tapes.

1.1.1 Test Method A gives a measure of the adherence, when peeled at 180° angle, to a standard steel panel or to other surface of interest for a single-coated tape.

1.1.2 Test Method B gives a measure of the adherence to the backing of a single-coated tape.

1.1.3 Test Method C gives a measure of the adherence of double-coated tape to a standard steel panel or other surface of interest.

1.1.4 Test Method D gives a measure of the adherence of the release liner to the adhesive of either single- or double-coated tape.

1.1.5 Test Method E gives a measure of the adherence of an adhesive transfer tape to a standard steel panel or other surface of interest.

1.1.6 Test Method F gives a measure of the adherence, when peeled at 90° angle, to a standard steel panel or other surface of interest for a single-coated tape.

1.2 These test methods provide a means of assessing the uniformity of the adhesion of a given type of pressure-sensitive adhesive tape. The assessment may be within a roll of tape, between rolls, or between production lots.

1.3 Variations in either the tape backing or the adhesive, or both, affect the response. Therefore, these test methods cannot be used to pinpoint the specific cause(s) of non-uniformity.

1.4 These test methods may not be appropriate to test tapes having relatively stiff backings, stiff liners, or backings showing high stretch at low forces. These characteristics will result in a high variability for the test response which is not a true indication of the real nature of the adhesive bond.

1.5 Values stated in either SI or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents, therefore, each system must be used independently without combining values in any way.

¹ These test methods are under the jurisdiction of ASTM Committee D10 on Packaging and are the direct responsibility of Subcommittee D10.14 on Tape and Labels.

Current edition approved Oct. 1, 2004. Published October 2004. Originally approved in 1976. Last previous edition approved in 2002 as D3330/D3330M – 02^{e1}. DOI: 10.1520/D3330_D3330M-04.

1.6 *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

A666 Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

D996 Terminology of Packaging and Distribution Environments

D3715/D3715M Practice for Quality Assurance of Pressure-Sensitive Tapes

D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing

D5750/D5750M Guide for Width and Length of Pressure-Sensitive Tape

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

2.2 AFERA Standard:³

4001 Self adhesive tapes – Measurement of peel adhesion

2.3 European Norm:⁴

EN 1939 Self adhesive tapes – Measurement of peel adhesion from stainless steel or from its own backing

2.4 Pressure Sensitive Tape Council Standards:⁵

PSTC 101 Peel Adhesion of Pressure Sensitive Tape

3. Terminology

3.1 *Definitions*—Terminology found in Terminology D996 shall apply.

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 Association des Fabricants Européens de Rubans Auto Adhésifs (AFERA), LAM, Laan Copes van Cattenburch 79, NL-2858 EW, The Hauge, Netherlands.

⁴ European Norm, (EN); available from Comité Européen de Normalisation (CEN), Rue de Stassart, 36, B-1050, Brussels, Belgium.

⁵ Pressure Sensitive Tape Council (PSTC), 400 North Michigan Ave., #2200, Chicago, IL 60611-4267.

4. Summary of Test Method

4.1 *Test Method A—Single-Coated Tapes, Peel Adhesion at 180° Angle*—A strip of tape is applied to a standard test panel (or other surface of interest) with controlled pressure. The tape is peeled from the panel at 180° angle at a specified rate, during which time the force required to effect peel is measured.

4.2 *Test Method B—Adhesion to Backing, Single-Coated Tapes*—A strip of the tape under test is applied to a rigid panel. A strip of the tape under test is applied to the backing of the first strip of tape and tested for peel adhesion as described in Test Method A.

4.3 *Test Method C—Double-Coated Tapes:*

4.3.1 *Face Side Adhesion*—The double-coated tape is adhered to a stainless steel panel (or other surface of interest), liner side up. The liner is removed and the exposed adhesive covered with a strip of 0.025-mm [0.001-in.] thick polyester film. The resulting tape is then tested as described in Test Method A.

4.3.2 *Liner Side Adhesion*—The face side adhesive is adhered to a 0.025-mm [0.001-in.] polyester film. The liner is removed and the tape is applied adhesive down to a stainless steel panel (or other surface of interest). Testing is conducted as described in Test Method A.

4.4 *Test Method D—Adhesion to Liner*—The tape is adhered to a standard steel test panel with the liner side up. The liner is peeled from the adhesive in the same manner as in peeling a single-coated tape from a standard panel as described in Test Method A.

4.5 *Test Method E—Adhesion of Adhesive Transfer Tapes:*

4.5.1 *Face Side*—The tape is adhered to a standard panel (or other surface of interest). The liner is removed and a 0.025-mm [0.001-in.] thick strip of polyester is adhered to form a film-backed strip of tape. The adhesion is measured as described in Test Method A.

4.5.2 *Linear Side*—The transfer tape is applied to a strip of 0.025-mm [0.001-in.] thick polyester film, the liner is removed and the resulting tape's adhesion is measured as described in Test Method A.

4.6 *Test Method F—Single-Coated Tapes, 90° Peel*—A strip of tape is applied to a standard test panel (or other surface of interest) with controlled pressure. The tape is peeled from the panel at 90° angle at a specified rate, during which time the force required to effect peel is measured.

5. Significance and Use

5.1 These test methods are tools for quality assurance use. Given specific pressure-sensitive tape and a requirement in terms of the minimum or maximum peel value expected for this tape, the data from the test can be used in conjunction with acceptance criteria.

5.2 Test Method A, B, C, E, or F can show the relative bond strength of a given tape to one or more surfaces (material and texture) as compared to the standard stainless steel panel. Substitution of representative samples of materials in question for the standard steel panel would suffice to do this.

5.3 Test Methods A, B, C, E or F cannot be used to compare two pressure-sensitive tapes of the same type but of different manufacture for their ability to adhere to a surface. This is

because the measured peel force is not normalized for a fixed area of stress. The area under stress varies with backing stiffness and adhesive rheology (firmness). Two different tapes seldom agree in these properties.

5.4 Test Method D can show the amount of force required to remove a liner that covers the adhesive side of a tape at a specified peel rate. The force will be different at other peel rates.

5.5 These test methods may not provide design information as there is usually no direct relationship between peel adhesion and any functional requirement.

6. Apparatus

6.1 *Specimen Cutter*—The specimen cutter shall hold two single-edged razor blades in parallel planes, a precise distance apart, to form a cutter of exact specimens widths. Two cutters, 12- and 24-mm [0.05- and 1-in.] cutting width, shall be available. Appropriate alternates which will not cause edge damage may be used.⁶

NOTE 1—The 12-mm [0.5-in.] cutter shall consist of a 12-mm [0.5-in.] thick by 220-mm [8-in.] length aluminum bar stock 12-mm [0.05-in.] wide. The edges for about 125 mm [5 in.] from one end shall be slightly rounded to form a handle. The width of the bar for 75 mm [3 in.] from the opposite end shall be narrowed to exactly 12 mm [0.5 in.] minus the thickness of a single razor blade (one of two used as cutting edges). The razor blades shall be held in position using side plates. The end of the cutter shall be cut away at 45° angle to expose the cutting edge at one end of the blades. The edges shall be separated by 12 ± 0.10 mm [0.5 in.]. The 24-mm [1-in.] cutter shall follow the same description except the bar stock shall be 24.0 mm [1 in.] and shall be narrowed exactly 24 mm [1 in.] minus the thickness of a single razor blade.

6.2 *Dispensing System*—For solvents, such as a wash bottle.

6.3 *Panel*—A stainless steel panel, 50 by 125 mm [2 by 5 in.] no less than 1.1 mm [0.043 in.] thickness, conforming to Type 302 or 304 of Specification A666, having a bright annealed finish. The surface roughness height shall be 50 ± 25 nm [2.0 ± 1.0 μ m.] arithmetical average deviation from the mean line. Panels showing stains, discoloration, or many scratches are not acceptable. New panels should be cleaned prior to use as described in 11.1, except with ten washes of the final solvent. Between uses, the panel test surface shall be protected from scratches and contamination, and the panels stored at conditions described in Section 10.

6.4 *Roller*—Mechanically or hand operated.

6.4.1 A steel roller 85 ± 2.5 mm [3.25 ± 0.1 in.] in diameter and 45 ± 1.5 mm [1.75 ± 0.05 in.] in width, covered with rubber approximately 6 mm [0.25 in.] in thickness, having a Shore scale A durometer hardness of 80 ± 5 . The surface shall be a true cylinder void of any convex or concave deviations. The mass of the roller shall be 2040 ± 45 g [4.5 ± 0.1 lb].

6.4.2 No part of the apparatus shall increase the mass of the roller during use. The roller shall move either mechanically or

⁶ These widths correspond to the primary metric (SI) units described in Guide D5750/D5750M. These so-called “modular metric” units are used throughout the world, except for Europe. If it is desirable to test slightly different widths (for example, 25 mm) of specimens than those described in 9.1, this should be noted (see 18.1.7) and calculations must also account for the difference (see 17.1).

by hand at the rate of 10 ± 0.5 mm/s [24 ± 0.5 in./min]. A mechanically operated roller is recommended for referee purposes.

NOTE 2—A simple check to determine if the rubber surface is cylindrical is to wrap the roller in a very thin paper (onionskin) and drag it across a flat glass plate on which is placed carbon paper, face up. The carbon rubs off onto the thin paper wrapper to reveal high spots or hollows on the rubber surface.

6.5 Adhesion Tester—A constant-rate-of-extension (CRE) tension tester shall be used. It is proposed to use an electronic machine taking at least one reading per mm [0.1 in.] of tape peeled. The tester shall have two clamps with centers in the same plane, parallel with the direction of the motion on the stressing clamp, and so aligned that they will hold the specimen wholly in the same plane; a means of moving the stressing clamp at a uniform rate of 5.0 ± 0.2 mm/s [12 ± 0.5 in./min] and a device for recording load. The instrument shall be calibrated to an accuracy of 0.5 % of full scale and the scale range used for any test shall be such that the mean test level falls within 20 to 80 % of full scale.

6.6 Fixture—90° peel for Test Method F.

7. Reagents and Materials

7.1 Purity of Reagents—Reagent grade chemicals should be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening accuracy of the determination.

7.2 Solvents:

7.2.1 Any of the following solvents may be used for cleaning:

7.2.1.1 Diactone alcohol non-residual, technical grade or better,

7.2.1.2 Methanol (95 %),

7.2.1.3 Methyl ethyl ketone (MEK),

7.2.1.4 n-Heptane, or

7.2.1.5 Acetone.

7.2.2 For referee testing, the final cleaning shall be with MEK or acetone.

7.2.3 Before selecting or using these solvents for cleaning test panels, be sure to read and follow all precautions on the chemical Material Safety Data Sheets (MSDS) and consult with Environmental, Health, and Safety (EHS) professionals.

7.3 Cleaning Material—Absorbent, surgical gauze, cotton wool or tissue may be used. To be suitable, materials must be lint-free during use, absorbent, contain no additives that are soluble in the solvents listed in **7.2** and made exclusively from virgin materials.

8. Sampling

8.1 Acceptance Sampling—Sampling shall be in accordance with Practice **D3715/D3715M**.

8.2 Sampling for Other Purposes—The sampling and the number of test specimens depends on the purpose of the testing. Practice **E122** is recommended. It is common to test at least five specimens of a particular tape. Test specimens should be taken from several rolls of tape, and whenever possible, among several production runs of tape. Strong conclusions about a specific property of a tape cannot be based on tests of a single unit (roll) of a product.

9. Test Specimen

9.1 The specimen shall be 24-mm [1-in.] wide. If the specimen is of a different width, refer to **Note 4**. A tolerance of ± 0.5 mm [$\pm 1/64$ in.] shall be allowed. The length shall be approximately 300 mm [12 in.].

9.2 Discard at least three but no more than six outer wraps of tape from the sample roll before taking the specimens for testing.

9.3 Remove one specimen per sample roll for each test to be performed. Remove the specimen from a freely rotating roll at the rate of 500 to 750 mm/s [20 to 30 in./s]. Where width or other factors causing a high adherence to backing makes it impossible to remove the specimen at the prescribed rate, remove it at a rate as close to 500 mm/s [20 in./s] as possible.

9.4 When tape is wider than 24 mm [1 in.], specimens of the widest specified width are to be cut from the center of a strip removed from the roll in accordance with **9.3**.

9.5 Apply specimen within 5 min after unwinding.

10. Conditioning

10.1 Condition the sample rolls of tape in the standard conditioning atmosphere as described in Practice **D4332** for a period of not less than 24 h. Test at these conditions. (**Warning**—The tester should know that by prolonged handling heat is transmitted to the stainless steel test panel. Therefore, during and after application of the adhesive tape to the test panel, the panel should be handled as little as possible.)

11. Test Method A—Single-Coated Tapes at 180° Angle

11.1 Dispense one of the solvents listed in **7.2.1** onto the panel, wiping it to dryness with fresh absorbent cleaning material. Repeat for a total of three washes with this solvent. The panel shall be allowed to dry at standard conditions for at least 10 min. If cleaned panel is not used within 10 h, it should be recleaned.

NOTE 3—Discard panels showing stains, discoloration, or many scratches. Avoid contacting panel surface with fingers. During storage, panels should be protected from damage or contamination.

11.2 Remove a 300-mm [12-in.] specimen of the tape to be tested, as described in **9.3**. Fold 12 mm [0.5 in.] at one end, adhesive to adhesive to form a tab. Touch other end of the specimen to an end of the test panel. Hold the other end of the specimen so that it does not make contact with the panel but is positioned loosely above it. Roll mechanically or by hand twice in each lengthwise direction, causing the roller to apply the tape to the panel. This prevents entrapment of air between the adhesive and the panel. Should this occur, discard the specimen.

NOTE 4—Where the width of the specimen is less than 24 mm [1 in.], prior to applying test specimen, apply a strip or strips of the tape, to give an equivalent width of 24 mm [1 in.] for rolling purposes or use roller of appropriate weight to obtain a line pressure equal to 2040 g [4.5 lb] for 24 mm [1 in.] width ± 35 %.

11.3 Individually prepare each specimen and test within 1 min.

NOTE 5—Longer dwell time will give different results. Peel adhesion increases with dwell time at different rates for various tapes. A longer