



Designation: D2860/D2860M – 17

Standard Test Method for Adhesion of Pressure-Sensitive Tape to Fiberboard at 90° Angle and Constant Stress¹

This standard is issued under the fixed designation D2860/D2860M; 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 U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of the property of adhesion of pressure-sensitive tape to a fiber-board surface. The user of this test method has the option of choosing the paper surface for the test. The test surface may be the standard linerboard, another linerboard (or paper) of individual interest, or a specific fiberboard.

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

1.3 *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.*

1.4 *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

D996 Terminology of Packaging and Distribution Environments

D2904 Practice for Interlaboratory Testing of a Textile Test

¹ This test method is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.14 on Tape and Labels.

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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.

Method that Produces Normally Distributed Data (Withdrawn 2008)³

D2906 Practice for Statements on Precision and Bias for Textiles (Withdrawn 2008)³

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

3. Terminology

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

4. Summary of Test Method

4.1 *Procedure A*—The pressure-sensitive tape is mounted on a rigid panel. The adhesive side is exposed. A strip of linerboard, which represents the fiberboard, is placed against the tape adhesive with controlled pressure. The area of contact is specified. The panel is mounted in a horizontal position. A specified mass is fastened to one end of the linerboard. The mass acts to peel the linerboard away from the adhesive at an angle of 90°. The time required to peel the linerboard from the tape is measured.

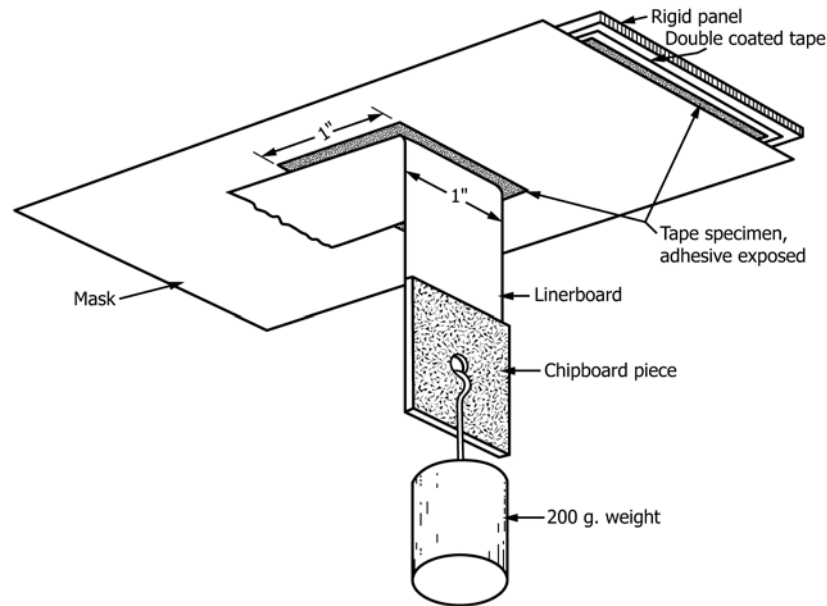
4.2 *Procedure B*—In this procedure, the fiberboard or the linerboard representing it is adhered to a rigid panel and the tape peeled from it. In all other respects, the procedure is the same as Procedure A.

5. Significance and Use

5.1 This test method is designed to show the adhesion of a pressure-sensitive tape to fiberboard when the tape is under a constant stress. Test data from this test method for some types of packaging tape relates to tape performance on fiberboard box closure.

5.2 Procedure A should be used when comparing tapes to an established requirement. The requirement may be established

³ The last approved version of this historical standard is referenced on www.astm.org.



NOTE 1—Fix panel securely in a horizontal plane.

FIG. 1 Test Assembly for Procedure A

using either the standard linerboard or another linerboard representing a specific fiberboard.

5.3 Procedure B should be used to rank tapes as to their ability to adhere to fiberboard.

6. Apparatus and Materials

6.1 *Tape*, pressure-sensitive, double-coated, 48-mm [2-in.] width. The tape shall exhibit sufficient adhesion to the panel and test specimen or fiberboard to avoid the failures cited in 10.1.9 and 10.2.14.

6.2 *Panel*—Any steel piece at least 50 by 125 mm [2 by 5 in.] and no less than 1.1 mm [0.043 in.] thick, having one face (2 by 5 in.) that does not deviate from a plane by more than 0.050 mm [0.002 in.].

6.3 *Stop Watch*.

6.4 *Razor Blade*, single-edge.

6.5 *Mask*—Any paper no more than 0.050 mm [0.002 in.] thick formed to a rectangle approximately 125 by 60 mm [5 by 2.5 in.] with a rectangular hole exactly 24 ± 0.25 [1.0 \pm 0.01] by 32 mm [1.25 in.] centered in the piece. The 24-mm [1-in.] hole dimension shall be in the 125-mm [5-in.] direction (see Fig. 1 and Fig. 2).

6.6 *Cutter*, for preparing fiberboard or linerboard and tape specimens.

6.7 *Paperboard Piece*, approximately 25 by 25 mm [1 by 1 in.], for reinforcement.

NOTE 1—Chipboard pads constructed from 0.030-in. thick fiberboard are typically used.

6.8 *Paper Punch*, single-hole.

6.9 *Fiberboard or Linerboard Surface*,⁴ against which the test is made.

6.9.1 For Procedure A, cut a rectangle exactly 24 ± 0.25 mm [1.0 \pm 0.01 in.] wide by at least 125 mm [5 in.] in length, from the linerboard representing the fiberboard on which the tape will be used. The long dimension shall lie at a right angle to the machine direction of the linerboard. Reinforce one end of the strip with a chipboard piece adhered with double-coated tape. Punch a hole at the center of the reinforcement.

6.9.2 For Procedure B, cut a rectangle, preferably 125 by 50 mm [5 by 2 in.], but no less than 50 by 50 mm [2 by 2 in.], from the fiberboard on which the tape will be used (or linerboard representing it). The long test dimension shall lie at a right angle to the machine direction of the linerboard.

6.9.3 For either procedure, prepare the linerboard or fiberboard in advance of testing and mark it to show which side to use. When comparing one roll of tape to another or one lot of tape to another, the linerboard or fiberboard should be from a single lot.

6.10 *Steel Roller*, 82.5 ± 2.5 mm [3.25 \pm 0.1 in.] in diameter and 45 ± 1.5 mm [1.75 \pm 0.05 in.] in width, covered with rubber approximately 6 mm [0.25 in.] in thickness having a Shore 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 \pm 0.1 lb]. The mass of the handle shall not add to the mass of the roller during use.

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

⁴ The linerboard accepted as the standard test surface, Standard Reference Material 1810A, is available from the Office of Standard Reference Materials, National Institute of Standards and Technology, Washington, DC 20234.

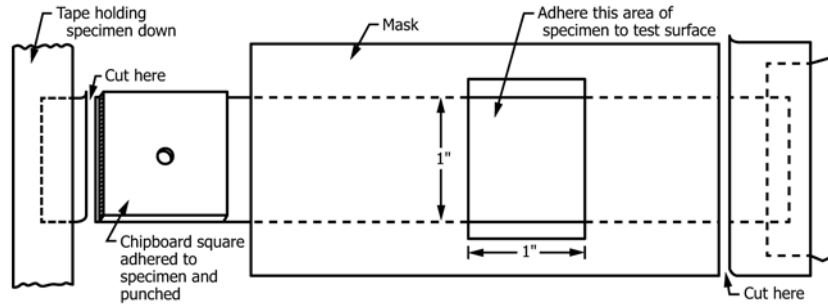


FIG. 2 Preparation of Specimen for Procedure B

it across a flat glass plate on which is placed a carbon paper, face up. The carbon rubs off onto the thin paper wrapper to reveal high spots or hollows on the rubber surface.

6.11 *Test Stand*, to support the panel securely in a horizontal plane during the test period.

6.12 *Mass*, 200 ± 0.2 g, with a hook.

6.13 *Timing System*, for measuring test time in minutes.

6.14 *Paper*, clean, unprinted, and without a coating of any kind, for use in adhering linerboard or fiberboard to the panel (Procedure B).

7. Sampling

7.1 Sampling shall be in accordance with Practice D4332.

8. Test Specimens

8.1 A roll or rolls of tape for testing must be at least 36 mm [1.5 in.] in width.

8.2 Unwind and discard at least three, but no more than six, outer wraps from the sample roll before taking specimens for testing.

8.3 Test five specimens from each roll of tape.

9. Conditioning

9.1 Condition sample rolls of tape and linerboard or fiberboard in the standard conditioning atmosphere as described in Practice D4332 for a period of not less than 24 h. Test at these conditions.

10. Procedure

10.1 *Procedure A*:

10.1.1 Adhere the double-coated tape to the panel with firm finger pressure and remove the liner.

10.1.2 Lightly sand the backing of the test tape on the roll for approximately 250 mm [10 in.] with 300-grit sandpaper to remove the easy unwind treatment. Start timing with the stop watch. Immediately unwind 300 to 450 mm [12 to 18 in.] of tape from a freely rotating roll at a rate of 500 to 750 mm [20 to 30 in.]/s.

10.1.3 Center the sanded area of this strip, adhesive side up, on the panel, aligning the long edges parallel with the panel long edges. Trim it to the panel dimensions. Do not allow any object to contact the adhesive.

10.1.4 Place a mask at the center of the specimen so that the 24-mm [1-in.] dimension of the hole in the mask lies parallel to the long dimension of the specimen edges (see Fig. 1). Rub against the mask to assure that the tape specimen is well adhered to the double-coated tape on the panel. Avoid touching the adhesive.

10.1.5 At 90 ± 5 s, position the linerboard strip (end opposite the hole) to span the mask and enter it lengthwise on the specimen adhesive. Ensure that the correct side of the linerboard is placed against the specimen adhesive. Do not apply any finger pressure to the specimen. Continue timing.

10.1.6 Roll the linerboard against the specimen lengthwise twice each way at a rate of 10 ± 0.5 mm/s [24 ± 0.5 in./min] using the rubber-covered roller.

10.1.7 Immediately set the panel, specimen side down, into the test stand, assuring that it will remain in a horizontal plane throughout the test.

10.1.8 At 180 ± 5 s (3 min from unwinding the tape from the roll), add the 200-g mass so that no shock load is imparted to the linerboard, and immediately start the time. Allow the test to continue until the linerboard has peeled free from the specimen adhesive.

10.1.9 Void all tests where the tape (test specimen) has pulled away from the panel (either the specimen from the double-coated tape or the double-coated tape from the panel). When this occurs, repeat the test assuring that the panel, the double-coated tape, and the test specimen are well bonded together.

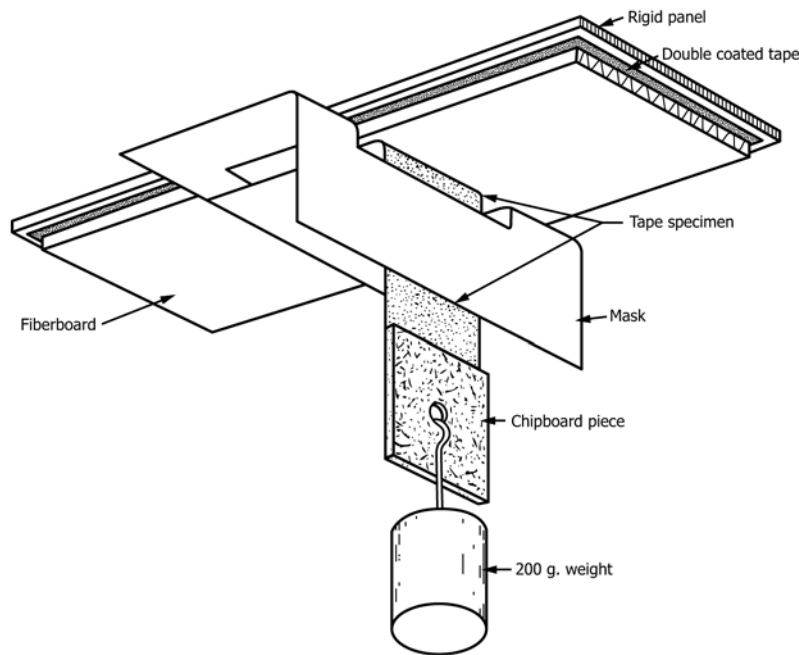
10.2 *Procedure B*:

10.2.1 Adhere the double-coated tape to the panel with firm finger pressure and remove the liner.

10.2.2 Superimpose the fiberboard (or linerboard) on the double-coated tape, exposing the correct side and assuring that the machine direction is at a right angle to the long dimension of the panel. Handle the fiberboard only at the edges and corners so that an area at least 35 mm [1.5 in.] square at its center is absolutely free of contamination.

10.2.3 Place a clean sheet of paper (6.14) on top of the fiberboard. Rub against this to assure that the fiberboard is well bonded to the double-coated tape on the panel. Do not rub the fiberboard surface with the paper or fingers.

10.2.4 Start timing with the stop watch. Immediately unwind 300 to 450 mm [12 to 18 in.] of tape from a freely rotating roll at a rate of 500 to 750 mm [20 to 30 in.]/s.



NOTE 1—Fix panel securely in a horizontal plane.

FIG. 3 Test Assembly for Procedure B

10.2.5 From the center of this strip, cut a specimen 24 ± 0.25 mm [1.0 ± 0.01 in.] wide and at least 180 mm [7 in.] in length. Handle this strip by its ends only. Do not allow adhesive to contact any object.

10.2.6 Lay the specimen, adhesive side up, on the work bench and tape the ends down to hold the specimen flat.

10.2.7 Apply a mask at one end of the specimen so that the 24-mm [1-in.] dimension of the hole lies parallel to the long edges of the specimen (see Fig. 2).

10.2.8 Apply the chipboard square to the exposed adhesive at the other end of the specimen (see Fig. 2).

10.2.9 Cut away the taped ends of the specimen. Punch a hole for the hook of the mass in the chipboard.

10.2.10 At 90 ± 5 s, position the specimen lengthwise on the fiberboard, adhesive down, so that the 1 by 1-in. [24 by 24-mm] adhesive area is approximately centered on the fiberboard. Do not apply any finger pressure to the specimen. Continue timing.

10.2.11 Roll the specimen lengthwise twice each way at a rate of 10.0 ± 0.2 mm/s [24 ± 0.5 in./min], using the rubber-covered roller.

10.2.12 Immediately set the panel, specimen side down, into the test stand, assuring that it will remain in a horizontal plane throughout the test.

10.2.13 At 180 ± 5 s (a total of 3 min from unwinding the tape from the roll), add the 200-g mass so that no shock load is imparted to the specimen and start the timer. Allow the test to continue until the specimen has peeled free from the fiberboard (see Fig. 3).

10.2.14 Void all tests where the fiberboard has pulled away from the panel (either the fiberboard from the double-coated tape or the double-coated tape from the panel). When this occurs, repeat the test, assuring that the panel, double-coated tape, and the fiberboard are well bonded together.

11. Calculation

11.1 To determine the test result for each roll of tape, convert each of the five specimen test results to its logarithm. Obtain the arithmetic mean of all logarithms and then convert the arithmetic mean logarithm back to time by obtaining its antilogarithm. This final step gives the test result for the roll of tape under consideration. No single specimen value shall be considered as representative of the roll under test.

12. Report

12.1 The report shall include the following:

12.1.1 A statement that this test method was used, indicating which procedure (A or B), and any deviations from the method as written,

12.1.2 Complete identification of each roll of tape tested including type, source, manufacturer's code number, and form,

12.1.3 Linerboard or fiberboard identification including the type, source, manufacturer's code number, and conditioning history prior to the test,

12.1.4 Number of specimens tested from each roll of tape,

12.1.5 Anomalous behavior during the test, that is, adhesive transfer or splitting paper fiber pulled free from the linerboard or fiberboard, delamination of the linerboard or fiberboard, and

12.1.6 Mean time value calculated in 11.1 for each of the rolls of tape under test.

13. Precision and Bias

13.1 *Summary*—The difference between two single observations should not exceed 27.7 % of the average of the two observations in transformed units in 95 out of 100 cases when both observations are taken by the same well-trained operator using the same piece of test equipment and specimens randomly drawn from the same sample of material. Larger

differences may occur under all other circumstances. The true value of adhesion to fiberboard at 90° angle under constant stress can only be defined in terms of a specific test method. Within this limitation, Test Method D2860/D2860M has no known bias. Sections 13.2 through 13.5 explain the basis for this summary and for evaluations made under other conditions. The information applies either to comparisons of specimens of the same material or to specimens of different materials.

NOTE 3—This precision statement applies only to Procedure A.

13.2 *Interlaboratory Test Data*⁵—An interlaboratory study was made in 1980 in which randomly drawn samples of two materials were tested in each of four laboratories. Two operators in each laboratory, each tested three specimens from each of three rolls of each material. The observed data did not conform to the assumptions underlying the analysis of variance. Therefore, before analysis, the data were transformed using the following equation:

$$C = \log_{10} D \quad (1)$$

where:

C = transformed datum, and

D = observed datum.

13.2.1 The components of variance for adhesion to fiberboard at 90° angle under constant stress expressed as coefficient of variation (Note 4) were calculated to be:

Single-operator component	3.0 % of the average in transformed units
Within-laboratory component	2.6 % of the average in transformed units
Between-laboratory component	1.1 % of the average in transformed units
Replication component	9.5 % of the average in transformed units

13.3 *Critical Differences*—For the components of variance reported in 12.1.1, two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the differences shown in Table 1.

NOTE 4—The calculations for coefficient of variation and other statistics found in subsequent sections of this statement are described in Practice D2906 and Appendix D2906 of Practice D2904.

⁵ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D10-1002. Contact ASTM Customer Service at service@astm.org.

TABLE 1 Critical Difference, Percent of Grand Average for the Conditions Noted^A

Number of Observations in Each Average	Single-Operator Precision	Within-Laboratory Precision	Between-Laboratory Precision
1	27.7	28.6	30.3
5	14.4	16.1	16.4
10	11.7	13.8	14.1

^A Before comparing two averages of observed data, transform them using Eq 1.

TABLE 2 Width of 95 % Confidence Limits, Percent of the Grand Average for the Conditions Noted^A

Number of Observations in Each Average	Single-Operator Precision	Within-Laboratory Precision	Between-Laboratory Precision
1	±19.6	±20.2	±21.4
5	±10.2	±11.4	±11.6
10	±8.3	±9.7	±10.0

^A Before evaluating the precision of a single average expressed in observed units of measure; transform the average using Eq 1, calculate in transformed units the average plus and minus the tabulated values, and convert the resulting values into observed units of measure using Eq 1. The values of the upper and lower confidence limits in observed units of measure will not be symmetrical about the average.

NOTE 5—The tabulated values of the critical differences and confidence limits should be considered to be a general statement particularly with respect to between-laboratory precision. Before a meaningful statement can be made about two specific laboratories, the amount of the statistical bias between them, if any, must be established with each comparison being based on recent data obtained on specimens randomly drawn from one sample of the material to be evaluated.

13.4 *Confidence Limits*—For the components of variance reported in 12.1, the single averages of observed values have the 95 % confidence limits (Note 5) shown in Table 2.

13.5 *Bias*—No justifiable statement can be made on the bias of Test Method D2860/D2860M for testing adhesion to fiberboard at 90° angle and constant stress since the true value cannot be established by an accepted referee method.

14. Keywords

14.1 adhesion at 90° angle and constant stress; pressure sensitive tape

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