



Standard Test Method for Time to Failure of Pressure Sensitive Articles Under Sustained Shear Loading¹

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1. Scope

1.1 This test method covers the ability of a pressure sensitive article (for example, tape, label, sticker, etc.) to remain adhered to a stainless steel panel under a constant load applied parallel to the bonding surface of the pressure sensitive article.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are for information only.

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.*

2. Referenced Documents

2.1 ASTM Standards:

A 666 Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar²

D 898 Test Method for Applied Weight Per Unit Area of Dried Adhesive Solids³

D 907 Terminology of Adhesives³

D 2651 Guide for Preparation of Metal Surfaces for Adhesive Bonding³

D 3654 Test Method for Holding Power of Pressure Sensitive Tapes, Procedure C⁴

E 171 Specification for Standard Atmospheres for Conditioning and Testing Flexible Barrier Materials⁴

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods⁵

E 691 Practice for Conducting an Interlaboratory Study to Determine Precision of a Test Method⁵

3. Terminology

3.1 *Definitions of Terms Specific to This Standard*—Many of the terms found in this test method are defined in Terminology D 907.

¹ This test method is under the jurisdiction of ASTM Committee D-14 on Adhesives and is the direct responsibility of Subcommittee D14.50 on Hot Melt and Pressure Sensitive Adhesives.

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² *Annual Book of ASTM Standards*, Vol 01.03.

³ *Annual Book of ASTM Standards*, Vol 15.06.

⁴ *Annual Book of ASTM Standards*, Vol 15.09.

⁵ *Annual Book of ASTM Standards*, Vol 14.02.

4. Summary of Test Method

4.1 This test method consists of bonding a standard area of a pressure sensitive article to a stainless steel panel. The bonded construction is allowed to dwell in a constant temperature and humidity environment for 30 min. The construction is then mounted vertically. A standard mass of 1.1 lb (500 g) is attached to the pressure sensitive article and allowed to act until the construction separates or until 3000 min elapse. If there is no separation after 3000 min, the test is repeated on a fresh specimen with a mass of 2.2 lb (1000 g) and allowed to act until separation occurs or until 3000 min elapse. If no separation occurs, perform Procedure C of Test Method D 3654 for shear holding power to stainless steel at 120°F (49°C). The test result is the time in minutes to separation.

5. Significance and Use

5.1 This test method measures the cohesive strength of the adhesive on a pressure sensitive article. The time to failure can predict end use properties of pressure sensitive articles such as edge ooze from cold flow; trimming, slitting and die cutting quality; telescoping in tapes; ability to seal packages; and vertical holding power.

5.2 This test method is suitable for quality control, development and applications testing.

5.3 If the adhesive is not already coated, the adhesive can be coated on smooth, clear polyester (PET) film backing 2 mil (0.05 mm) thick. The recommended dry adhesive thickness is 1.0 mil (0.025 mm).

5.4 Humidity has a strong effect on time to failure for many pressure sensitive articles. Therefore, humidity must be controlled in accordance with 7.1.

6. Apparatus

6.1 Test Stand and Auxiliary Equipment:

6.1.1 *Test Stand*, unit to hold test specimen bonded to stainless steel panel at an angle of $1.0 \pm 0.5^\circ$ to the vertical (Fig. 1). The stand also includes a timing device to measure the time to separation of the specimen from the panel.

6.1.1.1 The test stand must be isolated from external forces such as vibrations and air currents. Vibrations and air currents cause the mass to oscillate imparting a peel force on the adhesive. Use vibration dampening rubber feet under the test stand, if necessary. Place the stand on a wooden table or shelf away from doors or circulating air vents. Isolate the table or

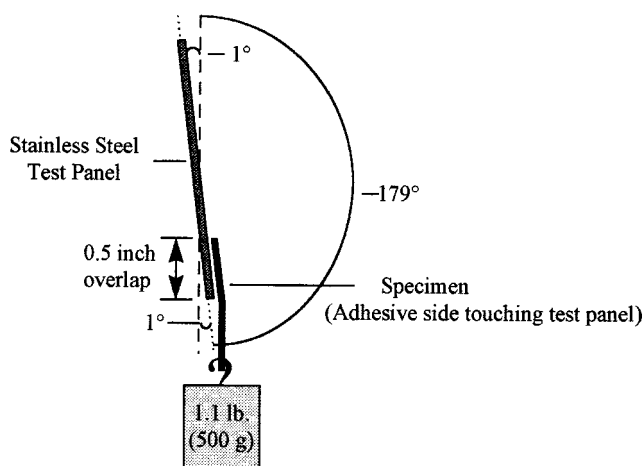


FIG. 1 Test Panel with Specimen and Mass (Side View)

shelf from room vibrations with vibration dampening materials.

6.1.2 *Standard Mass*, 1.10 ± 0.01 lb. (500 ± 5 g) and 2.20 ± 0.01 lb. (1000 ± 5 g). When the mass is correctly attached to the specimen, no peel forces are exerted on the adhesive because of the angle in the test stand holder (Fig. 1). The load is also equally distributed across the width of the specimen by a metal clip or piece of cardboard.

6.1.3 *Test Panel*—No. 302 or No. 304 stainless steel in accordance with Specification A 666 having a bright annealed finish. The panel dimensions are 1.0 by 1.0 in. (25.4 by 25.4 mm) or larger as best suited to the test stand. Panels must be free of scratches, stains or discoloration.

6.1.4 *Rubber Covered Roller*, used to adhere the specimen to the test panel. The roller has a mass of 4.5 ± 0.1 lb (2.04 kg) and a Shore A durometer hardness of 80 ± 5. The roller is constructed so that only the mass of the roller acts on the specimen to panel combination. Hand-held or mechanically driven rollers are acceptable.

6.1.5 *Sample Cutter*, die cutter, razor slitter or paper cutter capable of producing a cut width of 0.50 ± 0.01 in. (12.7 ± 0.2 mm).

6.1.6 *Absorbent, Lint-free Cleaning Material*, such as surgical gauze or tissue for solvent washing of test panels. The cleaning material should contain less than 0.25 % by weight of solvent extractable materials.

6.2 *Cleaning Solvents*, recommended cleaning solvents are acetone, diacetone alcohol, n-heptane, 99 % ethanol, reagent or analytical grade.

7. Conditioning

7.1 *Testing Room*—Condition and test samples in a controlled temperature and humidity room is described below:

7.1.1 Control the temperature to 73.4 ± 3.6°F (23.0 ± 2.0°C) as specified in Specification E 171.

7.1.2 Control the relative humidity to 50 % RH ± 2 % RH. The humidity range specified in Specification E 171, 50 % ± 5 % RH, is too large for this test.

7.1.2.1 Two independent studies were conducted on the effect of relative humidity on time to failure of pressure sensitive articles under sustained shear loading. For four

acrylate adhesive tapes, the time to failure decreased by 5.8, 5.5, 8.4 and 6.1 % for each 1 % increase in relative humidity. For each sample, the rate of humidity decrease was determined at 50 % RH. This high sensitivity to small humidity changes requires that humidity be controlled during the test.

7.2 Condition samples in a controlled temperature and humidity room, as described in 7.1, for at least 24 h before cutting the samples into test specimens (Sample Preparation, See Section 8).

8. Sample Preparation

8.1 Cut sample into 0.5 in. (12.7 mm) wide strips with the long dimension in the machine direction of the pressure sensitive article. The dimensions of the shear stand will dictate the specimen length. The mass drop distance (the distance between the bottom of the mass and the timer stop plate) must be a minimum of 0.5 in. (12.7 mm) and should be such that the shear stand does not transmit shock forces to the specimens that remain hanging when the mass drops. Cut at least three specimens for each pressure sensitive article to be tested (Fig. 2).

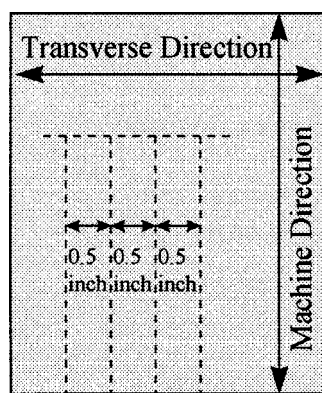
NOTE 1—If the sample to be tested incorporates PVC (or any other type of facestock with a tendency to elongate under load) as a facestock, the sample may be reinforced by overlaminating it with a non-elastic film, such as PET, prior to sample cutting. This minimizes the influence of the facestock on the time to failure.

9. Procedure

9.1 Clean the test panel three times by washing it with a cleaning solvent as described in 6.2 and the absorbent cleaning material as described in 6.1.6. Use a fresh piece of cleaning material each time. Allow at least two minutes for solvent evaporation after the third solvent wash. The user must ensure the cleaning method removes all adhesive residue from the test panel. To verify cleanliness, use the water break test in Guide D 2651.

9.2 Attach the adhesive surface of one end of the specimen to a clip or piece of cardboard to distribute the force of the mass evenly across the width of the specimen. Reinforce that end of the specimen with a piece of tape, a staple or both so that it will hold the mass securely.

9.3 Center the specimen on the bottom end of the clean test



Sample to be cut (into individual specimens) on dotted lines

FIG. 2 Typical Sample of a Pressure Sensitive Article (Schematic for Sample Preparation)

panel. Remove any release liner and apply the specimen to the panel without added pressure. The specimen covers 0.50 ± 0.02 in. by 0.50 ± 0.02 in. (12.7 by 12.7 mm) on the test panel.

9.4 Adhere the specimen to the panel by rolling the rubber covered roller over the covered area two times, once back and forth, at a velocity of 12 in. (300 mm)/min. Either a hand or a mechanical roller may be used.

9.5 Insert the panel and specimen into the test stand holder and wait 30 min before applying the standard mass.

9.6 Gently apply the 1.1 lb (500 g) mass to the specimen so that no impact force or oscillations are applied. The drop distance should be as described in 8.1.

9.7 Record the time elapsed in minutes when the specimen separates from the test panel.

9.7.1 If no separation occurs within 3000 min with the 1.1 lb (500 g) mass, repeat the test with a fresh specimen and attach the 2.2 lb (1000 g) mass in 9.6.

9.7.2 If no separation occurs within 3000 min with the 2.2 lb (1000 g) mass, terminate the test and use the conditions specified in Procedure C of Test Method D 3654.

9.8 Repeat the procedure at least two additional times for each sample to be tested for a total of three replicates.

10. Calculation

10.1 Calculate the average time to failure (of at least three specimens) in minutes and the standard deviation for each sample.

11. Report

11.1 Report the following information:

- 11.1.1 Adhesive identification and type, if known,
- 11.1.2 Cleaning solvent(s) used for cleaning test panel,
- 11.1.3 Adhesive coat weight or thickness, if known,
- 11.1.4 Facestock material and release liner used, if known,

11.1.5 Temperature and relative humidity of testing room,
11.1.6 Average time to failure (of at least three specimens) and standard deviation, and

11.1.7 Failure mode - adhesion, cohesion or transfer. Cohesion is the preferred failure mode for this test.

12. Precision and Bias

12.1 An interlaboratory study of this test method was conducted in accordance with Practice E 691. Seven laboratories reported three test results on each of two adhesive tapes. Results of the repeatability study are summarized in Table 1.

12.2 The precision information given below was calculated for the comparison of the average of three individual test determinations as specified in the test method.

12.3 The terms repeatability limit and reproducibility limit are used as specified in Practice E 177.

12.4 *Repeatability*—The repeatability of this test method was an increasing function of the value of the test result. See Table 1.

12.5 *Reproducibility*—The reproducibility of this test method was an increasing function of the value of the test result. See Table 1.

13. Keywords

13.1 adhesive; cohesion; pressure sensitive adhesive; pressure sensitive article; shear; sustained shear loading; time to failure

TABLE 1 Shear Test Precision Data (All Data in Minutes)

| Material | Average, min. | Repeatability Standard Deviation | Reproducibility Standard Deviation | Repeatability Limit | Reproducibility Limit |
|----------|---------------|----------------------------------|------------------------------------|---------------------|-----------------------|
| A | 278.7 | 34.9 | 72.4 | 97.8 | 202.8 |
| B | 742.6 | 48.8 | 163.5 | 136.7 | 457.7 |

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