



## Standard Test Method for T-Peel Strength of Hot Applied Sealants<sup>1</sup>

This standard is issued under the fixed designation C 906; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope

1.1 This test method covers a laboratory procedure for determining the peel strength of a hot-applied sealant, hereafter referred to as the sealant, when installed between flexible metal substrates of a T-type configuration. It also provides information on the adhesion of the sealant to the tested substrates.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are provided 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:

C 717 Terminology of Building Seals and Sealants<sup>2</sup>

### 3. Terminology

3.1 *Definitions*—See Terminology C 717 for definitions of the following terms used in this standard: adhesive failure, cohesive failure, hot applied sealant, sealant, and substrate.

#### 3.2 Descriptions of Terms Specific to This Standard:

3.2.1 *flexible*—indicates that the substrates shall have such dimensions and physical properties as to permit bending them through any angle up to 90° without breaking or cracking.

3.2.2 *specified temperature*—application temperature specified by the sealant manufacturer.

3.2.3 *T-peel strength*—the average load per unit width required to produce progressive separation of two bonded flexible substrates under conditions designated in this test method.

### 4. Apparatus

4.1 *Any Extrusion Apparatus*<sup>3</sup>, used to mechanically apply

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.07.

<sup>3</sup> The following devices have been found suitable for this purpose: Hardman PSA gun, available from Hardman, Inc., Belleville, NJ 07190; heated extruders, available from various manufacturers; and the Pyles Bulk Melters, available from Pyles Industries, 28990 Wixom Rd., Wixom, MI 48096.

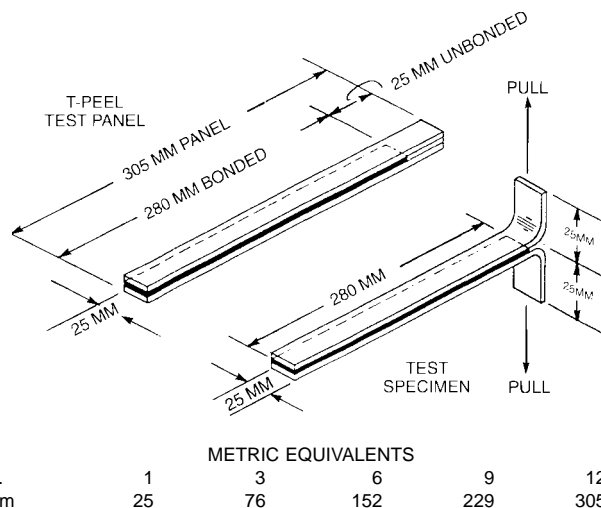


FIG. 1 Test Panel and Test Specimen

molten sealants and capable of delivering the required amount of 6.5 by 279.4 mm (1/4 by 11 in.) at the specified application temperature.

4.2 *Heated Press*, capable of compressing six 25.4 by 304.8 mm (1 by 12 in.) strips of aluminum specimens to a fixed stop.

4.3 *Silicone Release Paper*.

4.4 *Hot Knife*.

4.5 *Tension Testing Machine*,<sup>4</sup> capable of applying a tensile load having the conditions prescribed in 4.5.1-4.5.5.

4.5.1 The machine and loading range shall be so selected that the maximum load on the specimen falls between 15 and 85 % of the upper limit of the loading range.

4.5.2 The rate of movement between heads shall be 254 mm/min (10 in./min).

NOTE 1—It is difficult to meet this requirement when loads are measured with a spring-type or pendulum-type weighing device.

4.5.3 The machine shall be equipped with suitable grips capable of clamping the specimens firmly and without slippage throughout the tests.

4.5.4 The machine shall be autographic, giving a chart that can be read in terms of inches of separation as one coordinate and applied load as the other coordinate.

<sup>4</sup> A tension testing machine such as those available from Instron, 1580 Akron Peninsula Rd., Akron, OH 44313 or from Monsanto Chemical Company, 2689 Wingate Ave., Akron, OH 44314, or an equivalent, has been found suitable for this purpose.

4.5.5 The applied tension as measured and recorded shall be accurate within  $\pm 1\%$ .

4.6 *Room or Desiccators*, capable of maintaining a relative humidity of  $50 \pm 5\%$  at  $23 \pm 2^\circ\text{C}$  ( $73.4 \pm 3.6^\circ\text{F}$ ).

NOTE 2—A saturated solution of calcium nitrate will provide approximately a 51 % relative humidity at the testing temperature.

4.7 *Aluminum Alloy Strips*, 12 required, measuring 25.4 by 304.8 by 0.635 mm (1 by 12 by 0.025 in.). Alloy #5052-H32.

4.8 *Planimeter*, recommended, but optional.

## 5. Sampling

5.1 Sealant shall be free of external surface contaminants such as talc, oil, dust, and moisture. Handling of the sealant surfaces in contact with the substrate shall be minimized.

5.2 A 1.0 kg (2.2 lb) representative sample shall be taken from bulk stock for testing.

## 6. Test Specimens

6.1 Clean the 12 specimens of aluminum strips with soap and water followed by a water rinse and solvent wipe with methylethylketone (MEK).

6.2 For each of the 6 specimens, using the appropriate extrusion apparatus, extrude a bead of sealant 6.5 mm ( $\frac{1}{4}$  in.) in diameter by 279.4 mm (11 in.) long at the sealant manufacturer's recommended temperature on one aluminum strip and leave the upper 25.4 mm (1 in.) blank.

6.3 Complete the test specimen by placing a second aluminum strip on top of the bead parallel to the bottom strip, lightly contacted to form a bonded sandwich and cooled in a conditioning room at  $23 \pm 2^\circ\text{C}$  ( $73.4 \pm 3.6^\circ\text{F}$ ).

6.4 Place the sandwich between layers of silicone release paper in a shimmed press at the manufacturer's specified temperature (typical range between 121 and  $204^\circ\text{C}$ , equal to between 250 and  $400^\circ\text{F}$ ), for 1 min at approximately 1363 kg (3000 lb) total compressive force using shims to achieve a sealant thickness of 0.635 mm (0.025 in.)

NOTE 3—Since some sealants may rebound after removal from the press, the sample should be measured after cooling at  $23 \pm 2^\circ\text{C}$  ( $73.4 \pm 3.6^\circ\text{F}$ ). The thickness of the shim should be selected to provide the desired sealant thickness of 0.635 mm (0.025 in.)

6.5 After cooling, trim excess sealant from the edges with a hot knife.

6.6 At least six specimens shall be tested.

## 7. Conditioning

7.1 The first unbounded 25.4 mm (1 in.) ends of the substrate shall be pulled back manually to a  $90^\circ$  angle before conditioning.

7.2 Condition all test specimens at  $23 \pm 2^\circ\text{C}$  ( $73.4 \pm 3.6^\circ\text{F}$ ) at 50 % relative humidity for at least 24 h prior to testing.

7.3 Additional conditioning may be done as specified by mutual agreement between the purchaser and sealant manufacturer.

## 8. Procedure

8.1 Clamp the bent, unbonded ends of the test specimen in the test grips of the tension testing machine. Apply the load at a constant cross head speed of 254 mm (10 in.) per min.

NOTE 4—This speed will cause separation of the bond at a rate of 127 mm (5 in.) per min.

8.2 During the peel test, make an autographic recording of load versus head movement or load versus distance peeled.

8.3 Determine the peel strength over at least a 279.4 mm (11 in.) length of bond line after the initial peak. Ignore the first and last 25.4 mm (1 in.) of sample.

## 9. Calculation

9.1 Disregard the first and last 25.4 mm (1 in.) and determine from the autographic curve for 228.6 mm (9 in.) of peeling after the initial peak the average peeling load in lb/in. of the specimen width required to separate the adherents. It is preferred that the average be determined from the curve with the use of a planimeter.

NOTE 5—In case a planimeter is not used, the average may be calculated as the average of load reading taken at fixed increments of crosshead motion. For example, the load may be recorded at each 25 mm (1 in.) interval of head motion (or each 12.7 mm (0.5 in.) interval of bond separation) following the initial peak, until at least ten readings have been obtained.

## 10. Report

10.1 Report the following information:

10.1.1 Type of test machine and crosshead separation rate used,

10.1.2 Method of recording load and determining average load,

10.1.3 Average T-peel in strength in lb/in. of width,

10.1.4 Type of failure, for example, cohesive or adhesive failure,

10.1.5 All application temperatures used, and


10.1.6 Any other deviations from the test procedure.

## 11. Precision and Bias

11.1 The precision and bias of this test method are based upon data obtained from results of five laboratories using six replicate samples, aluminum substrates, and one sealant. All test samples were supplied to all participants by one supplier. All failures were cohesive. Data is based on a round robin where samples were prepared, in accordance with Section 6, at  $121^\circ\text{C}$  ( $250^\circ\text{F}$ ). The repeatability and reproducibility stated here are based on one supplier preparing all samples and five laboratories carrying out the test on the same samples. Results may vary based on individual laboratory preparation.

11.2 *Repeatability, I(r)*—The repeatability (within a given laboratory) interval for one material tested by five laboratories is 2.808. In future use of this test method, the difference between two test results obtained in the same laboratory on the same material will be expected to exceed 2.808 only about 5 % of the time.

11.3 *Reproducibility, I(R)*—The reproducibility (between given laboratories) interval for one material tested by five laboratories is 4.521. In future use of this test method, the difference between two test results obtained in a different laboratory on the same material will be expected to exceed 4.521 only about 5 % of the time.

 **C 906**

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