



Designation: ~~D2148 – 18~~ **D2148 – 19**

# Standard Test Methods for Bondable Silicone Rubber Tapes Used for Electrical Insulation<sup>1</sup>

This standard is issued under the fixed designation D2148; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 These test methods cover tests for bondable silicone rubber tapes which form a sealed structure either with the application of heat (and pressure if needed) or by the process of auto-adhesion (self-fusing).

1.2 The methods appear in the following sections:

Test Method	Section
Adhesion	3 – 10
Bond Strength	11 – 18
Dielectric Breakdown Voltage	19 – 26
Hardness	41
Length	33 and 34
Thickness	27 – 32
Width	36 – 40

~~1.3 Units—The values stated in inch-pound units are to be regarded as standard, except for °C. The values in SI units are the standard. The inch-pound units in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard for information only. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.~~

1.4 *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.* For a specific hazard statement see 23.1.1.

1.5 *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:*<sup>2</sup>

[D149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies](#)

[D374/D374M Test Methods for Thickness of Solid Electrical Insulation](#)

[D618 Practice for Conditioning Plastics for Testing](#)

[D1000 Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications](#)

[D1458 Test Methods for Fully Cured Silicone Rubber-Coated Glass Fabric and Tapes for Electrical Insulation \(Withdrawn 2019\)](#)<sup>3</sup>

[D2240 Test Method for Rubber Property—Durometer Hardness](#)

~~[D6054 Practice for Conditioning Electrical Insulating Materials for Testing \(Withdrawn 2012\)](#)~~<sup>3</sup>

<sup>1</sup> These methods are under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and are the direct responsibility of Subcommittee D09.07 on Electrical Insulating Materials.

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<sup>2</sup> 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.

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

\*A Summary of Changes section appears at the end of this standard

2.2 *ASTM Adjuncts:*  
Tack tester (one drawing)<sup>4</sup>

## ADHESION

### 3. Scope

3.1 This test method covers the determination of the self-adhesion of unsupported, self-fusing silicone rubber rectangular and taper-edge (**Note 1**) tape designed for use as electrical insulation.

NOTE 1—Taper-edge tape includes such cross sections as triangular, lens, etc.

3.2 *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.*

### 4. Hazards

#### 4.1 High Voltage:

4.1.1 Lethal voltages are a potential hazard during the performance of this test. It is essential that the test apparatus, and all associated equipment electrically connected to it, be properly designed and installed for safe operation.

4.1.2 Solidly ground all electrically conductive parts which it is possible for a person to contact during the test.

4.1.3 Provide means for use at the completion of any test to ground any parts which were at high voltage during the test or have the potential for acquiring an induced charge during the test or retaining a charge even after disconnection of the voltage source.

4.1.4 Thoroughly instruct all operators as to the correct procedures for performing tests safely.

4.1.5 When making high voltage tests, particularly in compressed gas or in oil, it is possible for the energy released at breakdown to be sufficient to result in fire, explosion, or rupture of the test chamber. Design test equipment, test chambers, and test specimens so as to minimize the possibility of such occurrences and to eliminate the possibility of personal injury. If the potential for fire exists, have fire suppression equipment available. See **23.1**.

### 5. Significance and Use

5.1 Self-adhesion is a primary initial property since it affects layer-to-layer bonding. The integrity of the bond can significantly affect the electrical and physical performance of the insulation system. Therefore, the degree of self-adhesion is directly related to apparatus performance.

5.2 A high degree of self-adhesion is desirable for most electrical applications. In this test, a short unwinding length indicates a high degree of self-adhesion.

5.3 This test method has been found useful as a quality control test for lot acceptance.

### 6. Apparatus

6.1 *Inclined Mandrel Tack Test Fixture*—A suggested fixture is shown in **Fig. 1**.<sup>4</sup> The mandrel shall consist of a  $\frac{5}{16}$ -in. (15.9-mm) 16 mm (0.625 in.) diameter aluminum rod mounted in low-friction bearings. Good alignment of bearings is necessary for accurate results. When properly assembled, the mandrel shall turn freely when loaded with a 1-oz (28.5-g) 28 g (1-oz) weight suspended from a cotton thread wound in a single layer at the center of the mandrel.

6.2 *Weights*, as specified in Section 8 and means for attachment.

6.3 Calibrated stopwatch capable of measuring accurately to one second.

### 7. Test Specimen

7.1 A test specimen shall consist of two pieces of tape 12 to 15 in. (305 to 380 mm) 305 to 380 mm (12 to 15 in.) long. Divisions spaced  $\frac{1}{4}$ -in. (25.4 mm) 25 mm (1 in.) apart shall be marked off on one piece of tape. If tapes contain an interliner, the interliner shall be removed just prior to wrapping the mandrel. Dirt and other forms of contamination shall be avoided.

### 8. Procedure

8.1 *Winding*—Half lap the unmarked specimen perfectly on the mandrel of the test fixture, using the suggested weight as shown in **Table 1**. These weights are not critical. However, they are necessary to get intimate contact and conformability of the tape. To obtain perfect half lapping, tilt the tack tester at an appropriate angle as shown in **Fig. 1**. Wrap the tape on the mandrel at a speed of approximately 18 in. (460 mm)/min. 460 mm (18 in.)/min. Using the winding procedure and weights just described, half lap the

<sup>4</sup> Available from ASTM International Headquarters. Order Adjunct No. **ADJD2148**. Original adjunct produced in 1965.

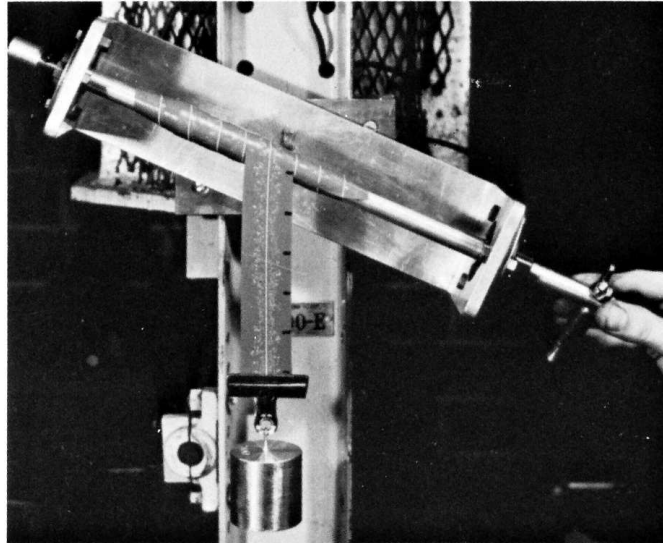


FIG. 1 Inclined Mandrel Tack Test Fixture

TABLE 1 Suggested Winding Weights For 1-in. Wide Tapes

Note—Winding weights are based on cross-sectional area and have been selected to produce approximately the same unit stress on all cross-sections. For tapes of dimensions not listed, use a winding weight of approximately 10.5 oz (300 g)/0.01 in.<sup>2</sup> (6.4 mm<sup>2</sup>).

Tape Thickness, in. (mm)		Weight, oz (g)
Triangular	Rectangular	
0.020 (0.51)	0.010 (0.25)	10.5 (300)
0.030 (0.76)	0.015 (0.38)	15.8 (450)
0.040 (1.02)	0.020 (0.51)	21.0 (600)
0.050 (1.27)	0.025 (0.64)	26.3 (750)
0.060 (1.52)	0.030 (0.76)	31.5 (900)
0.070 (1.78)	...	36.7 (1050)
0.080 (2.03)	...	42.0 (1200)

TABLE 1 Suggested Winding Weights For 1-in. Wide Tapes

Note—Winding weights are based on cross-sectional area and have been selected to produce approximately the same unit stress on all cross-sections. For tapes of dimensions not listed, use a winding weight of approximately 300 g (10.5 oz)/6 mm<sup>2</sup> (0.01 in.<sup>2</sup>).

Tape Thickness, mm (in.)		Weight, g (oz)
Triangular	Rectangular	
0.50 (0.020)	0.25 (0.010)	300 (10.5)
0.75 (0.030)	0.4 (0.015)	450 (15.8)
1.02 (0.040)	0.5 (0.02)	600 (21.0)
1.27 (0.050)	0.64 (0.025)	750 (26.4)
1.52 (0.060)	0.76 (0.030)	900 (31.7)
1.78 (0.070)	...	1050 (37.0)
2.03 (0.080)	...	1200 (42.3)

marked tape sample on the mandrel over the first piece of tape. With the winding weight attached, return the test fixture to a horizontal position and allow the tape to bond for 1 min. Remove the winding weight from the tape and the handle from the fixture and proceed with the unwinding test.

8.2 *Unwinding*—After the tape has bonded for 1 min, attach a load of 21 oz (600 g)/in. (25 mm) 600 g (21 oz)/25 mm (in.) of the original tape width (Note 2). Attach the weight to the free end of the tape by means of a bulldog paper clamp or other suitable device. Release the weight and record the length of tape unwound in 3 min. Although the original 1-in. 25 mm (1 in.) dimensions will elongate due to the unwind weight, consider each division as one unit. While the winding weights are not critical, the use of proper unwinding weights is mandatory. Consistent and comparable results depend upon accurate width measurements and the use of the proper unwinding weight.

NOTE 2—Commercial tapes are usually made to a  $\pm 1.6\frac{1}{4}$  in. ( $\pm 1.59$  mm) mm ( $\pm 0.06$  in.) tolerance. Therefore a 600-g weight shall be used for tapes varying in width from  $1\frac{5}{16}$  in. to  $1\frac{1}{4}$  in. (23.8 to 27 mm); mm (0.94 to 1.06 in.); a 750-g weight shall be used for tapes varying in width from

$\pm 30\frac{3}{4}$  to  $\pm 33\frac{3}{4}$  in. (30.2 to 33.3 mm) mm (1.19 to 1.31 in.) and a 900-g weight shall be used for tapes varying in width from  $\pm 37\frac{1}{4}$  to  $\pm 40\frac{1}{4}$  in. (36.5 to 39.7 mm) mm (1.44 to 1.56 in.). Tapes with widths outside these ranges shall be tested in accordance with their width (determined to the nearest  $\frac{1}{4}$  in. (1.59 mm) 1.6 mm (0.06 in.)). For example, a  $\pm 29\frac{1}{4}$  in. (28.6 mm) mm (1.125 in.) wide tape shall be tested with a 675-g weight. The unwinding weights shall be made to a tolerance of  $\pm 2$  %.

## 9. Report

9.1 Report the following information:

- 9.1.1 Description of material, type of cross-section, tape width and thickness,
- 9.1.2 Winding weight, in grams,
- 9.1.3 Unwinding weight, in grams, and
- 9.1.4 Length of unwind, to the nearest  $\frac{1}{4}$  unit.

## 10. Precision and Bias

10.1 This test method has been in use for many years, but no information has been presented to ASTM upon which to base a statement of precision. No activity has been planned to develop such information.

10.2 This test method has no bias because the value for adhesion is determined solely in terms of this test method itself.

## BOND STRENGTH

### 11. Terminology

11.1 *Definitions of Terms Specific to This Standard:*

11.1.1 *bond strength, of unvulcanized and semivulcanized supported silicone rubber tapes*—the strength of chemical linkages achieved between successive layers of tape under controlled vulcanizing conditions.

### 12. Significance and Use

12.1 The bond strength is an indication of the physical integrity that can be expected under end use conditions in which the insulating tapes are applied with an overlap.

### 13. Apparatus

13.1 *Bonding Press*—A platen press having the following characteristics:

- 13.1.1 A temperature range to  $205^{\circ}\text{C}$  (400 $^{\circ}\text{F}$ );  $205^{\circ}\text{C}$  (400  $^{\circ}\text{F}$ ).
- 13.1.2 A thermostat that will allow a set temperature to be maintained  $\pm 5^{\circ}\text{C}$  ( $\pm 9^{\circ}\text{F}$ );  $\pm 5^{\circ}\text{C}$  ( $\pm 9^{\circ}\text{F}$ ).
- 13.1.3 A pressure regulator to allow setting and control of the platen pressure.
- 13.1.4 A pressure indicator to show the pressure being exerted between the platen faces.
- 13.1.5 A timer to allow measurement of bonding time. It is preferred that a controller-type timer be used which will both indicate bonding time and also cause the platen pressure to be released and the platens separated at the end of the bonding period.

13.2 *Temperature-Measuring Device(s)* to indicate face temperature of the platen(s).

13.3 *Silicone Rubber Pad*, approximately  $\frac{1}{8}$  in. (3.20 mm) 3.2 mm (0.125 in.) thick, 60 to 70 Shore A durometer hardness, larger in dimension than the specimens to be tested. This is used as a pressure-equalizing device, compensating for irregularities in either the specimen or the platens.

13.4 *Polytetrafluoroethylene* or suitable release film, three sheets, approximately 2 to 4 mils (0.05 to 0.10 mm) 0.05 to 0.10 mm (2 to 4 mils) thick. One sheet is placed on each side of the specimens as a release sheet, the third sheet being used to separate the ends of the two test specimens.

13.5 *Testing Machine*—A power-driven testing machine of either the cross head or dead-weight pendulum type. The machine shall be equipped with a tension weighing device having a maximum capacity of 50 lb (22.7 kg) 22.7 kg (50 lb) graduated to read 0.1 lb (50 g) 50 g (0.1 lb) or less per scale division.

### 14. Test Specimen

14.1 The test specimen shall be selected to be representative of the material to be tested. The size of sample shall be sufficient to give six strips at least  $\pm 2.5$  to  $\pm 1.5$  in. (32 to 38 mm) wide and 6 in. (150 mm) 32 to 38 mm (1.25 to 1.5 in.) wide and 150 mm (6 in.) long. Care shall be taken to prevent contamination.

### 15. Conditioning

15.1 The specimen shall not be exposed to temperatures above  $30^{\circ}\text{C}$  (85 $^{\circ}\text{F}$ )  $30^{\circ}\text{C}$  (85  $^{\circ}\text{F}$ ) before bonding. The tests shall be conducted in the Standard Laboratory Atmosphere as described in Practice ~~D6054~~ D618.

### 16. Procedure

16.1 Cut the strips of material to  $\pm 2.5$  to  $\pm 1.5$  in. (32 to 38 mm) 32 to 38 mm (1.25 to 1.5 in.) wide and at least 6 in. (150 mm) 150 mm (6 in.) long, the length being measured in the warp or machine direction of the backing.