Designation: D 69 – 01

An American National Standard

Standard Test Methods for Friction Tapes[1]

This standard is issued under the fixed designation D 69; 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 methods and procedures for testing friction tapes. Such tapes consist of a woven fabric sheeting that has been impregnated with an adhesive insulating compound and cut into rolls of narrow width. These tapes are commonly used for protecting and binding in place, insulation applied to joints of electrical wires and cables, and for other mechanical purposes.

NOTE 1—The material specifications formerly included in these test methods are now contained in Specification D 4514.

1.2 The test methods included in this standard are as follows:

	Sections
Adhesion	6-11
Aged Adhesion	12-17
Breaking Strength	18-22
Dielectric Breakdown Voltage	23-28
Dimensions	29-34
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Parallelism	40-44
Tackiness	45-51

1.3 The values stated in inch-pound units are the standard. The SI units in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 2—There is no equivalent IEC standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies[2]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension[3]

D 1711 Terminology Relating to Electrical Insulation[2]

D 4514 Specification for Friction Tape[4]

D 5423 Specification for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation[4]

D 6054 Practice for Conditioning Electrical Insulating Materials for Testing[5]

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of other terms used in this specification, refer to Terminology D 1711.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *adhesion*, *n*—the resistance of the tape to unwind itself after being wound up under pressure, in accordance with this test method.

3.2.2 *breaking strength*, *n*—the force required, per unit width, to break the tape when tested in accordance with this test method.

3.2.3 *conditioning*, *n*—the exposure of the tape to the influence of a prescribed atmosphere for a stipulated period of time.

3.2.4 *length of tape in a roll*, *n*—the number of linear yards or metres of tape wound into a roll as measured in accordance with this test method.

3.2.5 *parallelism*, *n*—the difference in width between two mated ends of a tape that has been split in half, in accordance with this test method.

3.2.6 *tackiness*, *n*—the adherence of the friction tape surfaces to themselves after light contact has been made, in accordance with this test method.

4. Sampling

4.1 Select sample rolls at random from each shipment in accordance with the following table:

Number of Rolls in Shipment	Number of Rolls in Sample

[1] These test 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 Flexible and Rigid Insulating Materials.

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[2] *Annual Book of ASTM Standards*, Vol 10.01.

[3] *Annual Book of ASTM Standards*, Vol 09.01.

[4] *Annual Book of ASTM Standards*, Vol 10.02.

[5] *Annual Book of ASTM Standards*, Vol 08.01.

50 to 200	2
201 to 500	3
501 to 1000	4
1001 to 5000	5

For shipments in excess of 5000 rolls, take one additional roll for each additional 1000 rolls or fraction thereof.

4.2 A shipment shall consist of material shipped or intended for shipment to a customer and covered by one bill of lading.

4.3 Test each sample roll for conformance to all the requirements of the specification.

4.4 Remove and discard at least 24 in. (610 mm) of the outer layer of each sample roll before taking test specimens.

4.5 Unwind the test specimen from the roll at a slow, uniform rate without jerking.

5. Conditioning

5.1 Unless otherwise specified, condition the rolls for 16 h in a standard laboratory atmosphere as specified in Practice D 6054.

5.2 Unless otherwise specified, condition the test specimens for 1 h in a standard laboratory atmosphere as specified in Practice D 6054.

ADHESION TEST

6. Significance and Use

6.1 In most applications, a friction tape must have adequate adhesion to remain in place and function properly.

7. Apparatus

7.1 *Adhesion Tester*—An assembly similar to that shown in Fig. 1, consisting of a mandrel mounted in a level position in ball bearings. The mandrel shall be 0.25 in. (6.4 mm) in diameter with a slot approximately 0.0625 in. (1.6 mm) in width and long enough to accommodate the full width of tape. The mandrel shall turn freely under a force of 0.25 ozf (0.07 N) suspended from a thread wound in a single layer on the center of the mandrel. This assembly is mounted on a wall or other vertical surface to which a vertical scale has been affixed. This scale shall begin 2 in. (51 mm) below the mandrel and extended downward for a distance of 36 in. (915 mm). The scale shall be readable to ⅛ in. (3.2 mm).

7.2 *Weights*—Two sets of weights and a device suitable for clamping the weights to the end of a tape sample, such that a total load of 4.0 lbf/in. (17.8 N/25 mm) and 10 lbf/in. (44.5 N/25 mm) can be achieved.

8. Test Specimen

8.1 Cut a test specimen 23 in. (580 mm) in length of tape removed from the sample roll, with care being taken not to touch the adhesive surfaces to be tested.

9. Procedure

9.1 Insert one end of the specimen into the slot of the mandrel and wind 2 in. (51 mm) onto the mandrel.

9.2 Attach a total weight of 10 lbf/in. (44.5 N/25 mm) to the end of the specimen and wind the remaining 19 in. (480 mm) of the specimen onto the mandrel at an approximate rate of 12 in./min (300 mm/min).

9.3 Allow the tape to remain for 3 min with the weight attached, after which substitute a weight of 4.0 lbf/in. (17.8 N/25 mm) and allow the tape to unwind.

9.4 After the first 2 in. (51 mm) have unwound, start a timer. Stop the unwinding process after 60 s have elapsed, and measure the length which has unwound in that time.

10. Report

10.1 For each sample roll, report the adhesion as the length unwound in one minute.

11. Precision and Bias

11.1 *Precision*—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.

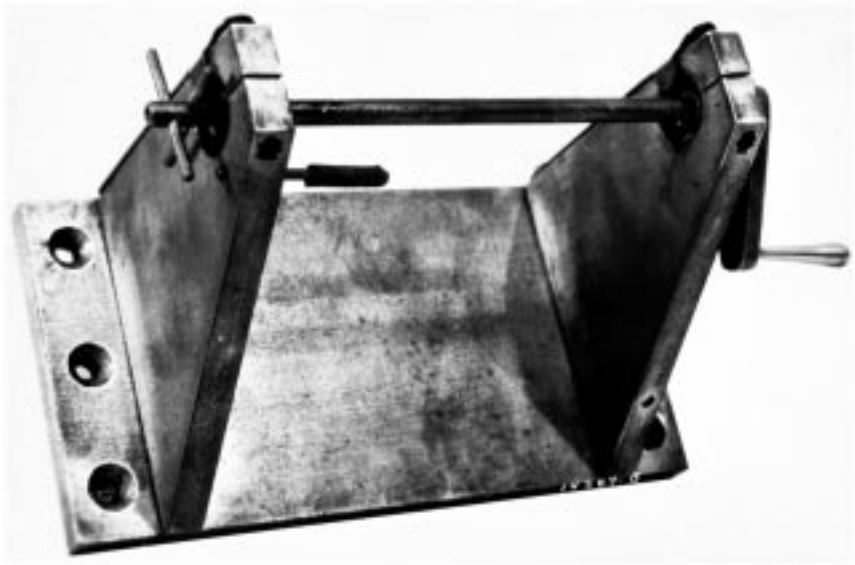

FIG. 1 Tester for Adhesion Test of Friction Tape

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

AGED ADHESION

12. Significance and Use

12.1 The adhesion of a friction tape must remain adequate after the tape has aged. Exposure in a dry oven is an attempt to simulate such shelf-storage aging.

13. Apparatus

13.1 *Oven*—An oven conforming to the requirements of Specification D 5423.

13.2 *Adhesion Tester*, in accordance with 7.1.

13.3 *Weights*, in accordance with 7.2, except that a total load of 3 lbf/in. (13.3 N/25 mm) instead of 4 lbf/in. (17.8 N/25 mm) can be achieved.

14. Test Specimen

14.1 Prepare the test specimen as described in Section 8.

15. Procedure

15.1 Expose the specimen to dry air in an oven at a temperature of 212 ± 2°F (100 ± 1°C) for a period of 16 h. Support the specimen in the oven by clips or other suitable devices, in such a way that the adhesion test portion hangs free and out of contact with oven parts or other tape specimens.

15.2 After aging, allow the specimens to condition at a temperature of 73.4 ± 2°F (23 ± 1°C) and 50 ± 2 % relative humidity for a period of not less than 4 h nor more than 8 h, during which the adhesive surface shall be protected from contact with foreign material.

15.3 Test the specimen for adhesion following the procedure of Section 9, except that the load applied to unwind the tape shall be 3 lbf/in. (13.3 N/25 mm) and not 4 lbf/in. (17.8 N/25 mm).

16. Report

16.1 For each sample roll, report the aged adhesion as the length unwound in one minute.

17. Precision and Bias

17.1 *Precision*—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.

17.2 *Bias*—This test method has no bias because the value for aged adhesion is determined solely in terms of this test method itself.

BREAKING STRENGTH

18. Significance and Use

18.1 The breaking strength of the tape is an indicator of uniform quality and the ability to withstand mechanical load in service.

19. Test Specimen

19.1 Test specimens shall consist of a single layer of tape 16 in. (400 mm) in length and the width of the tape as received.

20. Procedure

20.1 Measure the width of the specimen in accordance with Section 32.

20.2 Perform the test for breaking strength in accordance with Test Methods D 412.

20.3 Set the initial distance between the jaws of the testing machine at 12 in. (300 mm) and the rate of separation of the jaws at 20 in./min (8.5 mm/s).

21. Report

21.1 For each sample roll, report the breaking strength in lbf/in. (N/m) width.

22. Precision and Bias

22.1 *Precision*—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.

22.2 *Bias*—This test method has no bias because the value for breaking strength is determined solely in terms of this test method itself.

DIELECTRIC BREAKDOWN VOLTAGE

23. Significance and Use

23.1 This value does not correspond to the dielectric breakdown voltage to be expected in service. It may be of value in comparing different materials and in controlling manufacturing processes. This product usually is used only for mechanical protection. When coupled with experience, dielectric breakdown voltage may have limited value for design in the few cases where electrical breakdown is of functional significance.

24. Apparatus

24.1 *Dielectric Test Apparatus*, in accordance with Test Method D 149.

24.2 *Electrodes*—Flat plates corresponding to Type 4 of Test Method D 149.

25. Test Specimen

25.1 Make the test specimen from a single layer of tape 6.0 in. (150 mm) in length. In order to prevent flashover, increased width may be obtained by attaching to each side of the test specimen an additional piece of tape, making a ⅛ in. (3.0 mm) lap seam carefully rolled down.

26. Procedure

26.1 Determine the dielectric breakdown voltage in accordance with Test Method D 149 using the short time test. Start the test with an applied voltage that is less than 100 V, and raise it at a rate of 100 V/s until dielectric breakdown occurs.

27. Report

27.1 Report the dielectric breakdown voltage in volts for each sample roll.

28. Precision and Bias

28.1 *Precision*—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.

28.2 *Bias*—This test method has no bias because the value for dielectric breakdown voltage is determined solely in terms of this test method itself.

DIMENSIONS—LENGTH, WIDTH, AND THICKNESS

29. Significance and Use

29.1 Measurements of length, width, and thickness are necessary to ensure receiving the correct quantity of tape. The thickness measurement is of particular value in controlling uniformity and meeting design criteria.

30. Apparatus

30.1 *Steel Rule*—A steel rule capable of measuring to the nearest 1⁄64in. (0.04 mm).

30.2 *Thickness Gage*—A dead weight dial micrometer graduated to 0.001 in. (0.025 mm) and having a presser foot 0.25 ± 0.01 in. (6.35 ± 0.25 mm) in diameter, exerting a total force of 10.0 ± 0.1 ozf (2.78 ± 0.03 N).

31. Test Specimen

31.1 The test specimen is a full roll of tape as received from the supplier.

32. Procedure

32.1 *Length Determination*—Unwind the tape from the roll, placing it on a hard smooth surface, and measure the length to the nearest 1 in. (25 mm).

32.2 *Thickness*—Place the tape against the anvil of the gauge. Lower the presser foot onto the tape without excessive impact and observe the reading. Make five measurements at random in a length of not less than 1 yd. (0.9 m).

32.3 *Width*—Place the tape on a hard smooth surface and measure the width perpendicular to the edge with the steel scale, to the nearest 1⁄64 in. (0.40 mm). Make five measurements at random in a length of not less than 1 yd (0.9 m).

33. Report

33.1 Report the length, average thickness, and average width for each sample roll.

34. Precision and Bias

34.1 *Precision*—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.

34.2 *Bias*—This test method has no bias because the values for length, width and thickness are determined solely in terms of this test method itself.

DISCOLORATION OF COPPER

35. Significance and Use

35.1 The tendency of a friction tape to discolor copper is an indication of the level of sulfur or sulfur containing curatives present in the adhesive compound.

36. Apparatus

36.1 *Copper Rod*—Clean, bright, and smooth. Approximately ¼ in. (6.4 mm) in diameter and 3 in. (75 mm) in length.

36.2 *Test Tube*, capable of being sealed.

36.3 *Oven*, maintained at 212 ± 9°F (100 ± 5°C).

37. Procedure

37.1 Wind five superimposed layers of tape on the copper rod taking care to avoid touching the surface of the rod near the tape layers.

37.2 Place the sample in a closed test tube and heat at 212°F (100°C) for 16 h.

37.3 Cool the sample and visually inspect for the presence of a blue-black discoloration on the surface of the rod at the edge of the tape.

38. Report

38.1 For each sample roll, report the presence or absence of discoloration.

39. Precision and Bias

39.1 No statement is made about either the precision or the bias of this test method since the result merely states the presence or absence of discoloration.

PARALLELISM

40. Significance and Use

40.1 Parallelism is an indicator of the potential of a roll of friction tape to resist fraying at the edge when the roll is unwound. Parallelism is also an indicator of the overall quality and the degree of care which has been taken in slitting the tape.

41. Test Specimen

41.1 Make the test specimen from a single layer of tape 16 in. (400 mm) in length unwound from the sample roll.

42. Procedure

42.1 Tear the test specimen approximately in half lengthwise, assisting the tearing by first slitting one end for about ½ in. (12 mm) with a knife or a razor blade.

42.2 Cleanly cut a 2 in. (50 mm) length from each end of one of the torn halves.

42.3 Fold the remaining 12 in. (300 mm) length in half to bring the two ends together while mating along one edge.

42.4 Using a steel rule graduated to read 1⁄32 in. or 1.0 mm, measure the difference in width between the two mated ends and record that distance to the nearest 1⁄32 in. as the deviation from parallel.

43. Report

43.1 For each sample roll, report the measured deviation from parallel.

44. Precision and Bias

44.1 *Precision*—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.

44.2 *Bias*—This test method has no bias because the value for parallelism is determined solely in terms of this test method itself.

TACKINESS

45. Significance and Use

45.1 Tackiness of friction tape is a measure of the ability of the tape to stick to itself after light contact has been made. It is an indicator of the freshness of the impregnating compound and its performance as an adhesive.

46. Apparatus

46.1 *Roller*—A cylindrical glass or chrome-plated brass roller capable of applying a force of 0.4 oz (12 g) per inch (25.4 mm) width of tape. The roller shall have an outside diameter of not less than ½ in. (12.7 mm) nor more than 1.0 in. (25.4 mm) and a width to exceed that of the tape by at least ¼ in. (6.4 mm).

46.2 *Tweezers*, two pairs.

47. Test Specimen

47.1 Make the test specimens for the tackiness test by cutting six 8 in. (200 mm) lengths of tape removed from each sample roll, care being taken not to touch the surfaces to be tested.

48. Procedure

48.1 This test is performed three times, once for each possible combination of surfaces. The tests to be performed are: (*1*) front to front, (*2*) back to back, and (*3*) back to front. The back surface of the tape is toward the outside of the roll.

48.2 For a given combination of surfaces, place one specimen lightly on a clean, horizontal, smooth surface, with the test surface up. Place the second specimen, test surface down, evenly on the first specimen, allowing an overlap of ½ in. (13.0 mm) lengthwise.

48.3 Roll the roller over the specimens once at a slow uniform rate so that the 8 in. (200 mm) length is passed over in approximately 8 s, taking care that the only downward pressure on the specimens is due to the weight of the roller.

48.4 Pick up the two specimens from the end last in contact with the roller, using one pair of tweezers for each specimen.

48.5 Pull the ends of the specimens apart horizontally, keeping the forearms in contact with a rigid support, such as the edge of the table. The rate at which the specimens are separated shall be steady and not exceed 1 in./s (25 mm/s). Observe the point of separation of the two specimens, disregarding the last 1 in. (25 mm).

49. Interpretation

49.1 For surface combinations front to front (*1*) and back to front (*3*), tackiness is evidenced by the point of separation remaining in the same horizontal plane as the tweezers that pull the specimens apart.

49.2 For the surface combination back to back (*2*), tackiness is evidenced by the point of separation traveling along the tapes as the tweezers pull the specimens apart.

50. Report

50.1 Report whether or not the tape was tacky for each combination of surfaces tested.

51. Precision and Bias

51.1 No statement is made about either the precision or the bias of this test method since the result merely states whether there is conformance to the tackiness criteria.

52. Keywords

52.1 adhesion; aged adhesion; breaking strength; dielectric breakdown voltage; dimensions; discoloration of copper; friction tape; parallelism; tackiness