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An American National Standard

Standard Test Methods for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes[1]

This standard is issued under the fixed designation D 4325; 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 electrically insulating and semi-nonmetallic conducting rubber tapes designed for splicing, terminating, and sheath repair of electrical wire and cable.

1.2 The test methods appear in the following sections:

~~1.3The SI values are the standard. The inch-pound values given in parentheses are for information purposes only.~~

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

NOTE 1—There is no IEC equivalent to these methods.

1.4 Unless otherwise stated, measurements are made on tapes from which the removable separator has been removed.

1.5 *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.* For specific precaution statements see 43.1.

1.6 This is a fire-test response standard.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

D 150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical ~~Insulating Materials~~[2] Insulation

D 257 Test Methods for DC Resistance or Conductance of Insulating Materials

D 374 Test Methods for Thickness of Solid Electrical Insulation

D 412~~Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension~~ Test Methods for Vulcanized Rubber and Thermoplastic ElastomersTension

[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] 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* ~~, Vol 10.01.~~volume information, refer to the standard's Document Summary page on the ASTM website.

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

D 470 Test Methods for Crosslinked Insulations and Jackets for Wire and Cable
D 750 Test Method for Rubber Deterioration ~~in Carbon-Arc~~Using Artificial Weathering Apparatus
D 4388 Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
D 4496 Test Method for D-C Resistance or Conductance of Moderately Conductive Materials
E 591 Practice for Safety and Health Requirements Relating to Occupational Exposure to Ozone[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *fusion*, *n*—that property of rubber tape which causes adjacent layers of tape to become bonded (amalgamated) or adhered together when the tape is stretched and wound upon itself in layers.

SAMPLING

4. Sample and Specimen Requirements

4.1 Unless otherwise required by the detailed product specifications, take the rubber tapes at random from each shipment as follows:

Number of Rolls in Shipment	*Number of Sample Rolls*
50 to 200	2
201 to 500	3
501 to 1000	4
1001 to 5000	5

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

4.3 A shipment consists of material shipped or intended for shipment to a customer and covered by one bill of lading.

4.4 Test each sample roll in conformance to all requirements of the specification.

4.5 All test methods in this standard are intended to produce a single value for a single roll. Any reference to averaging of measurements refers to test averaging on a single roll and not to the average of all sample rolls.

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

4.7 Remove the test specimen from the roll at a slow, uniform rate without jerking.

CONDITIONING

5. Significance and Use

5.1 The physical and electrical properties, including break strength, elongation, dielectric strength, dissipation factor, permittivity, fusion, etc., will vary with temperature and moisture content. Control the temperature and moisture content of the sample for these test methods to yield consistent and reproducible results.

6. Procedure

6.1 For referee purposes, subject the rolls to standard atmospheric conditions of 23 ± 2 °C (73.4 ± 3.6 °F) and 50 ± 2 % relative humidity for a minimum period of 16 h before specimens are removed for test.

6.2 Unless otherwise specified, condition all test specimens for a period of 1 h and conduct the tests in a standard laboratory atmosphere at 23 ± 2 °C (73.4 ± 3.6 °F) and 50 ± 2 % relative humidity.

FUSION

7. Significance and Use

7.1 Fusion is responsible for holding the tape in place to form a permanent compressive force about a conductor or insulator in actual application.

8. Apparatus

8.1 *Winding Fixture*—The winding fixture is designed to hold a metal rod at each end and is fitted with a crank or other device to rotate the rod so that the specimen may be wound thereon. Attach the fixture to a rigid support with the rod held in a horizontal position.

8.2 *Rods*—Any suitable metal of 3-mm (0.125-in.) diameter and a minimum of 229 mm (9.0 in.) in length.

8.3 *Rule*, graduated in inches, 762-mm (30-in.) minimum length.

8.4 *Rule*, graduated in 0.4 mm (1/64 in.).

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

8.5 *Razor Blades*.

8.6 *Board*, with 3-mm (0.125-in.) diameter holes spaced about 50 mm (2 in.) apart on its surface to provide a base for supporting the rods in a near-vertical position.

9. Procedure

9.1 Prepare three specimens by cutting three strips of tape 280 mm (11 in.) in length from the sample roll selected and conditioned in accordance with Sections 4-6. Prepare and wind specimens in a manner that prevents oils or other contaminants from getting on the bonding surface of the tape.

9.2 Mount the rod horizontally in the winding fixture.

9.3 Attach the strip of tape near one end of the rod by winding the strip upon itself using 25 mm (1 in.) of the tape. Place the 762-mm (30-in.) rule next to the 254-mm (10-in.) tape strip. Stretch the tape strip to the desired length corresponding to percent elongation as specified in the product specification (Specification D 4388, Table 1).

9.4 ~~Move the tape to the proper angle and rotate the rod so that the tape is wrapped on the rod with a one-half lap for a length of 178 mm (7.0 in.).~~ Move the tape to the proper angle and rotate the rod so that the tape is wrapped on the rod with a one-half lap for a length of 178 mm (7.0 in.). Maintain enough hand pressure at the end of the tape strip as it is wound around the mandrel to ensure that it does not retract from its original elongation during the winding process. Care must be taken to avoid using so much hand pressure as to further stretch the tape as it is wound.

9.5 Change the angle of the tape and repeat the procedure in 9.4 winding back toward the start of the first wrap so that the second one-half overlap wrap is wound over the first wrap to provide a four layer build-up of tape.

9.6 After the final wrap, maintain constant pressure on the tape strip and score the tape with a new razor blade at the top of the rod, parallel to the rod. Break the tape on the score line, removing the tab. Remove the test specimen from the fixture and roll the specimen so formed between the palm of the hands for 5 to 10 s, being sure to roll up or down the entire length of the specimen. This completes the preparation of the test specimen.

9.7 Insert the wrapped specimen in the holes in the base of the board and allow them to condition at 23.0 ± 2 °C (73.4 ± 3.6 °F) and 50 ± 2 % relative humidity for 24 h. At the end of this period, if there is any flagging (end-lifting) of the tape, measure the length of the flag to the nearest 0.4 mm (1⁄64 in.), taking care not to cause additional unwrapping in the measuring operation Record the maximum, minimum and average length of the flag.

10. Report

10.1 Report the following information:

10.1.1 Identification of the tape tested, and

10.1.2 Pass or fail depending on the requirements outlined in the product specification (see Specification D 4388).

DIMENSIONS—LENGTH, WIDTH, AND THICKNESS

11. Significance and Use

11.1 Measurements of length, width, and thickness are necessary to ensure a customer is receiving the correct quantity of tape. The thickness measurement is of particular value in controlling uniformity and providing design criteria, as well as being used in the measurement of physical and electrical properties.

12. Apparatus

12.1 *Steel Rule*, capable of measuring to the nearest 0.4 mm (1⁄64 in.).

12.2 *Thickness Gage*—A dead weight dial micrometer as prescribed in Method C of Test Methods D 374, with the following modifications:

12.2.1 A micrometer with graduations to 0.01 mm (0.001 in).

12.2.2 A micrometer with a presser foot 6.35 ± 0.25 mm (0.25 ± 0.01 in.) in diameter exerting a total force of 2.50 ± 0.03 N (10.0 ± 0.1 oz) force.

12.2.3 Calibrate the gage for the actual load exerted by the presser foot.

13. Test Specimen

13.1 Select and condition the tape and specimen in accordance with Sections 4-6.

14. Procedure

14.1 *Length Determination*—Unwind the tape and separator from the roll, place it on a hard smooth surface, and measure the length to the nearest 0.4 mm (1⁄64 in.).

14.2 *Thickness*—Place the insulation surface against the anvil of the gage with the separator side up holding the sample in a manner such that it is smooth, yet not under tension. Lower the presser foot onto the tape in accordance with Test Methods D 374, allowing it to rest upon the tape for 2 s, and observe the reading on the dial. Take five measurements uniformly distributed over the length of the tape specimen. Report the average thickness to the nearest 0.005 mm (0.0002 in.).

14.3 *Width*—Place the test specimen, after conditioning, on a hard smooth surface. Measure the width perpendicular to the edge with the steel scale to the nearest 0.40 mm (1⁄64 in.).

15. Report

15.1 Report the following information:

15.1.1 Identification of the tape tested, and

15.1.2 Report the thickness, length, and width measured in accordance with the procedures outlined above.

16. Precision and Bias

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

16.2 *Bias*—This test method has no bias because the values are determined solely in terms of this test method itself.

TENSILE STRENGTH AND ELONGATION

17. Significance and Use

17.1 The tensile strength of the tape is an important measure of uniformity, quality, and ability to withstand stress in service.

17.2 The elongation of a tape is important as a measure of uniformity and quality and provides a rough indication of how much a workman may stretch the tape in use for splicing, terminating, and repairing of wires and cables.

18. Test Specimen

18.1 The test sample consists of a single layer of tape that is approximately 610 mm (24 in.) long, with the removable separator removed. Select and condition in accordance with Sections 4-6.

19. Procedure

19.1 Perform the tests for tensile strength and elongation in accordance with Test Methods D 412, with the following exceptions:

19.1.1 Cut five test specimens from a single ply of tape (rubber and separator) that is free from visible defects using the ASTM standard die, as shown in ~~Fig. number 1~~Fig. 1 (Die A) of Test Methods D 412, except that the ends of the specimen cut from a 19-mm (0.75-in.) tape need not be full width. Place bench marks on the specimens as directed in Test Methods D 412.

19.1.2 Measure the thickness in accordance with 14.2, removing the separator where it is not an integral part of the tape. Record the appropriate thickness.

19.1.3 Where jaw breaks occur, discard the results and retest.

20. Report

20.1 Report the following information:

20.1.1 Average breaking strength expressed in MPa (psi), and

20.1.2 Average percent elongation.

21. Precision and Bias

21.1 See precision and bias statements of Test Methods D 412 for general discussion of precision and bias of this test.

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

21.3 *Bias*—This test method has no bias because the values for tensile strength and elongation are determined solely in terms of this test method itself.

DISSIPATION FACTOR AND PERMITTIVITY

22. Significance and Use

22.1 The dissipation factor and permittivity of an electrically insulating rubber tape are properties of the material which are important when it is used as high-voltage insulation.

22.2 Measurements of dissipation factor and permittivity are nondestructive tests that are helpful in determining the product uniformity, moisture absorption, and changes in composition.

23. Conditioning

23.1 Unless otherwise specified, use the following conditions in preparing specimens and conducting measurements:

23.1.1 *As received*—Condition a set of specimens at 23 ± 2 °C (73.4 ± 3.6 °F) for 1 h at 50 ± 5 % relative humidity prior to testing at temperatures of 23 ± 2 °C.