Designation: D348 – 13

Standard Test Methods for Rigid Tubes Used for Electrical Insulation[1]

This standard is issued under the fixed designation D348; 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 U.S. Department of Defense.

1. Scope*

1.1 These test methods cover the testing of rigid tubes used in electrical insulation. These tubes include many types made from fibrous sheets of basic materials, such as cellulose, glass, or nylon, in the form of paper, woven fabrics, or mats, bonded together by natural or synthetic resins or by adhesives. Such tubes include vulcanized fiber and thermosetting laminates, as well as tubes made from cast, molded, or extruded natural or synthetic resins, with or without fillers or reinforcing materials.

1.2 Tubes tested by these test methods are most commonly circular in cross section; however, noncircular shapes are also in commercial use. To the extent that the individual methods are compatible with a particular noncircular shape, these test methods are applicable to these other shapes. For tests on noncircular tubes, appropriate comments shall be included in the test report, including details of orientation of test specimens with respect to the cross section of the tube.

1.3 The procedures appear in the following sections:

Procedure	Sections	ASTM Test Method Reference
Compressive Strength (Axial and Diametral)	12 to 17	E4
Conditioning.	4	...
Density	20 to 24	...
Dielectric Strength	25 to 32	D149
Dimensional Measurements	5	D668
Dissipation Factor and Permittivity	33 to 35	D150
Tensile Strength	6 to 11	E4
Water Absorption	18 to 19	D570

1.4 The values stated in inch-pound units are to be regarded as the standard. SI units in parentheses are for information only.

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 a specific hazard statement, see 27.1.1.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

D150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation

D570 Test Method for Water Absorption of Plastics

D668 Test Methods of Measuring Dimensions of Rigid Rods and Tubes Used for Electrical Insulation

D1711 Terminology Relating to Electrical Insulation

E4 Practices for Force Verification of Testing Machines

3. Terminology

3.1 *Definitions*—For definitions of terms used in these test methods, refer to Terminology D1711.

4. Conditioning

4.1 In order to eliminate the effects of previous history of humidity exposure and to obtain reproducible results (Note 1), the test specimens in all cases of dispute, shall be given a conditioning treatment for physical tests as follows:

4.1.1 *Tensile Strength, Compressive Strength (Axial and Diametral), and Density*—Condition the machined specimens prior to test by drying in an air-circulating oven for 48 h at 50 ± 3 °C, followed by cooling to room temperature in a desiccator. In either case, all specimens shall be tested at room temperature maintained at 23 ± 2 °C, 50 % relative humidity.

NOTE 1—The following are potential reasons to undertake conditioning of specimens: (*a*) for the purpose of bringing the material into equilibrium with standard laboratory atmospheric conditions of 23 °C and 50 % relative humidity; (*b*) simply to obtain reproducible results, irrespective of previous history of exposure; or (*c*) to subject the material to abnormal conditions of temperature or humidity in order to predict its service behavior.

[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* 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**

The conditions given here to obtain reproducible results will give physical values which could be somewhat higher or somewhat lower than values under equilibrium at normal conditions, depending upon the particular material and test. To ensure substantial equilibrium under normal conditions of humidity and temperature, however, will require from 20 to 100 days or more depending upon thickness and type of material and its previous history. Consequently, conditioning for reproducibility must of necessity be used for general purchase specifications and product control tests.

4.1.2 Conditioning of specimens for electrical tests is also necessary to obtain consistent results. In order to secure comparative results, specimens shall be conditioned at the same temperature and humidity.

5. Dimensional Measurements

5.1 Dimensional measurements of tube shall be made in accordance with Test Methods D668.

TENSILE STRENGTH

6. Significance and Use

6.1 Tension tests, properly interpreted, provide information with regard to the tensile properties of rigid tubing, when employed under conditions approximating those under which the tests are made. It is possible that the tensile strength values will vary with the size of the tube and with the temperature and atmospheric conditions. Tension tests provide data potentially useful for research and development and for engineering design, and quality control purposes.

7. Apparatus

7.1 Any universal testing machine is acceptable for use provided it is accurate to 1 % of the lowest breaking load to be applied. Jaws that tighten under load, such as wedge-grip jaws, shall be used with the specimen properly aligned.

7.2 The machine shall be verified in accordance with Practices E4.

8. Test Specimens

8.1 The test specimens shall be as shown in Fig. 1. The length, *L*, shall be as shown in Table 1. A groove shall be machined around the outside of the specimen at the center of its length so that the wall section after machining shall be 60 % of the original nominal wall thickness. This groove shall consist of a straight section 2.25 in. (57 mm) in length with a radius of 3 in. (76 mm) at each end joining it to the outside diameter. Steel or brass plugs having diameters such that they will fit snugly inside the tube, and having a length equal to the full jaw length plus 1 in. (25 mm) shall be placed in the ends of the specimen to prevent crushing. They can be located in the tube conveniently by separating and supporting them on a threaded metal rod. Details of plugs and test assembly are shown in Fig. 1.

9. Procedure

9.1 Test five specimens. Measure the average inside and outside diameters, determined from at least two measurements 90° apart, at the groove to the nearest 0.001 in. (0.03 mm) and calculate the cross-sectional area from these dimensions. Assemble the metal plugs with the tube as shown in Fig. 1. Grasp this assembly in the V-notched jaws of the testing machine.

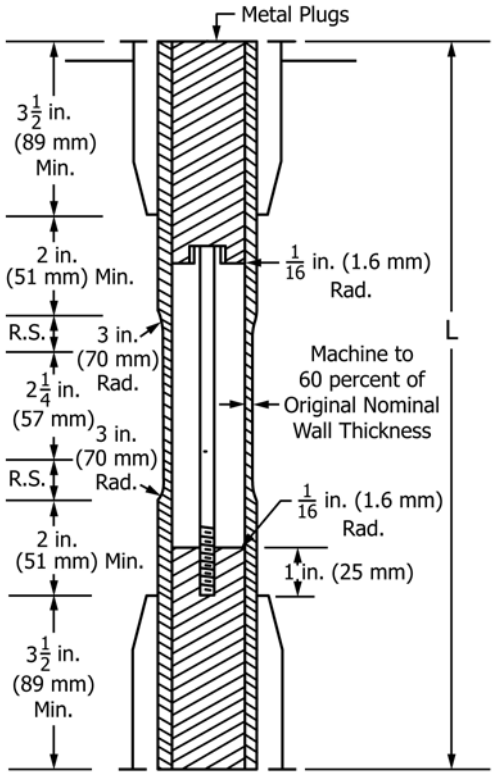

FIG. 1 Diagram Showing Location of Tube Tension Test Specimen in Testing Machine

9.2 *Speed of Testing*—The crosshead speed of the testing machine shall be such that the load can be accurately weighed, but shall not exceed 0.05 in./min (1.3 mm/min) when the machine is running idle.

10. Report

10.1 Report the following information:

10.1.1 The average inside and outside diameters of the specimen expressed to the nearest 0.001 in. (0.03 mm), each determined from at least two measurements 90° apart,

10.1.2 The average outside diameter of the reduced section expressed to the nearest 0.001 in. (0.03 mm),

10.1.3 The full wall thickness of the specimen,

10.1.4 The net area of the test section, $in.^2$ or mm^2,

10.1.5 The breaking load of each specimen, lbf or N,

10.1.6 The tensile strength of each specimen, psi or MPa, and

10.1.7 The room temperature.

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.

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