Designation: D8355 – 21

Standard Test Methods for Flammability of Electrical Insulating Materials Used for Sleeving or Tubing[1]

This standard is issued under the fixed designation D8355; 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.

NOTE—Subsection 1.2.1 was added and the yeardate was changed on March 31, 2021.

1. Scope

1.1 This is a fire-test-response standard.

1.2 This fire test response standard contains various tests applicable to electrical insulation materials used for sleeving or for tubing (including heat-shrinkable tubing).

1.2.1 Test methods C and D are applicable to heat-shrinkable tubing only.

1.3 Use the values stated in SI units in referee decisions; see IEEE/ASTM SI-10. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.4 *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions.*

1.5 *Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.*

1.6 *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.*

1.7 *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:*[2]

D350 Test Methods for Flexible Treated Sleeving Used for Electrical Insulation

D876 Test Methods for Nonrigid Vinyl Chloride Polymer Tubing Used for Electrical Insulation

D1711 Terminology Relating to Electrical Insulation

D2671 Test Methods for Heat-Shrinkable Tubing for Electrical Use

D2903 Specification for Crosslinked Chlorinated Polyolefin Heat-Shrinkable Tubing for Electrical Insulation

D3144 Specification for Crosslinked Poly(Vinylidene Fluoride) Heat-Shrinkable Tubing for Electrical Insulation

D3150 Specification for Crosslinked and Noncrosslinked Poly(Vinyl Chloride) Heat-Shrinkable Tubing for Electrical Insulation

D5025 Specification for Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials

D5207 Practice for Confirmation of 20-mm (50-W) and 125-mm (500-W) Test Flames for Small-Scale Burning Tests on Plastic Materials

E176 Terminology of Fire Standards

2.2 *ISO Standard:*[3]

ISO 13943 Fire Safety – Vocabulary

2.3 *Federal Standard:*[4]

PPP-T-45D Federal Specification for Tape; Paper, Gummed (Kraft)

2.4 *UL Standards:*[5]

UL 224 Extruded Insulated Tubing

UL 1441 Coated Electrical Sleeving

[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 D09.17 on Fire and Thermal Properties.

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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.

[3] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

[5] Available from Underwriters Laboratories (UL), UL Headquarters, 333 Pfingsten Road, Northbrook, IL, 60062, http://www.ul.com.

UL 2556 Wire and Cable Test Methods

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms relating to electrical and electronic insulating materials, the definitions in these test methods are in accordance with Terminology D1711. For terms relating to fire, the definitions in this test method are in accordance with Terminology E176 and ISO 13943. In case of conflict, the definitions given in Terminology E176 shall prevail.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *heat-shrinkable tubing, n*—tubing that will reduce in diameter from an expanded size to a predetermined size by the application of heat.

4. Summary of Test Methods

4.1 This standard incorporates four test methods suitable for assessing fire-test-response characteristics of electrical insulating materials exposed in the form of sleeving or tubing (including heat-shrinkable tubing). In all the tests the electrical insulating material is exposed to the flame from a gas-fueled burner.

4.1.1 Test Methods A and B are applicable to sleeving and tubing (including heat-shrinkable tubing), but Test Methods C and D are applicable to heat-shrinkable tubing only.

4.2 Test Method A assesses the resistance to spread of flame of the material, by measuring burn length and duration of burning. This test method was originally contained as Method A in Test Methods D350 (where it applied to sleeving), as Procedure A in Test Methods D876 (where it applied to tubing), and as Procedure A in Test Methods D2671 (where it applied to heat-shrinkable tubing). This test method is referenced in Specifications D2903 (for crosslinked chlorinated polyolefin heat-shrinkable tubing), D3144 (for poly(vinylidene fluoride) heat-shrinkable tubing), and D3150 (for crosslinked and non-crosslinked poly(vinyl chloride) heat-shrinkable tubing).

4.3 Test Method B assesses the rate of upward flame spread of the material. This test method was originally contained as Method B in Test Methods D350 (where it applied to sleeving).

4.4 Test Method C applies to electrical insulating material used for heat-shrinkable tubing. It assesses the propagation of flame in an upward direction, the duration of burning and the formation of flaming or glowing particles. The electrical insulating material, in contact with a metallic core, is exposed by placing it in contact with an internal metallic conductor simulating a common end use condition, while supported on a mandrel. This test method was originally contained as Procedure B in Test Methods D2671 (where it applied to heat-shrinkable tubing).

4.5 Test Method D applies to electrical insulating material used for heat-shrinkable tubing. It is similar to Test Method C, in 4.3, but differs from it in the specimen support mandrel. The electrical insulating material is in contact with a metallic core. Test Method D assesses the same fire-test-response characteristics as Test Method C, but it also determines the tendency to ignite nearby flammable materials by determining whether any falling flaming particles ignite a cotton indicator placed underneath the test specimen. Test Method D is a more severe flammability test than Test Method C. This test method was originally contained as Procedure C in Test Methods D2671 (where it applied to heat-shrinkable tubing).

5. Significance and Use

5.1 Test Method A is the required flammability test for: crosslinked chlorinated polyolefin heat-shrinkable tubing for electrical insulation (Specification D2903), crosslinked poly-(vinylidene fluoride) heat-shrinkable tubing for electrical insulation (Specification D3144), and crosslinked and noncrosslinked poly(vinyl chloride) heat-shrinkable tubing for electrical insulation (Specification D3150).

5.2 Test Method A is also one of the flammability tests used for nonrigid vinyl chloride polymer tubing used for electrical insulation (in Test Methods D876), flexible treated sleeving used for electrical insulation (Test Methods D350), and heat-shrinkable tubing for electrical use (Test Methods D2671).

5.3 Test Method B is another flammability test (together with Test Method A) used for flexible treated sleeving used for electrical insulation (Test Methods D350).

5.4 Test Methods C and D are other flammability tests (together with Test Method A) used for heat-shrinkable tubing for electrical use (Test Methods D2671). In both tests the electrical insulating material is fitted with a metallic core. The electrical insulating material is tested after shrinking, but using different mandrels.

5.5 In these test methods, the test specimens are subjected to one or more specific sets of laboratory test conditions. If different test conditions are substituted or the end-use conditions are changed, it is not always possible by or from this test to predict changes in the fire-test-response characteristics measured. The results are therefore valid only for the fire-test-exposure conditions described in this procedure.

TEST METHOD A

6. Scope

6.1 This test method assesses the resistance to spread of flame of the material, by measuring burn length and duration of burning.

7. Apparatus

7.1 *Chamber*—The chamber shall be a three-walled sheet metal enclosure 300 ± 10 mm (12 ± 0.4 in.) wide by 360 ± 10 mm (14 ± 0.4 in.) deep by 740 ± 10 mm (29 ± 0.4 in.) high, open at the top. It shall be equipped with two parallel horizontal metal rods placed 410 ± 10 mm (16 ± 0.4 in.) apart, and situated such that a wire stretched perpendicularly across each rod shall be at a 70° angle with the horizontal. The lower rod shall be approximately 50 ± 10 mm (2 ± 0.4 in.) from the rear wall.

7.2 *Bare Steel Wire*—A length of bare steel wire, approximately 0.74 mm (0.029 in.) in diameter, shall be used for supporting the test specimens during the test.

7.3 *Burner*—The burner shall meet the requirements of Specification D5025.

7.3.1 Adjust the burner barrel height, as indicated in Practice D5207 to confirm that the overall height of the gas flame is 125 ± 10 mm (4⅞ ± 0.4 in.) and that the blue inner cone is 40 ± 2 mm (1⁹⁄₁₆ ± 0.08 in.) high. A gas supply gauge pressure of 69 to 138 kPa (10 to 20 lbf/in.^{2}) has been found to be adequate to maintain the required flame. A cylinder shall not be used when this range of pressure is no longer sustainable at room temperature.

7.3.2 The burner shall be designed to provide a flame that is 125 ± 10 mm (4⅞ ± 0.4 in.) long, with an intensity of 500 W (1700 BTU/h).

7.4 *Burner Mounting*—The burner shall be mounted upon a positioning mechanism as shown in Fig. 1. As shown in the figure, a pivoted positioner which forms an extension of the center line of the burner barrel shall be attached to the barrel of the burner so as to locate the exact point of impingement of the inner cone on the test specimen. The base of the burner shall be tilted 25° from the horizontal during the period that the flame is applied to the test specimen, and the flame shall impinge upon the test specimen at an angle of 45°. The system shall contain a gas regulating valve as well as a shutoff valve.

7.5 *Gas Supply*—The fuel gas to be used shall be natural gas, methane gas, or propane gas. For referee purposes, commercial grade propane gas having a nominal heating value of 94 MJ/m^3 (2521 BTU/ft^3) and a relative specific gravity of 0.508 (to that of air) at a temperature of 15.5 ºC (60 °F) shall be used at a line pressure of 2.74 kPa (11 in., or 279 mm of water).

7.5.1 The methane gas shall be technical grade, 98.0 % minimum purity. The heating value of either methane or natural gas shall be 37 ± 1 MJ/m^3 or 8.9 kcal (thermochemical)/m^3 or 1000 BTU (thermochemical)/ft^3, at 25 ± 1 ºC (77 ± 2 ºF) and 101 kPa (14.7 psi).

NOTE 1—If no regular delivery lines are available for propane gas or for methane gas, the use of small tanks is an acceptable alternate.

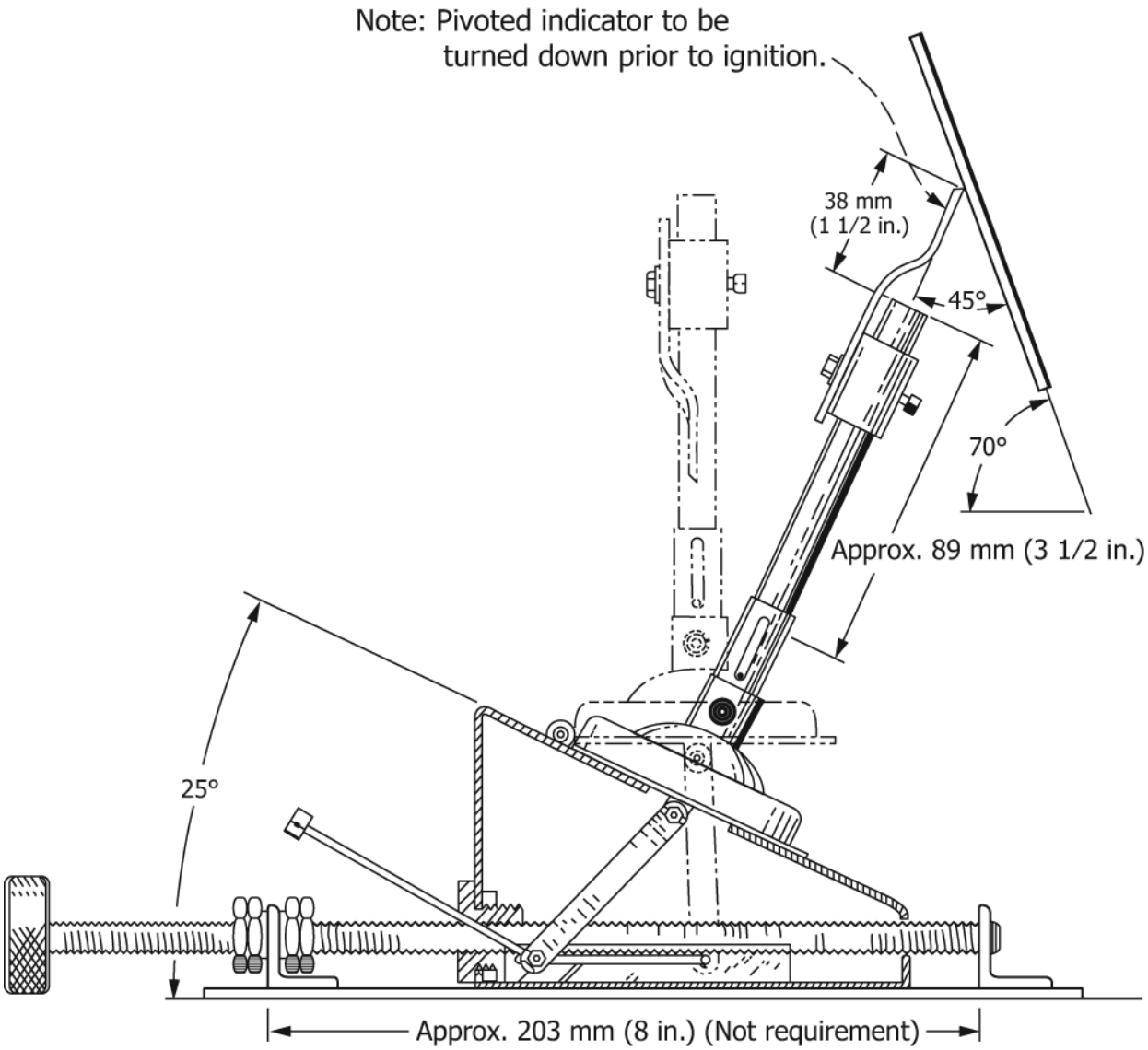

FIG. 1 Positioning Mechanism for Burner (Test Method A)