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An American National Standard

Standard Test Method for Ignition of Materials by Hot Wire Sources[1]

This standard is issued under the fixed designation D3874; 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.

1. Scope*

1.1 This test method is intended to differentiate, in a preliminary fashion, among materials with respect to their resistance to ignition because of their proximity to electrically-heated wires and other heat sources.[2]

1.2 This test method applies to molded or sheet materials available in thicknesses ranging from 0.25 to 6.4 mm (0.010 to 0.25 in.).

1.3 This test method applies to materials that are rigid at normal room temperatures. That is, it applies to materials for which the specimen does not deform during preparation, especially during the wire-wrapping step described in 10.1. Examples of deformation that render this test method inapplicable include:

1.3.1 Bowing, in either a transverse or a longitudinal direction, or twisting of the specimen, during the wire-wrapping step, to a degree visible to the eye.

1.3.2 Visible indentation of the wrapped wire into the specimen.

1.4 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only. (See IEEE/ASTM SI-10 for further details.)

1.5 This test method measures and describes the response or 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.

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

~~1.7Fire testing of products and materials is inherently hazardous, and adequate safeguards for personnel and property shall be employed in conducting these tests. Fire testing involves hazardous materials, operations, and equipment.~~

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

NOTE 1—Although this test method and IEC 60695-2-20, differ in approach and in detail, data obtained using either are technically equivalent.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D1711 Terminology Relating to Electrical Insulation

E176 Terminology of Fire Standards

IEEE/ASTM SI-10 International System of Units (SI) The Modernized Metric System

2.2 *IEC Standards:*

IEC 60695-2-20 Fire Hazard Testing—Section 20: Glowing/Hot-wire Based Test Methods, Hot-wire Coil Ignitability Test on Materials[4]

IEC 60695-4 Fire Hazard Testing—Part 4: Terminology Concerning Fire Tests[4]

2.3 *ISO Standards*

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[1] This test method is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.21 on Fire Performance Standards.

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[2] K. N. Mathes, Chapter 4, "Surface Failure Measurements", *Engineering Dielectrics, Vol. IIB, Electrical Properties of Solid Insulating Materials, Measurement Techniques*, R. Bartnikas, Editor, *ASTM STP 926*, ASTM, Philadelphia, 1987.

[3] 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.

[4] ~~Available from International Electrotechnical Commission (IEC), 3 Rue de Varembé, Geneva, Switzerland.~~

[4] Available from International Electrotechnical Commission (IEC), 3 rue de Varembé, Case postale 131, CH-1211, Geneva 20, Switzerland, http://www.iec.ch.

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

ISO 13943 Fire Safety—Vocabulary[5]

3. Terminology

3.1 *Definitions:*

3.1.1 Use Terminology E176 and ISO 13943 and IEC 60695-4 for definitions of terms used in this test method and associated with fire issues. Where differences exist in definitions, those contained in Terminology E176 shall be used. Use Terminology D1711 for definitions of terms used in this test method and associated with electrical insulation materials.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *ignition*, *n*—initiation of flaming produced by combustion in the gaseous phase that is accompanied by the emission of light.

4. Summary of Test Method

4.1 In this test method, a rectangular bar-shaped test specimen, with the center portion wrapped with a coil of heater wire, is supported horizontally at both ends. The circuit is then energized by applying a fixed power density to the heater wire, which rapidly heats up. The behavior of the test specimen is observed. until one of the following happens: (a) the material under test ignites, (b) the material under test melts, (c) 120 s of exposure have gone by without ignition or melting. The time to ignition and the time to melt through, as applicable, are recorded.

5. Significance and Use

5.1 During operation of electrical equipment, including wires, resistors, and other conductors, it is possible for overheating to occur, under certain conditions of operation, or when malfunctions occur. When this happens, a possible result is ignition of the insulation material.

5.2 This test method assesses the relative resistance of electrical insulating materials to ignition by the effect of hot wire sources.

5.3 This test method determines the average time, in seconds, required for material specimens to ignite under the specified conditions of test.

5.4 This method is suitable to characterize materials, subject to the appropriate limitations of an expected precision of ±15 %, to categorize materials.

5.5 In this procedure the specimens are subjected to one or more specific sets of laboratory 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. Therefore, the results are valid only for the fire test exposure conditions described in this procedure.

6. Apparatus

6.1 *Heater Wire*—The heater wire shall be a No. 24 AWG, Nichrome (Nickel-Chrome) wire, that is iron free, with the following nominal properties: a wire composition of 20 % chromium-80 % nickel, a diameter of 0.05 mm (0.020 in.), a nominal cold resistance of 5.28 Ω/m (1.61Ω/ft), and a length-to-mass ratio of 580 m/kg (864 ft/lb).

6.2 Calibrate each spool of test wire for energized resistance, in accordance with the method outlined in Annex A1. Such calibration is necessary due to the typical variability of wire lots in composition, processing, sizing, and metallurgy.

6.3 *Supply Circuit*—The supply circuit, which is a means for electrically energizing the heater wire, shall comply with 6.3.1-6.3.4.

6.3.1 The supply circuit capacity shall be sufficient to maintain a continuous linear 50 to 60 Hz power density of at least 0.31 W/mm (8.0 W/in.) over the length of the heater wire at or near unity power factor. The power density of the supply circuit at 60 A and 1.5 V shall approximate 0.3 W/mm.

6.3.2 The supply circuit shall have a means of voltage adjustment to achieve the desired current as determined from Annex A1. Such means of voltage adjustment shall provide a smooth and continuous adjustment of the power level.

6.3.3 The supply circuit shall have a means of voltage adjustment of measuring the power to within ±2 %.

6.3.4 The test circuit shall be provided with an easily actuated on-off switch for the test power, and with timers to record the duration of the application of test power.

6.4 *Test Chamber*—Use as a test chamber a draft-free closed chamber having a volume of at least 0.3 m^3 (10.5 ft^3). The ratio between any two transverse dimensions of the chamber shall not exceed 2.5. The test chamber shall be positively vented to the outside of the test facility before and after the test, but it shall remain closed and unvented during the test. The chamber shall be equipped with an observation window.

6.5 *Test Fixture*—Two supporting posts shall be positioned 70 mm (2¾ in.) apart to support the specimen in a horizontal position, at a height of 60 mm (2⅜ in.) above the bottom of the test chamber, in the approximate center of the test chamber.

6.6 *Specimen-Winding Fixture*—A fixture shall be provided to uniformly position the wire, with a spacing of 6.35 ± 0.05 mm (0.250 ± 0.002 in.) between turns and with a winding tension of 5.4 ± 0.02 N (1.21 ± 0.0045 lbf).

[5] Available from International Organization for Standardization (ISO), ~~1 Rue~~1, ch. de ~~Varembé,~~ la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, http://www.iso.ch.