



Designation: D4986 – 10

Standard Test Method for Horizontal Burning Characteristics of Cellular Polymeric Materials¹

This standard is issued under the fixed designation D4986; 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 fire-test-response test method describes a small-scale horizontally oriented burning test procedure for comparing the relative rate of burning and the extent and time of burning of cellular polymeric materials having a density less than 250 kg/m³.

1.2 The classification system described in the [Appendix X1](#) is intended for quality assurance and the preselection of component materials for products.

1.3 *This standard measures and describes 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.*

1.4 The values stated in SI units are to be regarded as standard.

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 [Note 3](#).

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

NOTE 1—This test method is equivalent to ISO 9772.

2. Referenced Documents

2.1 ASTM Standards:²

[D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries](#)

¹ This test method is under the jurisdiction of ASTM Committee [D20](#) on Plastics and is the direct responsibility of Subcommittee [D20.30](#) on Thermal Properties.

Current edition approved Jan. 1, 2010. Published February 2010. Originally approved in 1989. Last previous edition approved in 2003 as D4986 – 03. DOI: 10.1520/D4986-10.

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.

[D5025 Specification for Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials](#)

[E176 Terminology of Fire Standards](#)

[E437 Specification for Industrial Wire Cloth and Screens \(Square Opening Series\) \(Discontinued 2000\) Replaced by E 2016 \(Withdrawn 2000\)](#)³

2.2 *ISO Standard:*

[ISO 9772 Cellular Plastics—Determination of Horizontal Burning Characteristics of Small Specimens Subjected to a Small Flame](#)⁴

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of fire-related terms used in this test method, refer to Terminology [E176](#).

3.1.2 *afterflame time, n*—the length of time for which a material continues to flame, under specified conditions, after the ignition source has been removed.

3.1.3 *afterglow time, n*—the length of time for which a material continues to glow under specified test conditions, after the ignition source has been removed or cessation of flaming, or both.

3.1.4 *flame, v*—to undergo combustion in the gaseous phase with emission of light.

3.1.5 *glow, n*—visible light, other than from flaming, emitted by a solid undergoing combustion.

4. Summary of Test Method

4.1 This test method for measuring the burning characteristics of cellular polymeric materials employs a small standard test specimen 50 by 150 mm. The specimen is supported horizontally. One end is exposed to a specified gas flame for 60 s and the extent of burning is measured.

5. Significance and Use

5.1 This test method provides a means of measuring the time and extent of burning for cellular polymeric materials. It

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

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

also provides a means of measuring burning rates for materials that continue to burn past the specified gage marks.

5.2 This test method provides a means of comparing the burning characteristics of materials of like thickness density, cell size, and skin irregularities, including the effect of falling particles of cellular polymeric materials. It is suitable for quality control, specification acceptance, and for research and development. Examples include filled or reinforced, rigid or flexible, or cut or formed materials

5.3 In this test method, the specimens are subjected to one or more specific sets of laboratory fire test exposure conditions. If different test conditions are substituted or if the anticipated end-use conditions are changed, it is not always possible from this test method to predict changes in the performance characteristics measured. Therefore, the results are strictly valid only for the fire test exposure conditions described in this procedure.

5.4 This test method is not intended to be a criterion for fire hazard. The fire hazard created by materials depends upon the form and end use of the material. Assessment of fire hazard includes, but is not limited to, many factors such as flame spread, burning rate, ease of ignition, fuel contribution, heat evolution, products of combustion, and others.

6. Apparatus

6.1 *Test Chamber*—A laboratory hood free of induced or forced draft during test. The hood shall be totally enclosed, with a heat-resistant transparent window for observing the test. Alternatively, conduct the test in a cabinet placed inside the hood. The cabinet shall be constructed of noncombustible materials and shall have a transparent window for observing the test. The cabinet must provide adequate ventilation for characteristic burning, but must not allow drafts across the burning specimen; therefore, a suitable damper is necessary in some cases.

6.2 *Laboratory Burner*—Burner shall be constructed in accordance with Specification **D5025**.

6.3 *Wing Top*—Wing top, having an opening 48 ± 1 mm in length by 1.3 ± 0.05 mm in width fitted to the burner. (See Fig. 1.)

6.4 *Gas Supply*—Methane gas, technical grade or natural gas having a heat content of 37 ± 1 MJ/m³ with suitable regulator and meter for uniform gas flow.

6.5 *Wire Cloth*—Low-carbon, plain, steel wire, 6.4-mm mesh of 0.90 ± 0.05 -mm wire diameter. The cloth mesh and wire diameter shall be determined in accordance with Specification **E437**, Appendix X3. The wire cloth shall be cut to approximately 215 by 75 mm and shall be formed to provide a 90° bend at one end, 13 mm high. (See Fig. 1.)

6.6 *Support Fixture*—Any fixture that will support the wire cloth horizontally, 13 ± 1 mm above the burner wing top and 175 ± 25 mm above the base of the test chamber. Fig. 2 shows one acceptable arrangement.

6.7 *Timing Device(s)*—Accurate to ± 1 s.

6.8 *Linear Measuring Device*—Graduated in millimeters.

6.9 *Cotton*—A supply of dry, absorbent 100 % cotton.

6.10 *Desiccator*—Containing a suitable drying agent, capable of maintaining a relative humidity not exceeding 20 % at $23 \pm 2^\circ\text{C}$.

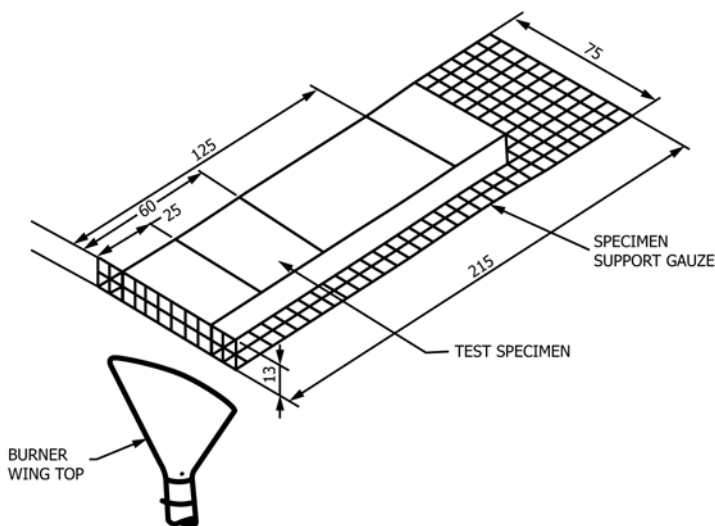
6.11 *Conditioning Room or Chamber*—Capable of being maintained at $23 \pm 2^\circ\text{C}$ and a relative humidity of 50 ± 10 %.

6.12 *Conditioning Oven*—A full-draft circulating air oven capable of being maintained at $70 \pm 2^\circ\text{C}$.

6.13 *Dial Gage Micrometer*—For measuring thicknesses with a 650-mm² pressure ft exerting a pressure of 0.175 ± 0.035 kPa.

7. Test Specimen

7.1 Test specimens, for materials being considered in a range of colors, thicknesses and densities, shall have representative ranges of these colors, thicknesses and densities tested.



NOTE 1—Dimensions in millimetres.

FIG. 1 Test Specimen and Specimen Support Gauze

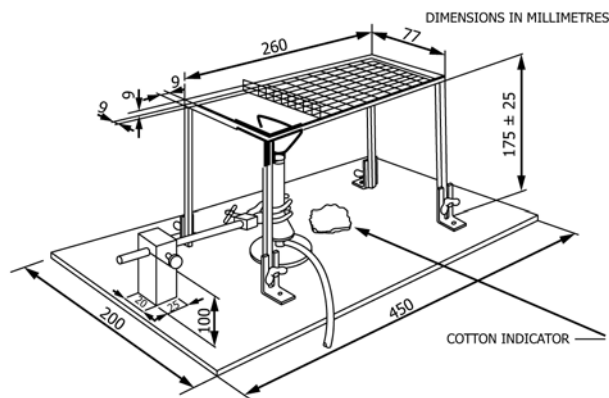


FIG. 2 Support Gauze Holder

7.1.1 Test specimens in the minimum and maximum densities shall be considered representative of the range, if the test results yield the same flame test classification. If the burning characteristics are not essentially the same for all specimens representing the range, evaluation is to be limited only to the materials in the densities tested or additional test specimens in intermediate densities are to be tested to determine the range.

7.1.2 Uncolored test specimens and test specimens with the highest level of organic and inorganic pigment loading by weight are considered representative of the color range, if the test results yield the same flame test classification. When certain pigments are known to affect flammability characteristics, they are also to be tested. Test specimens to be tested are those that:

- (a) contain no coloring
- (b) contain the highest level of organic pigments being considered for the respective application
- (c) contain the highest level of inorganic pigments being considered for the respective application
- (d) contain pigments which are known to adversely affect flammability characteristics

7.2 All specimens shall be cut from a representative sample of the material. Care shall be taken to remove all dust and any particles from the surface.

7.3 The standard test specimen shall be 150 mm ± 10 mm long by 50 mm ± 1 mm wide. Materials supplied in thicknesses over 13 mm shall be cut to 13 mm ± 1 mm thickness with any skin on one side. Materials supplied in thicknesses of 13 mm or less shall be tested at the thickness supplied, without removing any skin. (See 7.6.) If materials with adhesive applied are to be tested, specimens having adhesive on one side only shall be used. (See 7.6.)

NOTE 2—Tests made on test specimens of different thicknesses, or directions of anisotropy are not comparable.

7.4 Prepare a minimum of 20 specimens for the test. This includes 10 additional specimens in the event that the situation described in X1.3 or X1.5 is encountered.

7.5 Mark each specimen across its width with lines at 25 mm, 60 mm and 125 mm from one end, referred to hereafter as gauge marks (see Fig. 1).

7.6 Test specimens with a high density exterior (skin) on one side shall be tested with this side facing down. Test specimens with adhesive on one side shall be tested with this side facing up.

8. Conditioning

8.1 Condition specimen sets as follows:

8.1.1 Condition one set of five specimens for at least 48 h at a temperature of 23 ± 2°C and a relative humidity of 50 ± 10 % prior to testing.

8.1.2 Condition a second set of five specimens in a circulating air oven for 168 ± 2 h at 70 ± 2°C, and then cool in a desiccator for at least 4 h at room temperature prior to testing.

8.2 All specimens shall be tested in a laboratory atmosphere of 15 to 35°C and 45 to 75 % relative humidity.

9. Procedure

NOTE 3—**Warning:** Conduct the burning test in an enclosed laboratory hood or cabinet free of induced or forced draft. An exhaust fan is required for removing the products of combustion which may be toxic, immediately after the test.

NOTE 4—To maintain a draft-free environment during the test, it may be necessary to install a damper in the exhaust duct which can be closed during the test.

9.1 Position the formed wire cloth in the support fixture so that the major section is horizontal and the upturned edge is nearest the burner. The bottom of the cloth shall be 13 ± 1 mm above the burner wing top and 175 mm above the base of the test chamber. Place 0.05 to 0.08 g of cotton thinned to an area approximately 75 by 75 mm and a maximum thickness of 6 mm, on the base of the test chamber under the front portion of the wire cloth having the upturned ends.

9.2 Place the test specimen flat on the wire cloth with the 150 by 50-mm surface horizontal. The end of the specimen closer to the 60-mm mark is to be placed in contact with the upturned end of the wire cloth. (See Fig. 1.)

9.3 Place the burner, with wing top, remote from the specimen, ignite, and adjust it to produce a blue flame 38 mm high. Adjust the gas supply and the air ports of the burner until a yellow-tipped blue flame is produced, and then increase the air supply until the yellow tip just disappears. Measure the height of the flame, and, if necessary, readjust to obtain a flame 38 ± 2 mm high.

9.4 Place the burner under the upturned end of the wire cloth so that one edge of the flame is in line with the upturned end and the other edge of the flame extends into the front end of the specimen. (See Fig. 3.) The center of the wing top is to be in line with the longitudinal axis of the specimen.

9.5 Start the timing device(s) when the test flame is applied. Remove the flame after 60 s. Record the times when the flame reaches the 25-mm, 60-mm, or 125-mm mark, when the specimen extinguishes.

9.6 If the specimen burns past the 125-mm mark, the time for the specimen to burn from the 25-mm mark to the 125-mm mark is to be determined. Record the time, in seconds, as the burning time, *t*. Calculate the burning rate as 600/*t* cm/min.