Designation: D 3801 – 00

Standard Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position[1]

This standard is issued under the fixed designation D 3801; 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 standard covers a small-scale laboratory procedure for determining comparative burning characteristics of solid-plastic material, using a 20-mm flame applied to the base of specimens held in a vertical position.

NOTE 1—This test method and Test Method B of IEC 60695-11-10 are equivalent. IEC 60695-11-10 has replaced ISO 1210.

NOTE 2—For additional information on materials that burn up to the holding clamp by this test method, see Test Method D 635. For test methods of flexible plastics in the form of thin sheets and film, see Test Methods D 4804. For additional information on comparative burning characteristics and resistance to burn-through, see Test Method D 5048.

1.2 This test method was developed for polymeric materials used for parts in devices and appliances. The results are intended to serve as a preliminary indication of their acceptability with respect to flammability for a particular application. The final acceptance of the material is dependent upon its use in complete equipment that conforms with the standards applicable to such equipment.

1.3 The classification system described in the appendix is intended for quality assurance and the preselection of component materials for products.

1.4 It is possible that this test is applicable to nonmetallic materials other than plastics. Such application is outside the scope of this technical committee.

1.5 This test method is not intended to cover plastics when used as materials for building construction or finishing.

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

1.7 *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.*

1.8 *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.* See 9.1.1 for a specific hazard statement.

2. Referenced Documents

2.1 *ASTM Standards:*

D 635 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position[2]

D 883 Terminology Relating to Plastics[2]

D 4804 Test Methods for Determining the Flammability Characteristics of Nonrigid Solid Plastics[3]

D 5025 Specification for a Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials[3]

D 5048 Test Method for Measuring the Comparative Burning Characteristics and Resistance to Burn-Through of Solid Plastics Using a 125-mm Flame[3]

D 5207 Practice for Calibration of 20 and 125-mm Test Flames for Small-Scale Burning Tests on Plastic Materials[3]

E 176 Terminology of Fire Standards[4]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[5]

2.2 *IEC Standard:*[6]

60695-11-10 Fire Hazard Testing—Part 11-10: Test Flames—50W Horizontal and Vertical Flame Test Methods

2.3 *ISO Standard:*[6]

ISO 1210 Plastics—Determination of the Burning Behaviour of Horizontal and Vertical Specimens in Contact with a Small-Flame Ignition Source

3. Terminology

3.1 *Definitions*—For terms relating to plastics, the definitions in this test method are in accordance with Terminology

[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 (Section D20.30.03).

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[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 08.03.

[4] *Annual Book of ASTM Standards*, Vol 04.07.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

[6] Publications of the International Electrotechnical Commission (IEC) and International Organization for Standardization (ISO) are available from ANSI, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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

D 883. For terms relating to fire, the definitions used in this test method are in accordance with Terminology E 176.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *afterflame*—persistence of flaming of a material, after the ignition source has been removed.

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

3.2.3 *afterglow*—persistence of glowing of a material, after cessation of flaming or, if no flaming occurs, after removal of the ignition source.

3.2.4 *afterglow time*—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.

3.2.5 *flame-impingement time*—the time in seconds that the flame from the burner is in contact with the specimen.

3.2.6 *flaming material*—flaming drips or particles from the specimen that ignite the absorbent 100 % cotton.

4. Summary of Test Method

4.1 The procedure consists of subjecting a set of specimens of identical composition and geometry to a standard test flame for two 10-s flame applications. The afterflame time is recorded after the first flame application, and the afterflame and afterglow times are recorded after the second flame application. Information is also recorded on whether or not flaming material drips from the specimen.

5. Significance and Use

5.1 The tests results represent afterflame and afterglow time in seconds for a material of specified shape, under the conditions of this test method.

5.2 The effect of material thickness, color additives, and possible loss of volatile components is measurable.

5.3 The results, when tabulated, are potentially useful as a reference for comparing the relative performance of materials and as an aid in material selection.

5.4 In this procedure, the 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 may not be possible by or from this test method 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 test method.

6. Apparatus

6.1 *Test Chamber*, enclosed laboratory hood or chamber, free of induced or forced draft during test, having an inside volume of at least 0.5 m^3. An enclosed laboratory hood with a heat-resistant glass window and an exhaust fan for removing the products of combustion after the tests is recommended.

NOTE 3—Laboratory hoods may have induced drafts even with the exhaust fan off. A positive-closing damper may be needed.

NOTE 4—A mirror in the chamber, to provide a rear view of the specimen, has been found useful in some enclosures.

6.2 *Laboratory Burner*, constructed in accordance with Specification D 5025.

6.3 *Ring Stand*, with a clamp or the equivalent, adjustable for vertical positioning of specimens.

6.4 *Gas Supply*, a supply of technical-grade methane gas, minimum 98 % pure, with suitable regulator and meter for uniform gas flow. Natural gas having an energy density of 37 ± 1 MJ/m^3 has been found to provide similar results. However, technical-grade methane gas shall be used as the referee gas in cases of dispute.

6.5 *Timing Device*, accurate to 0.5 s.

6.6 *Cotton*, absorbent 100 % cotton.

6.7 *Desiccator*, containing anhydrous calcium chloride or other drying agent, capable of being maintained at 23 ± 2°C and relative humidity not exceeding 20 %.

6.8 *Conditioning Room or Chamber*, capable of being maintained at 23 ± 2°C and a relative humidity of 50 ± 5 %.

6.9 *Conditioning Oven*, a full-draft circulating-air oven capable of being maintained at 70 ± 1°C.

6.10 *Micrometer*, having a resolution of at least 0.01 mm.

7. Test Specimens

7.1 The standard specimen geometry shall be 13.0 ± 0.5 by 125 ± 5 mm in the thickness appropriate to the objectives of the determination. Materials thicker than 13 mm shall not be tested by this test method.

7.2 Surfaces shall be smooth and unbroken. Corner radius shall not exceed 1.3 mm. After any cutting operation, edges shall be fine-sanded to remove burrs, saw marks, and residual filaments.

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± 5 % prior to testing. Once removed from the conditioning room or chamber, specimens shall be tested within one hour.

8.1.2 Condition a second set of five specimens in a circulating-air oven for 168 h at 70 ± 1°C and then cool in a desiccator for at least 4 h at room temperature prior to testing. Once removed from the desiccator, specimens shall be tested within 30 min.

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

9. Procedure

9.1 Conduct the burning test in a chamber, enclosure, or laboratory hood free of induced or forced draft.

9.1.1 **Warning**—Combustion products contain toxic compounds. A system to contain and remove the products of combustion after a test, such as a laboratory hood with an exhaust fan, is required.

9.2 Clamp a specimen from the upper 6 mm of its length, with the longitudinal axis vertical, so that the lower end of the specimen is 300 ± 10 mm above a horizontal layer of cotton, approximately 50 by 50 mm, thinned to a maximum uncompressed thickness of 6 mm, maximum mass of 0.08 g. See Fig. 1.

9.3 Place the burner remote from the specimen, ignite, and adjust it to produce a blue flame 20 ± 2 mm high. Adjust the