



Standard Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical Position¹

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.

^{ε1} NOTE—Tables 1-3 were corrected editorially in March 1998.

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, Clause 9 of IEC 707, and Method B of ISO 1210-1991 are technically equivalent.

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.

NOTE 3—See Test Method D 3713 which, unless otherwise specified, uses the same specimens for determining the comparative resistance of solid plastics to ignition by a small flame.

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 This test method may be applied to other nonmetallic materials if found to be appropriate.

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. The values given in parentheses are for information only.

1.7 *This standard should be used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire-hazard or fire-risk of*

materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire-hazard assessment or a fire-risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard or fire risk of a particular end use.

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 10.1.1 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 Position²

D 883 Terminology Relating to Plastics²

D 1898 Practice for Sampling of Plastics²

D 3713 Test Method for Measuring Response of Solid Plastics to Ignition by a Small Flame³

D 4804 Test Methods for Determining the Flammability Characteristics of Nonrigid Solid Plastics⁴

D 5025 Specification for a Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials⁴

D 5048 Test Method for Measuring the Comparative Burning Characteristics and Resistance to Burn-Through of Solid Plastics Using a 125-mm Flame⁴

D 5207 Practice for Calibration of 20 and 125-mm Test Flames for Small-Scale Burning Tests on Plastic Materials⁴

E 176 Terminology of Fire Standards⁵

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁶

2.2 IEC Standard:⁷

² Annual Book of ASTM Standards, Vol 08.01.

³ Annual Book of ASTM Standards, Vol 08.02.

⁴ Annual Book of ASTM Standards, Vol 08.03.

⁵ Annual Book of ASTM Standards, Vol 04.07.

⁶ Annual Book of ASTM Standards, Vol 14.02.

⁷ 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.

¹ This test method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.30 on Thermal Properties (Section D20.30.03).

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In 1996, the precision and bias statement was updated to include polyamide.

707 Methods of Test for the Determination of the Flammability of Solid Electrical Insulating Materials When Exposed to an Igniting Source

2.3 ISO Standard:⁷

ISO 1210-1991 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 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, serve as a reference for comparing the relative performance of materials and can be 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 m³. 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 4—Laboratory hoods may have induced drafts even with the exhaust fan off. A positive-closing damper may be needed.

NOTE 5—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 with suitable regulator and meter for uniform gas flow. Natural gas having an energy density of approximately 37 MJ/m³ 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.

7. Sampling

7.1 Unless otherwise agreed upon, material shall be sampled in accordance with the General and Specific Sampling Procedures of Practice D 1898.

8. Test Specimens

8.1 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.

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

9. Conditioning

9.1 Condition specimen sets as follows:

9.1.1 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.

9.1.2 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.

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

10. Procedure

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