



Standard Test Method for Measuring Response of Solid Plastics to Ignition by a Small Flame¹

This standard is issued under the fixed designation D 3713; 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 is a fire-test-response standard.

1.2 This test method covers a small-scale procedure for characterizing the response of a plastic to an ignition source consisting of a small flame of controlled intensity applied to the base of a standard sample being held in a vertical position.

1.3 *This standard should be used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled 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 in 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.*

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

NOTE 1—See Method D 3801 which, unless otherwise specified, uses the same specimens for measuring the comparative extinguishing characteristics of solid plastics when tested in a vertical position.

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. Specific hazard statements are given in 10.1.*

NOTE 2—There is no similar or equivalent ISO standard.

2. Referenced Documents

2.1 ASTM Standards:

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

D 883 Terminology Relating to Plastics²

D 3801 Method for Measuring the Comparative Extinguishing Characteristics of Solid Plastics in a Vertical Position³

E 176 Terminology Relating to Fire Standards⁴

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).

Current edition approved Feb. 15, 1995. Published April 1995. Originally published as D 3713 - 78. Last previous edition D 3713 - 78 (1988)¹.

² This edition was updated to meet current Blue Book guidelines.

³ Annual Book of ASTM Standards, Vol 08.01.

⁴ Annual Book of ASTM Standards, Vol 08.02.

⁵ Annual Book of ASTM Standards, Vol 04.07.

3. Terminology

3.1 For definitions of terms used in this test method refer to the terminology contained in Terminologies D 883 or E 176.

3.2 Descriptions of Terms Specific to This Standard:

3.2.1 *burning (B)*—that mode of response where the flaming or glowing combustion, or both, exceeds 30 s after the burner is removed but the specimen is neither consumed nor produces dripping ignition of cotton.

3.2.2 *burning time*—that interval of time beginning immediately after removal of the burner flame and lasting until flaming and glowing combustion cease. The burning time, therefore, is the sum of the flame and glow times.

3.2.3 *consumed (C)*—that mode of response where combustible material in the specimen is totally consumed in 30 s or less, after the burner is removed (except for that portion of the specimen in the clamp). Immediately terminate the test if this condition occurs at any point during the test, and record the IRI as “C at (sample thickness),” signifying the material in the designated thickness cannot be evaluated by this method.

3.2.4 *dripping ignition (DI)*—that mode of response where the sample produces flaming droplets igniting cotton placed 305 mm (12 in.) below, either during flame impingement, or within 30 s after the burner is removed. Continued combustion of the specimen after dripping ignition is ignored unless the specimen is totally consumed in less than 30 s, in which case the IRI is reported as “C”.

3.2.5 *dripping, no ignition (D)*—that mode of response where the materials drip when tested in accordance with 10.8 but do not ignite cotton. They are assigned an IRI of D at *t*.

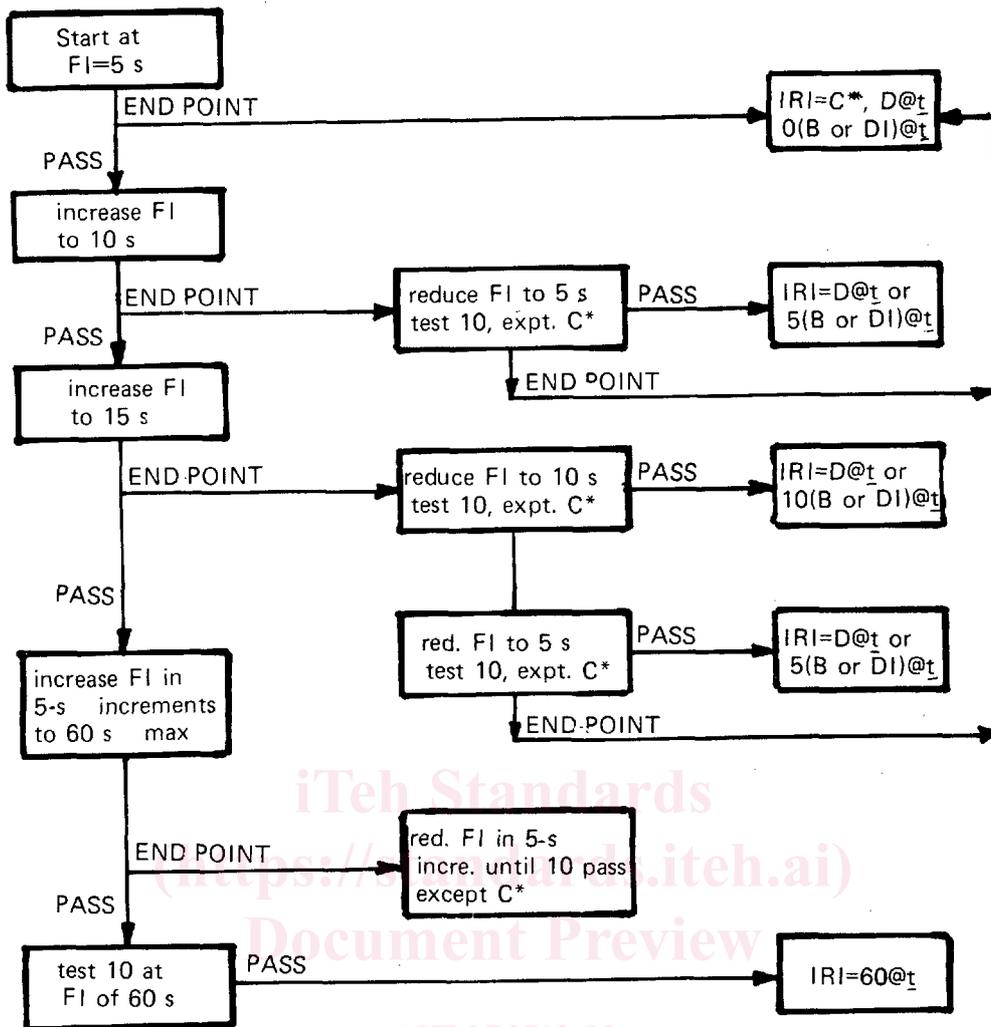
3.2.5.1 *Discussion*—The flame impingement time is not included in the IRI for materials displaying “D”-type behavior because time is not an end point. The end point is the dripping (without ignition of cotton) whenever it occurs, subject to the maximum flame impingement time restriction of 60 s.

3.2.6 *endpoint*—the point at which the burning time of the sample exceeds 30 s after the burner is removed; the material drips, with or without ignition of cotton, either during the flame application or within 30 s after the burner is removed; or the combustible material in the specimen is totally consumed within 30 s or less after the burner is removed.

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

3.2.8 *glow*—combustion without visible flame. It occurs after removal of the external flame or after cessation of the self-perpetuating flaming of the material.

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|------------------------|-------------------------------|
| B = Burns | FI = Flame Impingement Time |
| D = Drip, No Ignition | IRI = Ignition Response Index |
| DI = Dripping Ignition | t = Specimen Thickness, mm |
| C = Consumed | |

* Terminate test, see Section 5.6.1

FIG. 1 Flow Diagram of Test Sequence

3.2.9 *ignition response index (IRI)*—the response of a sample of specified thickness or shape to the thermal energy produced by a small flame. It consists of the maximum flame impingement time withstood by the sample without it being totally consumed (except the material in the clamp), or burning or glowing, or both, more than 30 s after removal of the ignition source, or producing droplets that ignite cotton. Thus, the IRI is composed of time in seconds or letter(s) denoting mode of response, or both, and the sample thickness.

3.3 *Examples of Designating Modes of Response:*

3.3.1 IRI = 0 B at 1.6 mm—Signifies material, in a

thickness of 1.6 mm, burns for more than 30 s if ignited for 5 s.

3.3.2 IRI = 35 B at 1.6 mm—Signifies material, in a thickness of 1.6 mm, can withstand a flame impingement time of 35 s, but will burn (flame or glow, or both) more than 30 s if ignited for 40 s or more.

3.3.3 IRI = 35 DI at 1.6 mm—Signifies material, in a thickness of 1.6 mm, can withstand a flame impingement time of 35 s, and the end point is dripping ignition of cotton at 40 s.

3.3.4 IRI = D at 1.6 mm—See 3.2.5 and 3.2.5.1.

3.3.5 IRI = 60 at 1.6 mm—Signifies material, in a

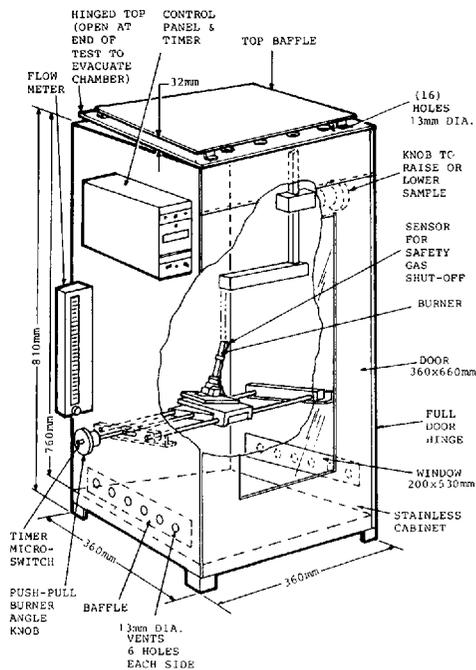


FIG. 2 Flame Test Chamber

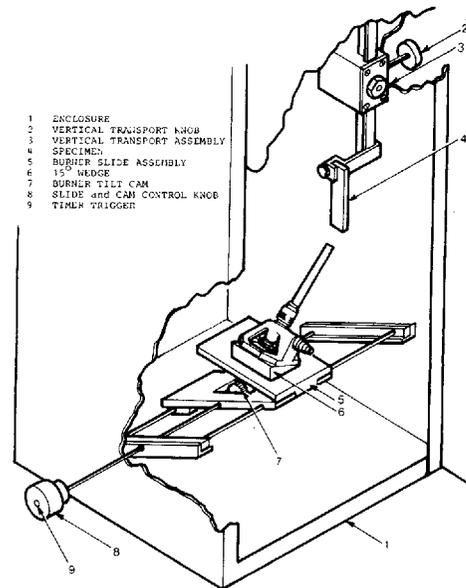


FIG. 3 Control Mechanism

thickness of 1.6 mm, withstood the maximum flame impingement time of 60 s without burning more than 30 s or producing droplets of any kind.

4. Summary of Test Method

4.1 A set of specimens of identical composition and geometry is subjected to a standard flame applied in uniformly increasing 5-s increments, as shown in Fig. 1, to a maximum of 60 s using a new specimen at each increment. If an endpoint occurs, the time of application is decreased until ten specimens tested consecutively, at the same duration, pass the test. This duration, along with the sample thickness and the letter(s) identifying the mode of response, is reported as the ignition response index.

4.1.1 Increasing the flame impingement time in 10-s increments is permissible, if experience with similar materials indicate that such a deviation will not influence the results.

4.2 Deviation from the specified stair-case sequence produces erroneous and unacceptable results. Test must be performed in the specified chamber (or equivalent), having external controls.

5. Significance and Use

5.1 The response of a material to the conditions herein prescribed may provide a useful element in controlling manufacturing processes, detecting material substitution, or as a measure of the deterioration of a material during use.

5.2 After a material has been assigned an ignition response index measured by this test method, subsequent lots of material in the same configuration may be compared to the Index for acceptance/rejection purposes with the application of a suitable sampling plan.

5.3 The response of a material will vary with mass of sample and ambient conditions. Test data are comparable to an index only if the index has been measured on a sample of

equal dimensions and under equivalent conditions.

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 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.

5.5 Due to the fixed relationship between the burner and the sample, samples that exhibit dripping characteristics cannot be further evaluated to their final ignition characteristics. This fact should be considered in evaluating and using final results.

6. Apparatus⁵

6.1 *Burner*, bunsen or Tirrill type, tube length 95 ± 6 mm and inside diameter of $9.5 + 1.5, -0.0$ mm. The tube shall not be equipped with end attachments such as stabilizers.

6.2 *Test Chamber*—The enclosure shall be free of induced or forced draft, similar to Figs. 2 and 3, equipped with external controls for manipulating the burner and specimen during the test, and a thermally actuated safety shutoff of the gas supply.

6.3 *Gas Supply*—A supply of natural gas or technical-grade methane rated at approximately 37 MJ/m^3 .

6.4 *Timer*—Electrically operated elapsed-time indicator with digital readout to 9999.9 s, push-button reset, remotely energized.

6.5 *Exhaust Hood*—A fume hood of at least 0.5 m^3 with a frontal opening height of 700 mm and an exhaust capacity of $3 \text{ m}^3/\text{min}$.

6.6 *Cotton*—A roll of untreated absorbent surgical cotton (100 % cotton).

6.7 *Thermocouple*, Awg 30, wire diameter $0.25 + 0.03$,

⁵ Apparatus can be obtained from Atlas Electrical Devices, 4114 N. Ravenswood Ave., Chicago, IL 60613. Request Model VFC-Plastics.