



Standard Test Method for Measuring the Ignition Strength of Cigarettes¹

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INTRODUCTION

The most common initiating event in a fatal fire in the United States is the dropping of a lit cigarette onto a bed or piece of upholstered furniture. The cigarette coal heats the furnishing materials to the point where smoldering combustion begins, perhaps followed by a transition to flaming combustion. Since limiting the frequency of ignitions is a principal approach to reducing fire loss, it is desirable to establish a test method for the propensity of a cigarette to ignite soft furnishings. This test method uses standard substrates to determine the extent to which, as the substrate draws heat from the cigarette, the cigarette combustion remains strong enough to be capable of initiating a fire.

1. Scope

1.1 This fire-test-response standard provides a standard measure of the capability of a cigarette, positioned on one of four standard substrates, to generate sufficient heat to continue burning and thus potentially cause ignition of bedding or upholstered furniture.

1.2 This method has value as a predictor of the relative propensity of a cigarette to ignite upholstered furnishings.

1.3 This method is applicable to cigarettes that burn along the length of a tobacco column.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 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.

1.6 *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.* For specific hazard statements, see Section 6.

¹ This test method is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.15 on Furnishings and Contents.

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2. Referenced Documents

2.1 ASTM Standards:²

E176 Terminology of Fire Standards

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E1352 Test Method for Cigarette Ignition Resistance of Mock-Up Upholstered Furniture Assemblies

E1353 Test Methods for Cigarette Ignition Resistance of Components of Upholstered Furniture

2.2 NFPA Standards:³

NFPA 260 Standard Methods of Tests and Classification Systems for Cigarette Ignition Resistance of Components of Upholstered Furniture

NFPA 261 Standard Method of Test for Determining Resistance of Mock-up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes

2.3 Other Standard:⁴

Standard for the Flammability of Mattresses and Mattress Pads, 16 Code of Federal Regulations, Part 1632

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method refer to Terminology E176.

3.2 *Definitions of Terms Specific to This Standard:*

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.

³ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269, <http://www.nfpa.org>.

⁴ Available from the Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001; http://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title16/16cfr1632_main_02.tpl.

3.2.1 *full-length burn, n*—the outcome of a determination in which the cigarette burns to or past the front plane of the tipping paper, which covers the filter and perhaps a short section of the tobacco column in a filter tip cigarette, or past the tips of the metal pins (see 7.5) if the cigarette has no filter.

4. Summary of Test Method

4.1 This test method measures the probability that a cigarette, placed on a substrate, will generate sufficient heat to maintain burning of the tobacco column. Each determination consists of placing a lit cigarette on the horizontal surface consisting of a set number of layers of filter paper or a single layer of filter paper on a thin sheet of full hard 302 stainless steel (1).⁵ Observation is made of whether or not the cigarette continues to burn to the beginning of the tipping paper. Forty determinations (comprising a test) are performed to obtain the relative probability that the cigarette will continue burning despite heat abstraction by the substrate.

5. Significance and Use

5.1 The most common initiating event in a fatal fire is the dropping of a cigarette onto a bed or piece of upholstered furniture, according to statistics provided by the National Fire Protection Association (2). Test Methods E1352 and E1353 and tests NFPA 261 and NFPA 260 have been developed to evaluate the susceptibility of upholstered furniture mock-ups and components to ignition by cigarettes. Federal Standard 16 CFR Part 1632, Standard for the Flammability of Mattresses and Mattress Pads, was promulgated to reduce the likelihood that mattresses and mattress pads would ignite from a lighted cigarette.

NOTE 1—While Test Methods E1352 and E1353 were originally equivalent to NFPA 261 and 260, respectively, this is no longer the case.

5.2 This test method enables comparison of the relative ignition strength of different cigarette designs.

5.3 In this procedure, the specimens are subjected to a set of laboratory conditions. If different conditions are substituted or the end use conditions are changed, it may not be possible, using this test, to predict quantitative changes in the fire test response characteristics measured. Therefore, the quantitative results are valid only for the fire test exposure conditions described in this procedure.

6. Hazards

6.1 This test method involves the use of combustible materials that are exposed to ignition sources. Consequently, the user shall take proper precautions to avoid thermal injuries.

6.1.1 Personnel shall be instructed on general procedures to handle an unwanted fire. Appropriate fire extinguishing equipment shall be provided to suppress any fires that exceed normal controlled limits.

6.2 Personnel shall take proper precautions to avoid inhaling combustion products.

6.2.1 Exhaust systems shall be checked regularly to ensure that they are removing all products of combustion from the workspace.

6.2.2 Respiratory equipment shall be made available for personnel.

6.3 The user shall ensure that all burning has ceased before discarding used test materials. An appropriate closed metal waste container shall be used in each fire test laboratory for safe disposal of specimens and test assemblies after being exposed to heat and fire.

7. Apparatus and Equipment

7.1 *Test and Conditioning Environment*—An environmental conditioning room shall be maintained which provides an area adequate for conditioning both cigarettes and filter paper specimens. This room shall be capable of maintaining a relative humidity of $55 \pm 5\%$ and a temperature of $23 \pm 3^\circ\text{C}$ ($73 \pm 5^\circ\text{F}$) and shall be continuously monitored. The room in which the tests are conducted, which may also be the conditioning room, shall be maintained within the same temperature and relative humidity ranges.

7.2 *Constant Humidity Box*—Alternatively, cigarettes and filter paper shall be stored in a box of sufficient size to hold the needed quantities of filter paper and cigarettes. The interior of the box shall be maintained at a relative humidity of $55 \pm 5\%$ and a temperature of $23 \pm 3^\circ\text{C}$ ($73 \pm 5^\circ\text{F}$) and shall be continuously monitored. A tray containing a saturated solution of sodium bromide (NaBr) in water will provide the appropriate relative humidity when the box temperature is as prescribed. The box shall be located convenient to the test chamber such that test materials shall not be exposed to a non-conditioned environment for more than 5 min between their removal from the box and the beginning of a test.

7.3 *Test Chamber*—A test chamber of the design photographed in Fig. 1 shall be constructed of clear plastic such as polymethylmethacrylate (PMMA), nominally 6 mm (0.25 in.) in thickness. The inside dimensions shall be: height: 340 ± 25 mm (13.4 ± 1 in.), width: 292 ± 6 mm (11.5 ± 0.25 in.), depth: 394 ± 6 mm (15.5 ± 0.25 in.). The full front panel of the chamber shall be hinged, with a latch to effect positive closure. The top of the chamber shall have a flattop cylindrical chimney of height 165 ± 13 mm (6.5 ± 0.5 in.) and inside diameter 152 ± 6 mm (6.00 ± 0.25 in.). The chimney shall be centered on the chamber top and sealed to the chamber top panel.

7.4 Substrate Holder:

7.4.1 A cylindrical support, shown in Fig. 2, shall be made of PMMA or similarly rigid material, dimensioned as follows. The outer diameter shall be 165 ± 1 mm (6.50 ± 0.04 in.), the inner diameter shall be 127 ± 1 mm (5.00 ± 0.04 in.), and the height shall be 50 ± 1 mm (1.97 ± 0.04 in.). A recess in the top, 10 ± 2.5 mm (0.40 ± 0.10 in.) deep, shall expand the inner diameter to 152 ± 1 mm (6.00 ± 0.04 in.). Three or four legs shall raise the bottom of the holder approximately 20 mm (0.80 in.) above the chamber floor.

NOTE 2—The outer diameter of the metal rim is not to exceed the inner diameter of the recess in the filter paper holder.

⁵ The boldface numbers in parentheses refer to a list of references at the end of this standard.



FIG. 1 Photograph of Test Chamber and Holder for the Filter Paper Substrates

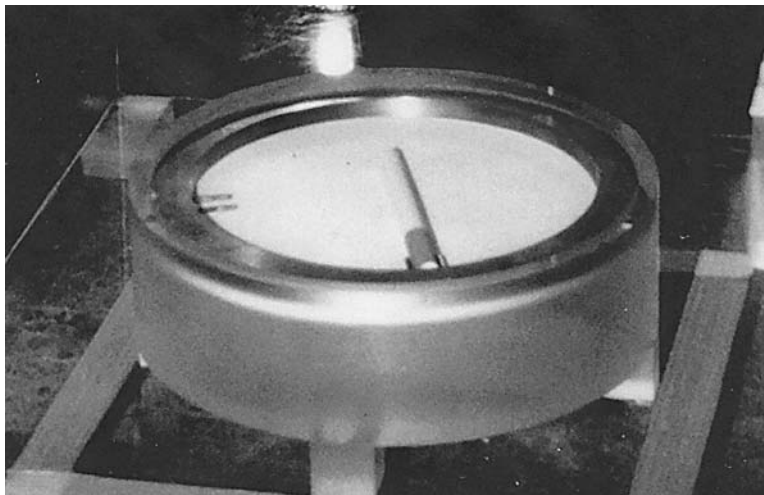


FIG. 2 Close-up of Test Cigarette, Filter Paper Holder, Metal Pins and Metal Rim

7.4.2 An adapter ring to support the stainless steel/paper substrate shall be made of PMMA or a similarly rigid material, dimensioned as follows. The outer diameter shall be 165 ± 1 mm (6.50 ± 0.04 in.), the inner diameter shall be 126 ± 1 mm (4.98 ± 0.04 in.), and the height shall be 15.5 ± 1 mm (0.61 ± 0.04 in.). A recess in the bottom, 10.0 ± 1 mm (0.40 ± 0.04 in.) deep, shall decrease the outer diameter to 150 ± 1 mm (5.90 ± 0.04 in.). The top surface of the adapter shall be flat to within ± 0.03 mm (0.001 in.). A schematic of the adapter ring is shown in Fig. 3. The assembled support for the stainless steel substrate is shown in Fig. 4.

7.5 *Metal Rim*—A circular brass or other dense metal rim, shown in Fig. 2, shall be used to hold the sheets of filter paper flat against each other. The outside diameter of the rim shall be 150 ± 2 mm (5.90 ± 0.08 in.). The inner diameter shall be 130 ± 2 mm (5.1 ± 0.08 in.). The rim surface shall be flat and smooth. A pair of parallel metal pins, each approximately 1 mm in diameter and 8.1 ± 0.05 mm (0.32 ± 0.02 in.) apart, shall protrude 17 ± 4 mm (0.65 ± 0.15 in.) toward the center of the rim. The pins are to be spaced to keep the non-ignited end of a conventional 25 mm circumference cigarette from rolling, but without pressuring the cigarette. If cigarettes of significantly different diameter are to be tested, other pairs of pins, appropriately spaced, shall be inserted into the rim.

7.5.1 The mass of the rim shall be 600 ± 10 g. If the mass of a rim is lower, a stacked second rim shall bring the total mass to 600 ± 10 g.

7.6 *Cigarette Holder*—A holder shall be used to support the lit cigarette in a horizontal position in the test chamber prior to placement of the cigarette onto the filter paper substrate. The holder shall not clamp the cigarette nor stress it in any other manner, nor shall it contact the cigarette within a nominal 30 mm (1.2 in.) of its lit end.

7.7 *Cigarette Ignition System*—A system consisting of an air draw component and an ignition source shall be used to ignite the test cigarettes. The cigarette shall be supported in a horizontal position. A butane gas lighter capable of producing a stable luminous flame 15 ± 3 mm (0.6 ± 0.1 in.) in length or a hot coil igniter shall be used for lighting the cigarette. The



FIG. 4 Close-up of a Test Cigarette on the Stainless Steel/Paper Substrate

airflow and the draw time through the lit cigarette shall be sufficient to establish a coal to within ± 1 mm (0.2 in.) from the tip of the cigarette. Appropriate filtering media shall be used downstream of the cigarette to remove smoke and condensable combustion gases in order to prevent contamination of the downstream components.

7.8 *Exhaust Hood*—A chemical or canopy hood shall be used for removing combustion products from the test room. Air flow through the hood shall be sufficient to remove cigarette and substrate combustion products while not being high enough to influence the combustion processes in the test chamber(s). (See 8.1.2.)

7.9 *Extinguishment*—Following a determination, the cigarette and sheets of filter paper shall be completely extinguished, for example, by smothering or by application of water.

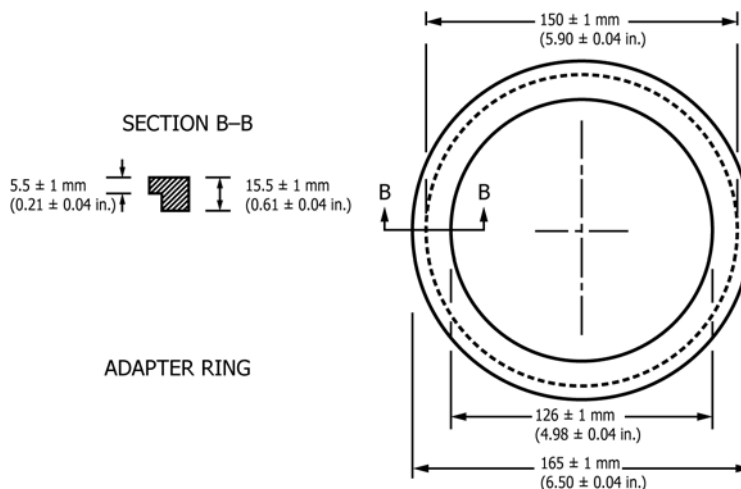


FIG. 3 Schematic of the Adapter Ring to Support the Stainless Steel Substrate