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Standard Test Method for Fire Testing of Vandalized Upholstered Furniture¹

This standard is issued under the fixed designation F3727; 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 The purpose of this test method is to determine the burning behavior of upholstered furniture used in public occupancies, such as detention and correctional, behavioral, and other confinement facilities, when it has been vandalized to expose the padding.

1.3 In this test method, a standardized vandalization method is applied to the upholstered furniture item and the results of exposing the furniture item to a standardized specified flaming ignition source under well-ventilated conditions are compared to those associated with the same item, in an unvandalized form, as tested using Test Method [E1537](#).

1.3.1 This test method is applicable to upholstered furniture and is not applicable to seating furniture that is not upholstered.

1.4 The specific fire-test response characteristics to be measured are heat release and mass loss.

1.5 Data are obtained describing the burning behavior from a specific ignition source until all burning has ceased, a period of 1 h has elapsed, or flashover appears inevitable.

1.6 This test method does not provide information on the fire performance of upholstered furniture in fire conditions other than those conditions specified. In particular, this test method does not apply to smoldering ignition by cigarettes.

1.7 The rate of heat release of the burning specimen is measured by an oxygen consumption method. See Practice [E2067](#) for further information.

1.8 The burning behavior is visually documented by photographic or video recordings, whenever possible.

1.9 The system of units to be used in referee decisions is the SI system of units, see [IEEE/ASTM SI-10](#) for further details. The units given in parentheses are for information only.

1.10 *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.

1.11 *Fire testing of products and materials is inherently hazardous, and adequate safeguards for personnel and property shall be employed in conducting these tests. This test method may involve hazardous materials, operations, and equipment.*

1.12 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.13 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[D123 Terminology Relating to Textiles](#)

[E176 Terminology of Fire Standards](#)

[E800 Guide for Measurement of Gases Present or Generated During Fires](#)

[E1537 Test Method for Fire Testing of Upholstered Furniture](#)

[E2067 Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests](#)

[IEEE/ASTM SI-10 International System of Units \(SI\): The Modern Metric System](#)

2.2 *ISO Standards:*³

[ISO 13943 Fire Safety—Vocabulary](#)

3. Terminology

3.1 *Definitions:*

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 1180 Avenue of the Americas, 10th Floor, New York, NY 10036, <http://www.ansi.org>.

¹ This test method is under the jurisdiction of ASTM Committee [F33](#) on Detention and Correctional Facilities and is the direct responsibility of Subcommittee [F33.05](#) on Furnishings and Equipment.

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3.1.1 For definitions of terms used in this test method and associated with fire issues, refer to Terminology **E176** and in ISO 13943. The definitions given in Terminology **E176** shall prevail in case of conflict.

3.1.2 For definitions of terms used in this test method and associated with textile issues refer to Terminology **D123**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *flaming debris, n*—flaming material that separates and falls from the test specimen during the fire test and continues to burn with flame. (See also *flaming droplets*.) **E176**

3.2.1.1 *Discussion*—The particular conditions under which continued flaming combustion is significant (such as for a particular duration or after striking a surface) may be different in different test methods. Where needed, such conditions should be specified in the test method or requirement. **E176**

3.2.2 *flaming droplets, n*—flaming, liquefied material that separates and drips from the test specimen during the fire test and continues to burn with flame. (See also *flaming debris*.) **E176**

3.2.2.1 *Discussion*—The particular conditions under which continued flaming combustion is significant (such as for a particular duration or after striking a surface) may be different in different test methods. Where needed, such conditions should be specified in the test method or requirement. **E176**

3.2.3 *product, n*—the upholstered furniture for which information is required. **E1537**

3.2.4 *specimen, n*—manufactured item of the product or representative prototype of the product. **E1537**

3.2.5 *upholstered, adj*—covered with material (as fabric or padding) to provide a soft surface. **E1537**

3.2.6 *upholstered seating furniture, n*—a unit of interior furnishing that (1) contains any surface that is covered, in whole or in part, with a fabric or other upholstery cover material, (2) contains upholstery material, and (3) is intended or promoted for sitting upon. **E1537**

3.2.7 *upholstery cover material, n*—the outermost layer of fabric or related materials used to enclose the main support system, or upholstery materials, or both, used in the furniture unit. **E1537**

3.2.8 *upholstery material, n*—the padding, stuffing, or filling material used in a furniture unit, which may be either loose or attached, enclosed by an upholstery cover material, or located between the upholstery cover material and support system, if present. **E1537**

3.2.8.1 *Discussion*—Upholstery material includes, but is not limited to, material, such as foams, cotton batting, polyester fiberfill, bonded cellulose, or down. **E1537**

4. Summary of Test Method

4.1 This test method determines a number of fire-test-response characteristics from a full-scale specimen of upholstered furniture or from a representative prototype of the upholstered furniture, as manufactured and after undergoing standardized vandalization. The item of upholstered furniture is ignited with a propane gas burner.

NOTE 1—The methodology in this test method is the same as that in Test Method **E1537**.

4.2 The upholstered furniture specimen is located directly beneath an exhaust duct.

4.3 The upholstered furniture specimen to be tested is placed on a weighing platform consisting of a thermal barrier placed on top of a mass measuring device (load cell).

4.4 The key measurements to be made are the rate of heat, the total amount of heat released, and the rate and amount of specimen mass lost.

4.5 Key observations to be reported include the presence of flaming droplets or flaming debris during the test.

4.6 The measurements of heat release, smoke release, and combustion gas release are made in an exhaust duct.

4.7 The measurements of mass loss are made directly from the results obtained by the load cell.

4.8 The upholstered furniture specimen is vandalized in a standardized format to expose the padding material.

4.9 The results obtained from the test with the vandalized furniture are compared with those obtained from an identical test specimen that has not been vandalized.

5. Significance and Use

5.1 This test method provides a means to measure a variety of fire-test-response characteristics resulting from burning a specimen of upholstered furniture, both as manufactured and after vandalization to expose the padding. The upholstered furniture specimen (see Section 6) is allowed to burn freely under well-ventilated conditions after ignition using a propane gas burner. The most important fire-test-response characteristic measured is the rate of heat release, which quantifies the intensity of the fire generated.

5.2 The rate of heat release is measured by the principle of oxygen consumption, based on the measurement of oxygen concentration in the exhaust duct. The assumptions and limitations of oxygen depletion calorimetry are discussed in Practice **E2067**.

5.3 The mass loss of the test specimen is measured continuously during the test using a load cell.

5.4 Other fire-test-response characteristics are optionally measured, namely smoke obscuration and the release of other combustion gases, as they are also potentially important in making decisions on fire safety.

5.5 The type of ignition chosen (a flaming source) is common in both accidental and intentional fires in public occupancies. This test method is thus applicable to upholstered furniture in public occupancies. Such facilities include, but are not limited to, correctional facilities, as well as nursing care homes, health care facilities, public auditoriums, hotels, and motels.

5.6 It has been shown that if the gas burner for this test method is used at a flow rate of 13 L/min, the test method

to 19.3 kW), it approximates the ignition propensity of five crumpled sheets of newspaper located on the seating cushion.⁴

5.7 This test method is not applicable to the ignition of upholstered furniture by cigarettes.

5.8 The test configuration to be used in this test method is an open calorimeter (or furniture calorimeter).

5.9 In this procedure, the specimens are subjected to one or more specific sets of laboratory test conditions. If different test conditions, such as the ignition source type or duration of application, are substituted or the end-use conditions are changed, it is not always 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 procedure.

6. Test Specimen

6.1 The unvandalized test specimen consists of a full-size manufactured item of upholstered furniture or of a representative prototype of the upholstered furniture.

6.2 The vandalized test specimen consists of an item identical to the unvandalized test specimen, but which has been vandalized in the standardized fashion described in 6.3.

6.3 Vandalization of Test Specimen:

6.3.1 Each cushion (including a head rest cushion, if available) shall be vandalized for testing.

6.3.2 Make an incision in the shape of an X, using a tool such as a utility knife, starting at each corner of the surface of each specimen cushion and extending for a distance as indicated in Table 1 or Table 2, towards the opposite corner (see Fig. 1). This means that the length of each of the two cuts will be such that the cuts will intersect at the center of each specimen cushion.

6.3.3 The outer layers to be cut shall involve the fabric, or the fabric and interliner. The interliner shall be included with the outer fabric, irrespective of whether it is adhered, or not, to the back of the fabric or to the padding. The incisions shall be deep enough to expose the padding layer.

6.3.4 The layers that were cut shall be pulled back from the center intersection point towards the outside edge, and cut again across the triangular pulled back section, thus leaving some fabric (or fabric and interliner) covering the padding. This same procedure is repeated for all four folded sections of the specimen.

⁴ Ohlemiller, T. J., and Villa, K., "Furniture Flammability: An Investigation of the California Technical Bulletin 133 Test, Part II: Characterization of the Ignition Source and a Comparable Gas Burner," NISTIR 90-4348, 1990.

TABLE 1 Instructions for Vandalization Incision

If width of cushion is 300 mm or less	Begin and end incision at 75 mm from cushion edge
If width of cushion is more than 300 mm but less than 560 mm	Begin and end incision at 150 mm from cushion edge
If width of cushion is 560 mm or more	Begin and end incision at 200 mm from cushion edge

TABLE 2 Instructions for Vandalization Incision Based on Fig. 1

For Width A	Begin and End Incision at B
300 mm or less	75 mm
300 mm > A > 560 mm	150 mm
560 mm or more	200 mm



FIG. 1 Schematic of Upholstered Furniture

7. Test Layout and Instrumentation

7.1 *Open Calorimeter Layout*—The area surrounding the test specimen shall be sufficiently large that there are no heat radiation effects from the walls or any other nearby objects. The airflow to the test specimen shall be symmetrical from all sides. Position a hood with an exhaust collection system above the test specimen, such that it collects all the combustion gases. There shall be no obstructions to the air supply to the test setup.

NOTE 2—Research indicates that measurements of heat release in a test room and in a furniture calorimeter give similar results for heat release in the duct, for heat release rates lower than 600 kW.⁵

7.1.1 Construct the exhaust collection system with the following minimal requirements: a blower, steel hood, duct, bidirectional probe, thermocouple(s), oxygen measurement

⁵ Parker, W. J., Tu, K. M., Nurbakhsh, S., and Damant, G. H., "Furniture Flammability: An Investigation of the California Technical Bulletin 133 Test, Part III: Full Scale Chair Burns," NISTIR 90-4375, 1990.