



Standard Test Method for Fire Testing of Mattresses¹

This standard is issued under the fixed designation E 1590; 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 approval. 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 provides a means of determining the burning behavior of mattresses used in public occupancies by measuring specific fire test responses when the test specimen, a mattress or mattress with foundation, is subjected to a specified flaming ignition source under well ventilated conditions.

1.3 This is a test method for mattresses or mattresses with foundations.

1.4 Test data are obtained describing the burning behavior, following application of a specific ignition source, from ignition until all burning has ceased, a period of 1 h has elapsed, or flashover appears inevitable.

1.5 This test method does not provide information on the fire performance of mattresses under fire conditions other than those specified in this test method. In particular, this test method does not apply to smoldering ignition by cigarettes. See 5.12 for further information.

1.6 The rate of heat release of burning test specimen is measured by an oxygen consumption method. See 5.12.4 for further information.

1.7 Other measurements are the production of light-obscuring smoke and the concentrations of certain toxic gas species in the combustion gases. See 5.12.5 for further information.

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

1.9 Use the SI system of units in referee decisions; see IEEE/ASTM SI-10. 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D 123 Terminology Relating to Textiles

E 84 Test Method for Surface Burning Characteristics of Building Materials

E 176 Terminology of Fire Standards

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

E 800 Guide for Measurement of Gases Present or Generated During Fires

E 1354 Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

E 1474 Test Method for Determining the Heat Release Rate of Upholstered Furniture and Mattress Components or Composites Using a Bench Scale Oxygen Consumption Calorimeter

E 1537 Test Method for Fire Testing of Upholstered Furniture

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

2.2 *ISO Standards:*

ISO 4880 Burning Behaviour of Textiles and Textile Products—Vocabulary³

ISO 9705 Fire Tests—Full Scale Room Test for Surface Products³

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.

Current edition approved May 1, 2007. Published May 2007. Originally approved in 1994. Last previous edition approved in 2002 as E 1590 – 02.

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 International Standardization Organization, P.O. Box 56, CH-1211, Geneva 20, Switzerland.

ISO 13943 Fire Safety—Vocabulary³

2.3 *UL Standards:*

UL 1056 Fire Test of Upholstered Furniture⁴

UL 1895 Fire Test of Mattresses⁴

2.4 *CA Standards:*

CA Technical Bulletin 121 Flammability Test Procedure for Mattresses for Use in Public Occupancies⁵

CA Technical Bulletin 129 Flammability Test Procedure for Mattresses for Use in Public Buildings⁵

CA Technical Bulletin 133 Flammability Test Procedure for Seating Furniture for Use in Public Occupancies⁵

2.5 *Other Documents:*

CFR Part 1632 Standard for the Flammability of Mattresses and Mattress Pads (formerly DOC FF4-72, 40 FR 59940)⁶

Nordtest Method NT Fire 032 Upholstered Furniture: Burning Behavior—Full Scale Test⁷

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method and associated with fire issues, refer to the terminology contained in Terminology E 176 and ISO 13943. In case of conflict, the definitions given in Terminology E 176 shall prevail. For definitions of terms used in this test method and associated with textile issues, refer to the terminology contained in Terminology D 123 and ISO 4880. In case of conflict, the definitions given in Terminology D 123 shall prevail.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *product, n*—mattress, or mattress with foundation, for which fire-test-response characteristics are to be measured.

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

4. Summary of Test Method

4.1 This fire-test-response test method determines a number of fire-test-response characteristics associated with a full-scale test specimen, mattress or mattress with foundation, ignited with a propane gas burner. Measurements to be made include the rate of heat and smoke release, total amount of heat released, rates and concentrations of carbon oxides released, and rates and amounts of mass of test specimen lost. Other optional measurements are also described.

4.2 In Test Configurations A and B, the test specimen is placed on a weighing platform located in a test room. An exhaust hood, connected to a duct, is located at the doorway of the room.

4.3 In Test Configuration C, the test specimen is placed on a weighing platform located directly under a hood.

4.4 Heat, smoke, and combustion gas release instrumentation is placed in the duct.

4.5 Additional (optional) instrumentation placed in the test room is also described.

⁴ Available from Underwriters Laboratories, Inc., 333 Pfingsten Rd., Northbrook, IL 60062.

⁵ Available from California Bureau of Home Furnishings and Thermal Insulation, State of California, Dept. of Consumer Affairs, 3485 Orange Grove Ave., North Highlands, CA 95660-5595.

⁶ Available from Consumer Product Safety Commission, Washington, DC 20207.

⁷ Available from Nordtest, P.O. Box 22, SF-00341, Helsingfors, Finland.

5. Significance and Use

5.1 This test method provides a means of measuring a variety of fire-test-response characteristics resulting from burning a test specimen, mattress or mattress with foundation. After ignition using a propane gas burner, the test specimen is permitted to burn freely under well-ventilated conditions. The most important fire-test-response characteristic measured in this test method 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. Annex A3 discusses the assumptions and limitations.

5.3 This test method also provides measures of other fire-test-response characteristics, including smoke obscuration (as the rate of smoke release, total smoke released, or optical density of smoke), combustion gas release (as concentrations of combustion gases), and mass loss, which are important to making decisions on fire safety.

5.4 In the majority of fires, the most important gaseous components of smoke are the carbon oxides, present in all fires. They are indicators of the toxicity of the atmosphere and of the completeness of combustion. Measurement of concentrations of carbon oxides are useful for two purposes: (1) as part of fire hazard assessment calculations and (2) to improve the accuracy of heat release measurements. Other toxic combustion gases, which are specific to certain materials, are also indicators of the toxicity of the atmosphere, but are less crucial for determining combustion completeness and are optional measures; however, fire hazard assessment often requires their measurement.

5.5 The type of ignition chosen (flaming source) is common in both accidental and intentional fires in public occupancies. The test method is thus applicable to mattresses in public occupancies. Such facilities include, but are not limited to, health-care facilities, old age convalescent and board and care homes, and college dormitories and residence halls.

5.6 One of the following three configurations is to be used in this test method:

5.6.1 *Test Configuration A*—A test room with the following dimensions: 3.66 by 2.44 by 2.44 m (12 by 8 by 8 ft) high.

5.6.2 *Test Configuration B*—A test room with the following dimensions: 3.66 by 3.05 by 2.44 m (12 by 10 by 8 ft) high.

5.6.3 *Test Configuration C*—An open calorimeter (or furniture calorimeter).

5.7 Rooms of other dimensions are acceptable where it has been shown that equivalent test results are obtained.

5.8 Measurements in the three test configurations listed in 5.6 have been shown to give similar results for heat release in the duct, and mass loss, up to a rate of heat release of 600 kW (1).⁸

5.9 Measurements of temperatures, gas concentrations, and smoke obscuration in the room are dependent on room size.

5.10 This test method has been designed to provide details for the means to build and operate equipment capable of running tests as required by CA TB 129. However, this test method is more general than that technical bulletin.

⁸ The boldface numbers in parentheses refer to the list of references at the end of this test method.

5.11 Studies on the flammability performance of mattresses indicate that bench scale fire tests are useful for preliminary evaluations of component materials for substitution purposes (see Appendix X3).

5.12 Limitations:

5.12.1 This test method is not applicable to ignition by cigarettes, or by any other smoldering source.

5.12.2 The ignition source in this test method is a flaming source, and it has been shown that mattresses, particularly in public occupancies, are involved in fires with flaming ignition sources. Moreover, this particular ignition source has been shown to be able to provide a distinction between different kinds of mattress items. However, the fraction of actual flaming mattress fires occurring with ignitions more or less intense than that used here is not known.

5.12.3 It is not known whether the results of this test method will be equally valid when a mattress is burned under conditions different from those specified. In particular, it is unclear whether the use of a different ignition source, or the same ignition source but having a different duration of flame exposure or a different gas-flow rate, will change the results.

5.12.4 The value of rate of heat release corresponding to the critical limit between propagating mattress fires and non-propagating fires is not known.

5.12.5 As yet, there is not a known direct correlation between smoke obscuration or smoke toxicity measurements in the exhaust duct and overall fire hazard.

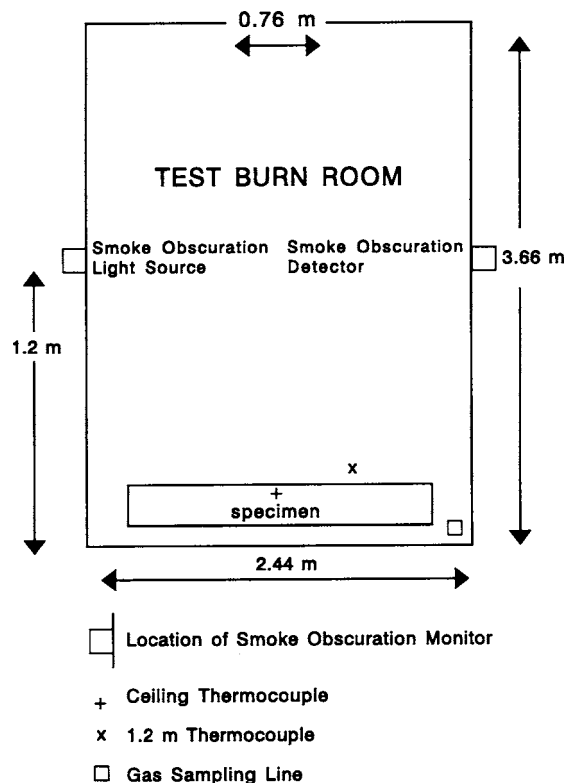
6. Apparatus

6.1 Room Layout and Instrumentation:

6.1.1 Test Room Layout (Test Configuration A)—The test room shall have dimensions of 2.44 m ± 25 mm by 3.66 m ± 25 mm by 2.44 m ± 25 mm (8 by 12 by 8 ft) high. The room shall have no openings other than a doorway opening 0.76 m ± 6.4 mm by 2.03 m ± 6.4 mm (30 by 80 in.), located as indicated in Fig. 1, and other small openings, as necessary, to make test measurements. Construct the test room of wooden or metal studs, and line it with fire-rated gypsum wallboard or calcium silicate wallboard. Position a hood, as described in Annex A1, outside of the room doorway, such that it collects all of the combustion gases. There shall be no obstructions to the air supply to the test setup.

NOTE 1—Both Type X gypsum wallboard and calcium silicate wallboard with a thickness of at least 13 mm (0.5 in.) have been found acceptable. If the thickness of the wallboard is larger, it will not affect the results of this test method.

6.1.2 Test Room Layout (Test Configuration B)—The test room shall have dimensions of 3.05 m ± 25 mm by 3.66 m ± 25 mm by 2.44 m ± 25 mm (10 by 12 by 8 ft) high. The room shall have no openings other than a doorway opening 0.97 m ± 6.4 mm by 2.06 m ± 6.4 mm (38 by 81 in.), located as indicated in Fig. 2, and other small openings, as necessary, to make test measurements. Construct the test room of wooden or metal studs, and line it with fire-rated gypsum wallboard or calcium silicate wallboard. Position a hood, as described in Annex A1, outside of the room doorway, such that it collects all of the combustion gases. There shall be no obstructions to the air supply to the test method setup. (See Note 1.)



NOTE 1—See text for tolerances; room instrumentation is optional.
FIG. 1 Test Room Configuration A

6.1.3 Open Calorimeter Layout (Test Configuration C):

6.1.3.1 The area surrounding the test specimen in an open calorimeter layout 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.

6.1.3.2 If the heat release rate of the test specimen is below 600 kW, a load cell sited under a hood, and where the distance between the test specimen and any wall is 1 m (3.3 ft) or more, is acceptable.

6.1.3.3 The air supply to the calorimeter shall be sufficient so that it does not affect the burning process.

6.1.4 General Discussion of Room Layout—Heat release measurements in the duct, made in Test Configurations A, B, and C, have been shown to yield similar results for heat release rates below 600 kW (see X1.4) (1).

6.1.5 Other Test Room Furnishings—The test room shall contain no furnishings except for the test specimen.

6.1.6 Location of Test Specimen, for Test Configurations A or B—Position the test specimen on a weighing platform in a corner. Ensure that the test specimen is at a distance of between 0.10 and 0.25 m (4 and 10 in.) from both walls (Fig. 1 and Fig. 2).

6.1.7 Location of Test Specimen, for Test Configuration C—Position the test specimen on a weighing platform underneath the hood (Fig. 3).

6.2 Ignition Source:

6.2.1 As the ignition source, use a gas burner in the shape of a T, as described in Fig. 4.