



Standard Test Method for Fire Testing of Stacked Chairs¹

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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 stacking chairs used in public occupancies by measuring specific fire-test responses when a stack of chairs is subjected to a specified flaming ignition source under well ventilated conditions.

1.3 This test method is limited to stacked chairs.

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 under test conditions appears inevitable.

1.5 This test method does not provide information on the fire performance of stacked chairs under fire conditions other than those conditions specified in this test method. In particular, this test method does not apply to smoldering ignition by cigarettes. See 5.11 for further information.

1.6 The rate of heat release of the burning test specimen is measured by an oxygen consumption method. See 5.11.4 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 5.11.5 for further information.

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

1.9 *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.*

1.10 *Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.*

¹ This test method is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.21 on Smoke and Combustion Products.

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1.11 Use the SI system of units in referee decisions; see [IEEE/ASTM SI-10](#). The units given in parentheses are for information only.

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

[D123 Terminology Relating to Textiles](#)

[E84 Test Method for Surface Burning Characteristics of Building Materials](#)

[E176 Terminology of Fire Standards](#)

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

[E1354 Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter](#)

[E1474 Test Method for Determining the Heat Release Rate of Upholstered Furniture and Mattress Components or Composites Using a Bench Scale Oxygen Consumption Calorimeter](#)

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

[E1590 Test Method for Fire Testing of Mattresses](#)

[IEEE/ASTM SI-10 American National Standard for Use of the International System of Units \(SI\): The Modern Metric System](#)

2.2 *ISO Standards:*

[ISO 4880 Burning Behaviour of Textiles and Textile Products—Vocabulary](#)³

[ISO 9705 Fire Tests—Full Scale Room Test for Surface Products](#)³

[ISO 13943 Fire Safety—Vocabulary](#)³

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 Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

2.3 UL Standards:

UL 1056 Fire Test of Upholstered Furniture (withdrawn)⁴

UL 1895 Fire Test of Mattresses (withdrawn)⁴

2.4 CA Standards:

CA TB 129, Flammability Test Procedure for Mattresses for Use in Public Buildings⁵

CA TB 133, Flammability Test Procedure for Seating Furniture for Use in Public Occupancies⁵

2.5 NFPA Standard:

NFPA 289 Standard Method of Fire Test for Individual Fuel Packages⁶

2.6 Other Document:

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 Terminology **E176** and ISO 13943. In case of conflict, the definitions in Terminology **E176** shall prevail. For definitions of terms used in this test method and associated with textile issues refer to Terminology **D123** and ISO 4880. In case of conflict, the definitions in Terminology **D123** shall prevail.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *stacking chair, n*—chair that is intended to be stacked when not in use.

3.2.2 *test specimen, n*—stack of five identical stacking chairs.

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

3.2.4 *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.

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

3.2.6 *upholstery material, n*—the padding, stuffing, or filling material used in a furniture item, 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.

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

⁴ Available from Underwriters Laboratories (UL) (hard copy only), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

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

⁶ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

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

4. Summary of Test Method

4.1 This fire-test-response test method determines a number of fire-test-response characteristics associated with a stack of five stacking chairs, 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.

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 stack of five stacking chairs. 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, that 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: as part of fire hazard assessment calculations and 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 atmospheres, 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. This test method is thus applicable to stacked chairs in public occupancies. Such facilities include, but are not limited to, health-care facilities, old-age convalescent and board and care homes, college dormitories and residence halls, and hotels and motels.

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 high (12 by 8 by 8 ft).

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

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 Studies on the flammability performance of furniture indicate that bench-scale fire tests are useful for preliminary evaluations of component materials for substitution purposes (see Appendix X2).

5.11 *Limitations:*

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

5.11.2 The ignition source in this test method is a flaming source. Moreover, this particular ignition source has been shown to be able to provide a distinction among different kinds of stacked chairs. However, the fraction of actual flaming stacked chair fires occurring with ignitions more or less intense than that used here is not known.

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

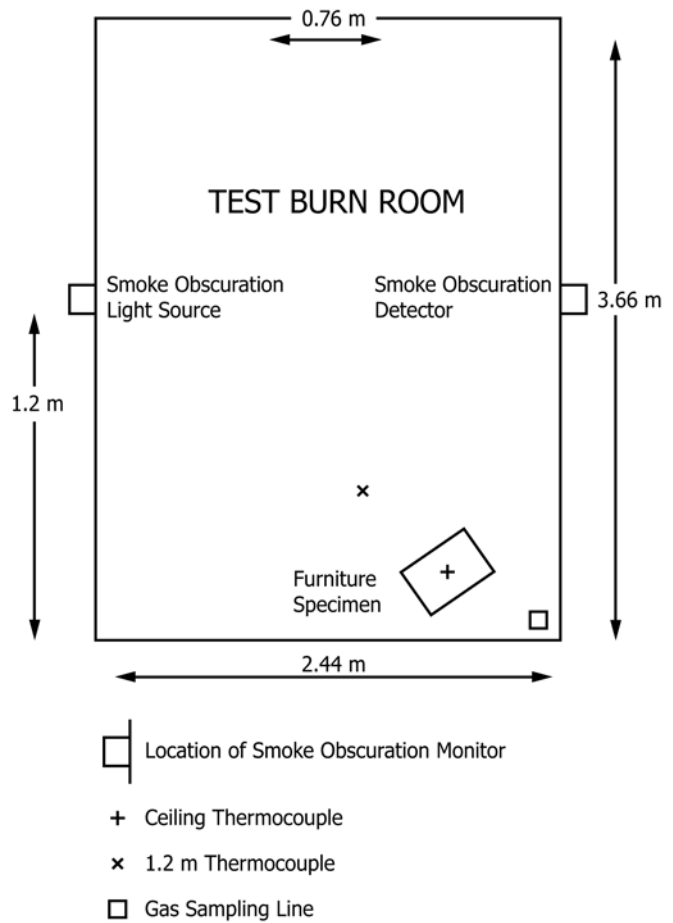
5.11.4 The value of rate of heat release corresponding to the critical limit between propagating fires and nonpropagating fires is not known.

5.11.5 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 high (8 by 12 by 8 ft). 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



NOTE 1—See text for tolerances; room instrumentation is optional.

FIG. 1 Test Room Configuration for Test Configuration A

Annex A1, outside 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 nominal thickness of at least 13 mm (0.5 in.) have been found acceptable. If the thickness of the wallboard used is greater, 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 high (10 by 12 by 8 ft). 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 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 2—Both Type X gypsum wallboard and calcium silicate wallboard with a nominal thickness of at least 13 mm (0.5 in.) have been found acceptable. If the thickness of the wallboard used is greater, it will not affect the results of this test method.

6.1.3 *Open Calorimeter Layout (Test Configuration C):*

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