



Designation: ~~F3214 – 18~~ F3214 – 23

Standard Practice for Characterization of Fire Properties of Materials Specified Seating, Upholstery, and Padding Materials for Vehicles Associated with Amusement Rides and Devices¹

This standard is issued under the fixed designation F3214; 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 practice covers material properties related to flammability, smoke products and heat release rates for materials specified~~describes the required smoldering ignition fire properties for seating, upholstery, and padding materials used for vehicles associated with amusement rides and devices.

~~1.2 This practice includes an annex with an example of an optional open flame test method for padding materials.~~

~~1.3 This practice also defines specific requirements for standardized test methods for determining material properties related to flammability, smoke production and heat release rates for materials specified for vehicles associated with~~contains a non-mandatory appendix with optional guidance for the procedure to follow in the event that an optional fire hazard analysis is to be conducted for vehicles used on amusement rides and devices.

~~1.3.1 In the event that such a fire hazard analysis is to be conducted, it needs to include considerations related to heat release, smoldering, and flaming ignition, flame spread and smoke release.~~

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~~1.3.2 The appendix contains specific recommendations of standardized fire test methods that are suitable (but not required) for determining material properties related to heat release rates, smoldering, and flaming ignition, flammability, and smoke release for materials.~~

~~1.4 This practice defines acceptance criteria for the material properties of flammability, smoke production and heat release rates for seating, upholstery and padding materials specified for vehicles on amusement rides and devices.~~is not a fire test method.

~~1.5 This practice does not require the conduction of a fire hazard analysis.~~

~~1.6 This practice does not address the use of active fire protection measures, such as fire sprinklers, or smoke, fire, or heat detectors.~~

~~1.7 This practice includes an appendix (non-mandatory), which provides additional information (for example, rationale, background, interpretations, drawings, commentary, and so forth) to improve the user's understanding and application of the~~

¹ This practice is under the jurisdiction of ASTM Committee F24 on Amusement Rides and Devices and is the direct responsibility of Subcommittee F24.10 on Test Methods and Component Parts.

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criteria presented in this practice. The appendix information shall not be interpreted as mandatory design criteria. does not address the probability of any fire scenario associated with amusement rides or devices resulting in a hazardous event. Thus, this practice does not address the potential risk associated with any fire scenario. Practice F2291-21 includes general requirement to assess and mitigate hazards for all rides and devices.

1.8 This practice shall not apply to:

1.8.1 Materials specified for amusement rides or devices ~~not associated with the vehicle.~~ other than those associated specifically with the ride vehicle assembly.

1.8.2 Materials used for the construction of facilities.

1.8.3 Fluids and lubricants.

1.8.4 ~~Mats~~ Vehicles used on water slides or other aquatic devices.

1.9 The values stated in SI units, see **IEEE/ASTM SI-10-16**, are to be regarded as standard. The values given in parentheses, if any, after SI units are provided for information only and are not considered standard.

1.10 *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.*

1.11 *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

[D635 Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position](#)

[D1929 Test Method for Determining Ignition Temperature of Plastics](#)

[D2843 Test Method for Density of Smoke from the Burning or Decomposition of Plastics](#)

[D2859 Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials](#)

[D6413/D6413M Test Method for Flame Resistance of Textiles \(Vertical Test\)](#)

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

[E136 Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C](#)

[E162 Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source](#)

[E176 Terminology of Fire Standards](#)

[E648 Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source](#)

[E662 Test Method for Specific Optical Density of Smoke Generated by Solid Materials](#)

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

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

[F747 Terminology Relating to Amusement Rides and Devices](#)

[F2291 Practice for Design of Amusement Rides and Devices](#)

[IEEE/ASTM SI-10-16 American National Standard for Metric Practice](#)

2.2 BSI Standards:³

[BS 5852 Methods of test for assessment of the ignitability of upholstered seating by smouldering and flaming ignition sources \(2006\)](#)

2.3 CPSC Standards:⁴

[16 CFR 1615 Standard for the Flammability of Children's Sleepwear Sizes 0 through 6X \(FF-3-71\) \(2017\)](#)

[16 CFR 1640 Standard for the Flammability of Upholstered Furniture \(2021\)](#)

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 British Standards Institution (BSI), 389 Chiswick High Rd., London W4 4AL, U.K., <http://www.bsigroup.com>.

⁴ Available from U.S. Consumer Product Safety Commission (CPSC), 4330 East West Hwy., Bethesda, MD 20814, <http://www.cpsc.gov>.

2.4 *DIN Standard:*⁵

[DIN 4102 Fire behavior of building materials and building components](#)

2.5 *EN Standards:*⁶

[EN-1021-1 Assessment of the Ignitability of Upholstered Furniture – Assessment of the ignitability of upholstered furniture – Part 1: Ignition source smouldering cigarette \(2014\)](#)

2.6 *ISO Standards:*⁷

[ISO 5659-2 Plastics — Smoke generation — Part 2: Determination of optical density by a single chamber test \(2017\)](#)

[ISO 5660-1 Fire tests – Reaction to fire – Part 1: Rate of heat release from building products – \(Cone calorimeter method\)](#)

[ISO 5660-2 Reaction-to-fire tests – Heat release, smoke production and mass loss rate, Part 2: Smoke production rate \(dynamic measurement\)](#)

2.7 *NFPA Standards:*⁸

[NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems](#)

[NFPA 260 Standard Methods of Tests and Classification System for Cigarette Ignition, Standard Methods of Tests and Classification System for Cigarette Ignition, Resistance of Components of Upholstered Furniture](#)

[NFPA 275 Standard Method of Fire Tests for the Evaluation of Thermal Barriers \(2017\)](#)

[NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth \(2019\)](#)

[NFPA 289 Standard Method of Fire Test for Individual Fuel Packages \(2019\)](#)

[NFPA 701 Standard Methods of Fire Tests for Flame Propagation of Textiles and Films \(2019\)](#)

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminology [F747-21](#).

3.2 See [For 5.1](#) for definitions applicable to this practice and associated with fire issues, refer to Terminology [E176](#) standard: [21a^{e1}](#).

4. Significance and Use

4.1 This practice is intended for use whenever the characterization of fire properties for materials specified requires that seating, upholstery, and padding materials used for vehicles associated with amusement rides and devices are to be determined. The existence of this practice is not intended to imply that there is a requirement to perform specific testing on amusement rides or devices exhibit adequate smoldering ignition properties.

4.1.1 Noncombustible materials are permitted to be used as seating, upholstery, and padding materials, and do not require testing for smoldering ignition.

4.2 The structural components or framing associated with a vehicle or ride are not considered seating, upholstery, or padding materials.

4.3 [Annex A1](#) provides an optional open flame test suitable for seat padding materials.

4.4 [Appendix X1](#) The purpose of this provides non-mandatory guidance for conducting an analysis of fire scenarios associated with the operation of vehicles associated with amusement rides and devices. The conduction of a fire hazard analysis is not a requirement of this practice. The purpose of [Appendix X1](#) practice is to provide designers, engineers, manufacturers, owners, and operators with criteria and references for materials specified for vehicles associated with amusement rides and devices or a major modification fire properties of materials used in vehicles either following construction or major modifications of an amusement ride or device.

4.5 This practice does not address the probability of occurrence of a hazardous event in any fire scenario associated with

⁵ Available from Deutsches Institut für Normung e.V.(DIN), Am DIN-Platz, Burggrafenstrasse 6, 10787 Berlin, Germany, <http://www.din.de>.

⁶ Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, <http://www.cen.eu>.

⁷ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

⁸ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

amusement rides or devices. Thus, this practice does not address the potential risk associated with any fire scenario. Practice F2291-21 includes general requirement to assess and mitigate hazards for all rides and devices.

4.6 The requirements in this practice are not intended to supersede any additional or alternate requirements provided by the authority having jurisdiction.

5. Fire Properties of Seating, Upholstery, and Padding Materials

5.1 ~~When required by this practice, the following definitions shall apply:~~ Seating, upholstery, and padding materials used in vehicles associated with amusement rides or devices shall be resistant to smoldering ignition by complying with any one of the following:

5.1.1 ~~vehicle, n—device that directly carries or conveys person(s):~~

5.1.2 ~~open vehicle, n—vehicle which is open such that smoke and products of combustion will not collect inside the vehicle and riders are directly exposed to the ambient environment through which the ride vehicle passes:~~

5.1.1 ~~unrestrained vehicle, n—Exhibiting a vehicle with restraints conforming to Class 1, 2 or 3~~ Class I classification when tested in accordance with Practice NFPA F2291, and designed in a way that allows riders to leave the vehicle and move away from the ride envelope, allowing the riders to self-evacuate under emergency conditions where practicable. 260 (2019).

5.1.2 ~~restrained vehicle, n—Passing vehicle with restraints conforming to Class 3, 4 or 5 in accordance with Practice F2291, and designed in a way that does not allow riders to leave the vehicle and move away from the ride envelope, precluding the riders from self-evacuation under emergency conditions, where practicable.~~ the requirements of EN 1021 Part 1 (2006).

5.1.3 Passing the requirements of 16 CFR 1640 (2021).

5.1.4 ~~enclosed vehicle, n—Being noncombustible materials.~~ restrained vehicle which is enclosed such that it may be possible for smoke or products of combustion to collect inside of the vehicle compartment and riders are considered restrained.

NOTE 1—Combustible materials used for the production of upholstered furniture sold in the United States are required to comply with 16 CFR 1640. The 16 CFR 1640 smoldering ignition test is similar to the tests in NFPA 260 (2019) and in EN 1021 Part 1 (2006). Therefore, materials complying with any of those tests are commercially available and would not need to be retested to a similar standard.

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5.2 ~~Material Selection:~~ For the purposes of this practice, noncombustible materials are those that pass Test Method E136-22.

5.2.1 Materials should be selected in the following order:

5.2.1.1 ~~Select Noncombustible Materials~~—For the purposes of this practice, non-combustible materials shall be defined as materials that pass Test Method E136.

5.2.1.2 ~~Fire Retardant Materials~~—For the purposes of this practice, fire retardant materials shall be defined as a material so constructed or treated that it will delay ignition, inhibit flame spread or not support flame. The required level of fire retardancy and verification method shall be documented in the ride analysis as specified in Practice F2291.

5.2.1.3 Materials that meet the specific pass/fail criteria as defined in Table 1.

5.2.1 ~~When material selection does not follow the process outlined in Noncombustible materials 5.2.1, or if the criteria in 5.2.1.2 or 5.2.1.3 are not met, materials shall be selected based upon a fire hazard analysis of the material to demonstrate an acceptable level of safety which is supported by the ride analysis.~~ required to be tested for smoldering ignition.

5.2.2 Materials that are inherently noncombustible, such as most metals, are not required to be tested in accordance with Test Method E136-22.

5.3 ~~Materials specified for vehicles associated with amusement rides and devices shall conform to the specific fire tests in Table 1. If specific criteria for a material specified for a vehicle associated with an amusement ride or device is not included in Table 1, refer to 5.2.~~

~~5.4 When a fire hazard analysis is required, test specimen(s) shall be tested in accordance with Test Method E1354 or ISO-5660. Specimens shall be tested with a retainer frame. Test specimens shall be fabricated in the sample size required (100 by 100 mm). Specimens shall be configured to substantially reflect the end-use configuration. The testing shall provide the following data:~~

~~5.4.1 *Time to Ignition, Tig (seconds)*—If Time to Ignition is greater than or equal to the unsupervised ride cycle time, then the material is acceptable and need not meet the other criteria in 5.3. The unsupervised ride cycle time is the time which patrons are out of the direct line of sight of an operator during one ride cycle.~~

~~5.4.2 Maximum 30 s (sliding) average Heat Release Rate, HRR30 maximum (kW):~~

~~5.4.3 Average Smoke Production Rate, SPRave (m²/kg):~~

~~5.4.4 Time to Peak Heat Release Rate, T_p (seconds):~~

~~5.4.5 Peak Heat Release Rate, PHRR (kW/m²):~~

~~5.4.6 Total Heat Released, THR (MJ/m²):~~

~~5.4.7 Average Heat Release Rate 180 s, HRR180s (kW/m²):~~

~~5.4.8 Specific Smoke Extinction Area, SEA (m²/kg):~~

6. Report

6.1 Report the following information for each material assessed for response to smoldering ignition:

6.1.1 Description of the material being tested, including its composition or generic identification, thickness, and any relevant additional details.

6.1.2 The smoldering ignition test used.

6.1.3 If the material was tested to NFPA 260 (2019), whether the material achieved a Class I classification.

6.1.4 If the material was tested to EN 1021 Part 1 (2006) or to 16 CFR 1640 (2021), whether the material complied with the test requirements.

6.1.5 Any relevant test observations.

7. Keywords

7.1 amusement ride; device; fire; fire properties; hazard analysis; heat release; ignition; smoke release; smoldering

ANNEX

(Mandatory Information)

A1. OPEN FLAME TEST FOR PADDING MATERIALS

A1.1 Fire policy caveats, associated with this annex:

A1.1.1 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.

A1.1.2 Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.

A1.2 Summary of Test Method—The vertical flame test of padding materials is used to determine the flame propagation of paddings in the vertical orientation. The small open flame ignition source represents a match, candle, or cigarette lighter or similar size ignition source.

NOTE A1.1—This test method is based on the open flame test in the 2000 edition of the CA Technical Bulletin 117, “Requirements, Test Procedures, and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstery Furniture.”

A1.3 A small open flame is applied to the lower edge of the test specimen. The burning of the test specimen is observed, and the char length and after-flame times are recorded and averaged, along with any flaming melts or drips.

A1.4 Conditioning—Condition test specimens prior to the test for a minimum of 24 ± 1 h at 70 ± 5 °F and less than 55 % relative humidity. If conditions in the test area are not the same as in the conditioning area, tests shall begin within 10 ± 1 min of removal from conditioning area.

A1.5 Test Apparatus:

A1.5.1 Gas Flame Ignition Source—The burner shall have a tube of 11 ± 0.5 mm (0.43 ± 0.02 in.) inside diameter. The input line to the burner shall be equipped with a needle valve. It shall have a variable orifice to adjust the height of the flame. The burner shall be equipped with an adjustable stop collar, to allow it to be positioned quickly under the test specimen. The burner shall be connected to the gas source by rubber or other flexible tubing. The gas used shall be methane, of at least 97 % purity. The flow rate of methane shall be 45 ± 2 mL/min ($1.6 \pm 0.1 \times 10^{-3}$ ft³/min) at 23 ± 2 °C (73 ± 4 °F), which produces a flame height of approximately 38 mm (1 ½ in.) (measured from the center end of the burner tube when held horizontally and the flame allowed to burn freely in air).

A1.5.2 Test Chamber—The test chamber shall be a steel cabinet with inside dimensions of approximately 32.9 cm ($12 \frac{15}{16}$ in.) wide, 32.9 cm ($12 \frac{15}{16}$ in.) deep, and 76.2 cm. (30 in.) high. It shall have a frame which permits the suspension of the specimen holder over the center of the base of the cabinet at such a height that the bottom of the specimen holder is 1.7 cm ($\frac{3}{4}$ in.) above the highest point of the barrel of the gas burner and perpendicular to the front of the cabinet. The front of the cabinet shall be a close-fitting door with a glass insert to permit observation of the entire test. The cabinet floor shall be permitted to be covered with a removable noncombustible surface, whose length and width are approximately 2.5 cm (1 in.) less than the cabinet floor dimensions. The test chamber to be used in this test method is illustrated in Fig. A1.1.

NOTE A1.2—This test chamber is the one described in 16 CFR 1615, Standard for the Flammability of Children’s Sleepwear Sizes 0 through 6X (FF-3-71) (2017).

A1.5.3 Specimen Holder—A stainless-steel specimen holder fabricated in accordance with Fig. A1.2 shall be used. This holder is designed for testing padding specimens 12 mm (0.5 in.) thick.

A1.5.4 Additional items to be provided:

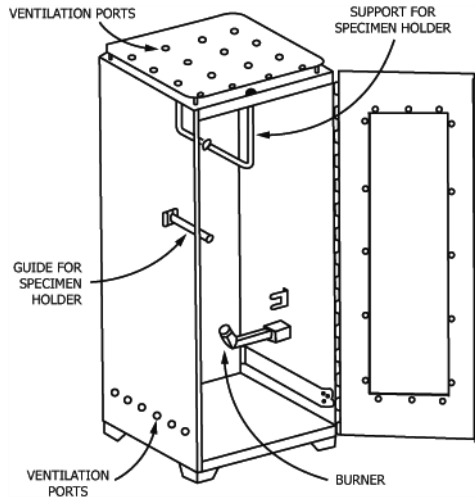


FIG. A1.1 Test Cabinet



FIG. A1.2 Specimen Holder

iTeh Standards
 (https://standards.itih.ai)
 Document Preview

ASTM F3214-23
<https://standards.itih.ai/catalog/standards/sist/74db0627-8001-4a76-a351-7ea649058074/astm-f3214-23>

A1.5.4.1 A stopwatch, accurate to 0.01 s and capable of measuring for at least 1 h.

A1.5.4.2 A steel measure (ruler or tape), graduated to 1 mm (0.04 in.) intervals and at least 300 mm (12 in.) in length.

A1.6 Test Specimens—Cut each test specimen to size: 305 ± 5 mm by 75 ± 5 mm by 12 ± 2 mm (12 ± 0.2 in. by 3 ± 0.2 in. by ½ ± 0.08 in.). Specimens less than 12 mm (½ in.) in thickness shall be permitted to be used if the full 12 mm thickness is not available.

A1.7 Test Procedure:

A1.7.1 Age each test specimen in a forced air circulating oven for 24 ± 1 h at 104 ± 2 °C (220 ± 5 °F), suspending specimens so that they do not contact each other. Then remove all samples from the oven and suspend on a conditioning rack for 24 ± 1 additional hours, before testing.