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Standard Specification for Flame-Resistant Materials Used in Camping Tentage¹

This standard is issued under the fixed designation D 4372; 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 specification covers the evaluation of the flame resistance of fabric and other pliable materials used in camping tentage.

1.2 It provides for certification of materials by suppliers and for labeling programs to caution the user against actions detrimental to flame-retardant treated fabrics. It also facilitates the identification of tentage as being constructed of flame-resistant materials, and it identifies the manufacturer.

1.3 This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.

1.4 The following precautionary caveat pertains only to the test method portion, Sections 8 and 9, of this specification:

1.5 *This standard does not purport to address all of the safety problems, 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:

D 123 Terminology Relating to Textiles²

D 1776 Practice for Conditioning Textiles for Testing²

D 4391 Terminology Relating to the Burning Behavior of Textiles³

G 23 Test Method for Measuring Humidity with a Psychrometer (The Measurement of Wet-Bulb and Dry-Bulb Temperatures)⁴

3. Terminology

3.1 Definitions:

3.1.1 *after-flame time, n*—the length of time for which a material continues to flame after the ignition source has been removed.

3.1.2 *camping tentage*—any portable temporary shelter or

structure designed to protect persons from the elements, all or a portion of the covering of which is made of fabric or other pliable materials.

3.1.2.1 *Discussion*—The term “camping tentage” includes but is not limited to; camping tents, play tents, recreational vehicle awnings, dining flies, and canopies, fabric screen houses, add-a-rooms, and ice fishing tents.

3.1.3 *flame resistance, n*—the property of a material whereby flaming combustion is prevented, terminated, or inhibited following application of a flaming or nonflaming source of ignition, with or without subsequent removal of the ignition source.

3.1.3.1 *Discussion*—Flame resistance can be inherent property of the basic material or product, or it may be imparted by specific treatment. The degree of flame resistance exhibited by a specific material during testing may vary with different test conditions.

3.1.4 *flame resistant, adj*—having flame resistance.

3.1.4.1 *Discussion*—“Flame resistant” is the mandated description for certain products that meet established conformance standards or specifications when the product is tested by a specific method. Where no conformance standards exist, “flame resistant” is a relative term and is used to compare one material to another.

3.1.5 *glow, n*—visible, flameless combustion of the solid phase of a material.

3.1.5.1 *Discussion*—A solid may both glow and give off combustibles that burn in the gas phase (that is, flame) but the two are not necessarily interdependent. Aspects of glow not involving combustion are defined in dictionaries of general terms.

3.1.6 For definitions of terms relating to burning behavior, refer to Terminology D 4391. For definitions of other textile terms used in this specification, refer to Terminology D 123.

3.2 Description of Terms Specific to This Standard:

3.2.1 *flooring materials*—any pliable planer structure used as a base surface in camping tentage, but excluding such things as rugs or carpets placed in the tent that are not integral parts of the item.

3.2.2 *wall and top material*—any pliable planer structure used as a nonbase surface in camping tentage including roofs, sides, windows, screens, doors, awnings, flies, and canopies.

4. Physical Requirements

4.1 *Flame Resistance of Flooring*—When subjected to the test described in Section 8, no specimen from a sample unit of flooring material shall be damaged within 1.0 in. (25 mm) of the edge of the hole in the flattening frame. This requirement includes specimens that were unattached and

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² Annual Book of ASTM Standards, Vol 07.01.

³ Annual Book of ASTM Standards, Vol 07.02.

⁴ Annual Book of ASTM Standards, Vol 06.01.

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TABLE 1 Damaged Length

Untreated Weight of Material Being Tested, oz/yd ² (g/m ²)	Maximum Average Damaged Length for Sample Unit, in. (mm)	Maximum Damaged Length for an Individual Specimen in. (mm)
Over 10 (340)	4.5 (114)	10.0 (250)
Over 8 but not over 10 (270 to 340)	5.5 (139)	10.0 (250)
Over 6 but not over 8 (200 to 270)	6.5 (165)	10.0 (250)
Over 4 but not over 6 (140 to 200)	7.5 (190)	10.0 (250)
Over 1.5 but not over 4 (50 to 140)	8.5 (216)	10.0 (250)
Not over 1.5 (5)	9.0 (241)	10.0 (250)

unweathered, specimens that were leached but unweathered, and specimens that were weathered but unleached.

4.2 Flame Resistance of Walls and Tops—When subjected to the test described in Section 9, no specimen from a sample unit of wall or top materials shall have an after-flame time of more than 4 s; the average after-flame time for all specimens in a sample unit shall not exceed 2 s. The damage length (distance from the bottom of the specimen to a point above which all materials is sound) for the sample unit and individual specimens shall not exceed the values shown in Table 1. Portions or residues that break or drip from the test specimens shall not continue to flame after they strike the burner platform. This requirement includes specimens that were unleached and unweathered, specimens that were leached but unweathered, and specimens that were weathered but unleached.

5. Conditioning

5.1 Flame tests shall be performed under or upon immediate removal from standard atmospheric conditions and on specimens in moisture equilibrium under standard atmospheric conditions, as follows:

5.1.1 The standard atmospheric conditions for testing textiles are 65 ± 2 % relative humidity at a temperature of $70 \pm 2^\circ\text{F}$ ($21.1 \pm 1^\circ\text{C}$).

5.1.2 Moisture equilibrium is considered to have been reached when, after free exposure of the material to air in motion controlled at standard atmospheric conditions given in 5.1.1, the change in mass of successive weighings made at intervals of 1 h is no greater than 0.25 %.

5.2 In the event of disputes concerning the results of tests that may be affected by the moisture content, the material shall be preconditioned by being brought to moisture equilibrium with an atmosphere having a relative humidity of not over 10 % and a temperature not over 125°F (52°C) as directed in 5.1.2. The material shall then be brought to moisture equilibrium under the conditions given in 5.1.1 and 5.1.2 and then tested.

6. Specimen Preparation and Procedure for Leaching

6.1 Test Specimen—Leach 4 specimens of flooring material per sample lot prior to testing. Handle specimens of wall and top materials in a similar manner.

6.1.1 Flooring Material Dimensions—Each test specimen shall be a 9 by 9 $\pm \frac{1}{16}$ in. (230 by 230 ± 2 mm) section of the flooring material to be tested.

6.1.2 Wall and Top Materials Dimensions—Each test specimen shall be rectangles of cloth $2\frac{3}{4}$ by $12 \pm \frac{1}{16}$ in. (70 by 305 ± 2 mm) with the long dimension parallel to either warp or filling directions of the material.

6.2 Apparatus:

6.2.1 Water Container or Tank, of such shape and size that the specimen can be submerged therein with all surfaces of the specimen having full access to the water. For cloth specimens the container shall allow not less than $\frac{1}{2}$ gal (1.89 L) of water for each square foot (0.093 m²) of specimen. The water shall be changed by a continuous flow or by emptying and refilling so that there shall be at least six complete changes of water in a 72 h period.

6.2.2 Means of Maintaining Water, at a temperature of 60 to 70°F (15.5 to 21°C) and at a pH of 6.0 to 8.0 during the test.

6.2.3 Means for Holding the Specimen, submerged throughout the leaching period.

6.3 Procedure—Immerse the specimens in water at a temperature of 60 to 70°F (15.5 to 21°C) and at a pH of 6.0 to 8.0 for 72 h. Prior to further testing, remove the specimen, air-dry, and bring to standard atmospheric conditions for testing textiles.

7. Specimen Preparation and Procedure for Accelerated Weathering

7.1 Test Specimen—Weather 4 specimens of flooring material per sample lot prior to testing. Handle specimens of wall and top materials in a similar manner.

7.1.1 Flooring Material Dimensions—Each test specimen shall be a 9 by 9 $\pm \frac{1}{16}$ in. (230 by 230 ± 2 mm) section of the flooring material to be tested.

7.1.2 Wall and Top Material Dimensions—Each test specimen shall be rectangles of cloth $2\frac{3}{4}$ by $12 \pm \frac{1}{16}$ in. (70 by 305 ± 2 mm) with the long dimension parallel to either the warp or filling directions of the materials.

7.2 Apparatus:

7.2.1 Vertical Carbon Arc, mounted at the center of a vertical cylinder. The arc shall be designed to accommodate either two or three pairs of carbons but shall burn only one pair at a time, automatically transferring from one pair to another as the carbons are consumed. The carbons shall be Sunshine-cored and coppercoated, No. 22 for the upper pair and No. 13 for the lower pair. The arc shall be operated on 60 A and 50 V across the arc for alternating current and on 50 A and 60 V across the arc for direct current.

7.2.2 Rotating Rack, with holder in which the specimens are suspended vertically and normally to radiation from the arc with the center of the face of the specimen at a radial distance of approximately 18 in. (457 mm) from the arc.

7.2.3 Water-Spray Nozzles, mounted horizontally (the water-spray assembly vertically) in the test chamber inside the specimen rack and so placed that the water shall strike the specimens evenly over their entire length in the form of a fine spray in sufficient volume to cover specimens immediately on impact. The apparatus shall be so operated that the specimens are exposed to successive cycles of 102 min of light without spray and 18 min of light with spray.

7.2.4 Means for Maintaining the Required Temperature of Water, in the spray.

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7.2.5 Means for Maintaining the Required Pressure of Water, entering the spray.

7.2.6 Means for Delivering the Required Quantity of Water, per spray nozzle to the specimen.

7.2.7 Exhaust Fan, to ventilate the arc effectively.

7.2.8 Black Panel Thermometer Unit, for measuring the temperature within the machine. This unit shall consist of a metal panel to the base of which is attached the sensitive portion of a bimetallic dial-type thermometer. The entire base is then coated twice with long lasting baked enamel paint.

7.3 Procedure:

7.3.1 Rotate the rack about the arc at a uniform speed of 1 rpm.

7.3.2 The temperature of water in the spray shall be $80 \pm 10^\circ\text{F}$ ($26.7 \pm 5.6^\circ\text{C}$).

7.3.3 The pressure of the water entering the spray shall be 1 to 18 psi (7 to 124 kPa) inclusive.

7.3.4 The quantity of water delivered to the specimen shall be 0.12 to 0.25 gal/h (0.45 to 0.95 dm³/h) per spray nozzle, inclusive.

7.3.5 The black panel temperature at the exposure plane of the specimen rack shall be $155 \pm 10^\circ\text{F}$ ($68 \pm 5.7^\circ\text{C}$) when measured in the following manner: Before reading the temperature, the machine shall be full of specimens and shall be in operation long enough for thermal equilibrium to be established. Mount the black panel in the test-panel rack and take readings at the point where water spray is not striking the panel.

7.3.6 Suspend the specimen on the rotating rack without tension and in such a way that the ends or corners cannot curl. The long dimension of the specimen shall be in the vertical position and shall be indicated on the reverse side of the cloth. No test portion of the specimen shall be over 7 in. (178 mm) above or below the horizontal plane of the arc.

7.3.7 Expose the specimen to normal radiation from the arc for 100 h.

7.3.8 At the end of the exposure period, remove the specimen from the machine, allow to dry, and bring to standard atmospheric conditions prior to further testing.

TEST METHODS

8. Flame Resistance of Flooring Material

8.1 Uses and Significance—This test method simulates the burning characteristics of a flooring of a camping tent, ignited at the center of the material. The slight elevation of the specimen simulates the air pockets found under a tent floor in field conditions. This test method can be used to determine the effects of finishes and other fabric treatment on the burning properties of the materials under controlled laboratory conditions.

8.2 Test Specimens—The test specimens shall be in accordance with 6.1.1 and 7.1.1. Test four individual specimens, no two specimens containing the same warp or fill or filaments. For specimens' condition refer to 4.1 and 4.2.

8.3 Apparatus:

8.3.1 Test Chamber, consisting of an open top hollow cube made of noncombustible material with inside dimensions 12 by 12 by 12 in. (305 by 305 by 305 mm) and a minimum of ¼ in. (6 mm) wall thickness. The flat bottom of the box shall be made of the same material as the sides and

shall be easily removable. The sides shall be fastened together with screws or brackets and taped to prevent air leakage into the box during use.

8.3.2 Supporting Frame—A steel plate, 9 by 9 in. (230 by 230 mm), with a ¼ in. (25 by 25 by 2 mm) thick shim affixed to the underside of each corner is required to support the material above the floor of the chamber during the course of the test. The edge of the supporting frame must be kept clean.

8.3.3 Flattening Frame—A steel plate 9 by 9 in. (230 by 230 mm), ¼ in. (6 mm) thick with an 8-in. (203-mm) diameter hole in its center is required to hold the flooring material flat during the course of the test.

8.3.4 Punch, capable of making a ¼ in. (6 mm) diameter hole in the center of the specimen of flooring material to be tested.

8.3.5 Standard Igniting Source—Methenamine timed burning tablet⁵ or an equal tablet. These tablets shall be stored in a desiccator over a desiccant for 24 h prior to use. (Small quantities of sorbed water may cause the tablets to fracture when first ignited. If a major fracture occurs, any results from that test shall be ignored, and it shall be repeated.)

8.3.6 Hood, capable of being closed and having its draft turned off during each test and capable of removing rapidly the products of combustion following each test. The front or sides of the hood should be transparent to permit observation of the tests in progress.

8.3.7 Mirror, small, mounted above the test chamber at an angle to permit observation of the specimen from outside of the hood.

8.4 Sampling:

8.4.1 Lot Size—A lot is defined as all the fabric in a single manufacturing run of one type of fabric.

8.4.2 Lot Sample—Unless otherwise agreed upon, as when specified in applicable material specifications, randomly take as the lot sample the number of samples defined as follows:

Lot size in yards	Sample size
800 or less	2
801 up to and including 22 000	3
22 001 and over	5

8.4.3 Laboratory Sample—For fabric rolls, take as a laboratory sample a full width swatch 1 m (or 1 yd) long from the outside of each roll in the lot sample after first discarding a complete full width wrap length from the very end of each roll.

8.5 Procedure:

8.5.1 Place the test chamber in the draft-protected environment (hood with draft off) with its bottom in place and the supporting frame centered in the bottom of the chamber, shimmed side down.

8.5.2 Punch a ¼ in. (6 mm) diameter hole in the center of the specimen of flooring material to be tested.

8.5.3 Place the specimen on the supporting frame in the position in which it will be used, exercising care that the

⁵ Methenamine Reagent Table No. 1588, available from Eli Lilly, Inc., 307 East McCarty St. or 740 South Alabama, Indianapolis, IN 46206, has been found satisfactory.