This document is not an ASTM standard and is intended only to provide the user of an ASTM standard an indication of what changes have been made to the previous version. Because it may not be technically possible to adequately depict all changes accurately, ASTM recommends that users consult prior editions as appropriate. In all cases only the current version of the standard as published by ASTM is to be considered the official document.

Designation: ~~D7016/D7016M – 18~~ D7016/D7016M – 20

Standard Test Method to Evaluate Edge Binding Components Used in Mattresses After Exposure to An Open Flame[1]

This standard is issued under the fixed designation D7016/D7016M; 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.

INTRODUCTION

Evaluation of raw material components is a vital and ongoing part of any manufacturing operation, especially when each item can contribute to the technical performance of the final product. Components used in a mattress construction govern the ultimate product performance, its comfort and durability, and also affect its flammability behavior.

The textile components used on the exterior of the mattress—mattress tape and sewing thread—are critical for holding the structure together. These components contribute to the aesthetics of the structure, and they are also susceptible to ignition when exposed to an open flame hazard. Data which indicate that these two components are able to meet minimum performance criteria when exposed to an open flame provides the mattress manufacturers with valuable information.

The value of these data increases when the behavior of components in a small scale test correlate to the behavior of these components in a full scale mattress burn test. The performance criteria require that: *(1)* the components do not support the combustion of the afterflame and, *(2)* that these components demonstrate post flame exposure characteristics which contribute to the retention of structural integrity and prevent seam rupture. This test method can be used as a quality control technique in a supplier quality assurance program.

ASTM D7016/D7016M-20
https://standards.iteh.ai/catalog/standards/sist/63d8d7c4-cdeb-4006-a79f-b458605c0598/astm-d7016-d7016m-20

1. Scope

1.1 This test method measures the flammability characteristics of mattress edge bindings and sewing threads during and after exposure to an open flame ignition source.

1.1.1 This test method is used to evaluate these components either independently or in combination for use in mattresses designed with a fire barrier fabric.

1.1.1.1 The test method is used to evaluate mattress edge binding and sewing thread when the design requires the use of these components.

1.1.2 This test method can be used as a screening test method to determine how sewing thread and mattress edge binding component combinations will perform.

1.2 *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under*

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.52 on Flammability.

Current edition approved ~~Aug. 1, 2018~~Aug. 1, 2020. Published ~~August 2018~~September 2020. Originally approved in 2004. Last previous edition approved in ~~2014~~2018 as D7016~~–14.~~–18. DOI: ~~10.1520/D7016_D7016M-18.~~10.1520/D7016_D7016M-20.

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. United States

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.

1.3 Fire testing of products and materials is inherently hazardous, and adequate safeguards for personnel and property shall be employed in conducting these tests.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system ~~may~~are not ~~be~~necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the ~~other. Combining~~other, and values from the two systems ~~may result in non-conformance with the standard.~~shall not be combined.

1.5 *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.*

1.6 *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

D204 Test Methods for Sewing Threads

D1683 Test Method for Failure in Sewn Seams of Woven Fabrics

D4391 Terminology Relating to The Burning Behavior of Textiles

D7138 Test Method to Determine Melting Temperature of Synthetic Fibers

D7140 Test Method to Measure Heat Transfer Through Textile Thermal Barrier Materials

2.2 *AATCC ~~Method:~~Method*[3]

~~Standard Laboratory Practice for Home Laundering Fabrics Prior to Flammability Testing to Differentiate Between Durable and Non-Durable Finishes~~AATCC M7 Standard Laboratory Practice for Home Laundering Fabrics Prior to Flammability Testing to Differentiate Between Durable and Non-Durable Finishes

2.3 *Federal Standards:*[4]

Code of Federal ~~Regulations—Title 16—Commercial~~ Regulations – Title 16 – Commercial Practices Chapter II—Consumer Product Safety Commission Part 1615 Standard for ~~the~~The Flammability of Children's ~~Sleepwear;~~Sleepwear: Sizes 0 through ~~6X,~~ 6X – Revision of January 1, 2001

Code of Federal ~~Regulations, 16 CFR~~ Regulations – Title 16 – Commercial Practices Chapter II – Consumer Product Safety Commission Part 1633 Standard for the Flammability (Open Flame) of Mattress ~~Sets~~SetsStandard for the Flammability (Open Flame) of Mattress Sets (16 CFR 1633)

2.4 *NFPA Standards:*[5]

NFPA 701 Standard Methods of Fire Tests for Flame Propagation of Textiles and Films (1999 Edition)

2.5 *ISO Standard:*[6]

ISO 17493 Test Method for Convective Heat Resistance Using a Hot Air Circulating Oven

2.6 *Military Standards, Commercial Item Description (CID):*[6]

A-A 55195 Thread Para-Aramid, Spun, Intermediate Modulus; Type I – Normal Performance; Type II – High Performance

A-A 55220 Thread, Para-Aramid, Intermediate Modulus

3. Terminology

3.1 *Definitions:*

3.1.1 *afterflame, n*—persistent flaming of a material after the ignition source has been removed.

---

[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] ~~American Association of Textile Colorists and Chemists, PO Box 12215, Research Triangle Park, NC 27709.Available~~ Available from American Association of Textile Chemists and Colorists (AATCC), P.O. Box 12215, Research Triangle Park, NC ~~27709,~~27709-2215, http://www.aatcc.org.

[4] Government Printing Office, 732 N. Capital Street N.W., Washington, DC 20401.

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

[6] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

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

3.1.3 *char length, n—in measuring flame resistance of textiles*, the distance from the fabric edge, which is directly exposed to the flame to the furthest point of visible fabric damage.

3.1.3.1 *Discussion*—

Char length represents the maximum length of a fabric specimen which can be consumed by a vertical flame.

3.1.4 *fire barrier composite, n*—a multilayer structure which consists of a non-flame resistant fabric that is secured to a flame resistant fabric.

3.1.5 *fire barrier fabric, n*—a single layer structure made of fibers which are either inherently flame resistant or chemically treated to be flame retardant.

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

3.1.7 *ignition, n*—the initiation of combustion.

3.2 For other terms ~~used in this test method related to textiles refer to~~ related to burning behavior of textiles see Terminology ~~D123~~D4391.

3.3 For other terms related to textiles see Terminology D123.

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

4. Summary of Test Method

4.1 Sewing thread is evaluated for break strength before and after exposure to air at an elevated temperature.

4.2 Flame resistance of edge binding tape is determined by char length measurements.

4.3 Specimens of fire barrier fabrics which are secured using inherently flame resistant sewing thread and edge binding tape are exposed to an open flame to determine if seam integrity is maintained.

https://standards.iteh.ai/catalog/standards/sist/e4add7c4-cde6-4006-a79f-b458605c0598/astm-d7016-d7016m-20

5. Significance and Use

5.1 This test method evaluates the edge binding assembly used to determine how well the two external elements along the mattress edge, essentially, the edge tape and FR sewing thread, behave after exposure to an open flame and a hot air oven. These data can be used to confirm that either the mattress or foundation, or both will pass when tested using 16 CFR1633. Evaluation of raw material components is a vital and ongoing part of any manufacturing operation, especially when each item can contribute to the technical performance of the final product.

5.2 ~~This test method measures the behavior of mattress edge binding and sewing thread during~~ Inherently flame resistant (FR) sewing thread is used as shown in Fig. 1, Fig. 2, and ~~after~~Fig. 3 ~~exposure to an open flame ignition source.~~to secure and encapsulate the following elements:

5.2.1 Test method measures the behavior of mattress edge binding tape that joins and closes the assembly of either the mattress or the box spring foundation, or both, and sewing thread during and after exposure to an open flame ignition source.

5.2.2 Test method can be used to determine if the encapsulated multilayer assembly of mattress cover, fire barrier, and foam (when used) work together to prevent entry of open flame to mattress interior.

5.3 Flame resistance of the components used to close the perimeter of a mattress is an important factor in limiting the potential of a bedding fire by preventing the chance for seam failure.

5.4 Data which show a correlation of behavior for both the sewing thread and edge binding tape, when tested as a subassembly

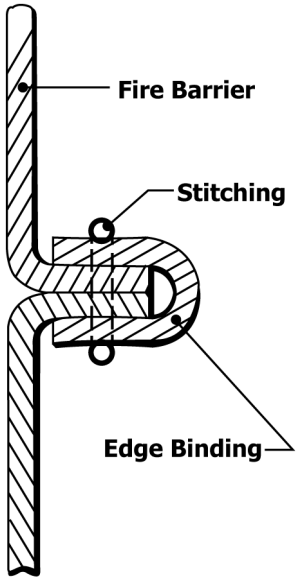
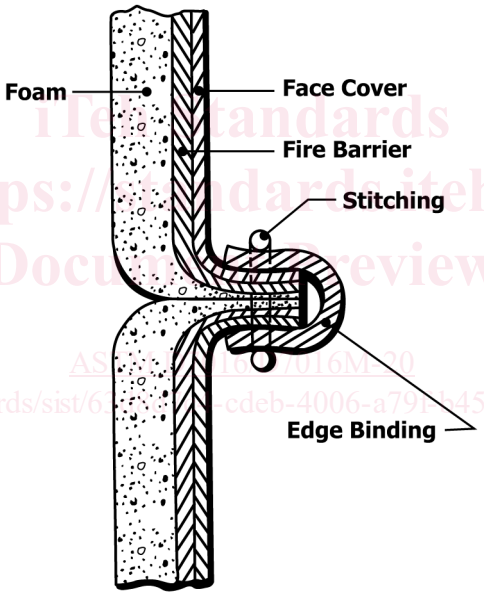


FIG. 21 Mattress Edge Bound ~~Sample—Profile~~Sample – Profile



iTeh Standards
(https://standards.iteh.ai)
Document Preview
ASTM D7016/D7016M-20
https://standards.iteh.ai/catalog/standards/sist/6...cdeb-4006-a79...458605c0598/astm-d7016-d7016m-20

FIG. 52 Before ~~Trimming—Profile~~Trimming – Profile

according to this test method, and also when tested using a full scale composite mattress burn test, such as 16 CFR 1633, can provide the manufacturer with important information. These data can be valuable when selecting components to be used in the manufacture of its products which are designed to use mattress edge binding and sewing thread.

5.5 The level of performance required for these components is *(1)* that they do not support the afterflame, and *(2)* that these components demonstrate post flame exposure characteristics which contribute to retaining the structural integrity of the subassembly.

5.6 In case of a dispute arising from differences in reported results when using this test method for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens which are as homogeneous as possible and which are from a lot of material of the type in question. The test specimens should then be sent to each laboratory for testing. The average results from the two laboratories should be compared using Student's *t*-test and an acceptable probability level chosen by the two parties before testing

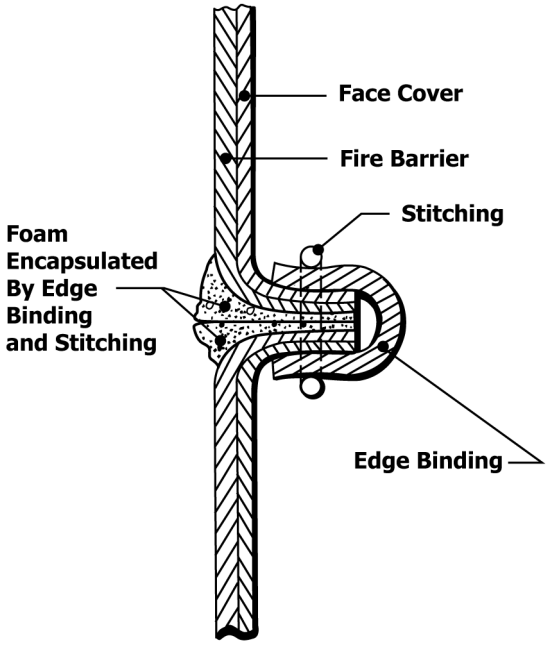


FIG. 63 After ~~Trimming—Profile~~Trimming – Profile

is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results with consideration ~~to the~~ of known bias.

6. Sewing Thread

6.1 Using Test Method D204 determine the average initial break strength of the sewing thread.

6.2 Using Test Method D7138, evaluate the sewing thread to confirm that the fiber does not melt when exposed to a temperature of 285 ± 1°C [550 ± 3°F].

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ASTM D7016/D7016M-20
https://standards.iteh.ai/catalog/standards/sist/63d8d7c4-cdeb-4006-a79f-b458605c0598/astm-d7016-d7016m-20

6.3 After determination that the fiber does not melt, cut six specimens of sewing thread to a length of 460 ± 3 mm [18 ± 0.125 in.] and suspend them in a hot air circulating oven as used in ISO 17493.

6.3.1 Expose specimens for 30 minutes at a temperature of 260 ± 1°C [500 ± 3°F].

6.3.2 Using Test Method D204, confirm that the average break strength after exposure to hot air exceeds 65 % of initial break strength.[7]

7. Edge Binding Tape

7.1 Measure the flame resistance and char length of the edge binding tape using the test procedure noted in Section 1615.4 Code of Federal ~~Regulations—Title 16—Commercial Practices Chapter II—Consumer~~ Regulations –Title 16 – Commercial Practices Chapter II – Consumer Product Safety Commission Part 1615, ~~Standard for The Flammability of Children's Sleepwear; sizes 0 through 6X Revision of January 1, 2001~~ with the following modifications:

7.1.1 Test specimens both as received (unwashed), and after being washed five times in accordance with AATCC ~~Standard Laboratory Practice for Home Laundering Fabrics Prior to Flammability Testing to Differentiate Between Durable and Non-Durable Finishes.~~M7.

[7] The time and temperature requirements of Test Method 1534 were developed using data originally developed by the U.S. Air Force in 1968. These data were used to determine the melting point of synthetic fibers which would be made into yarns for fabrics and sewing threads and then used to manufacture protective clothing worn by military pilots, tank crew personnel, shipboard personnel, and space suits worn by astronauts. The testing threshold used to evaluate fibers was established as a benchmark for a wide array of textile products. Sewing threads which melt when exposed to high temperatures do not demonstrate any retained break strength. Those sewing threads which are able to withstand exposure at this elevated temperature retain measurable strength characteristics between 65 to 85 % of the original break strength.

7.1.2 Cut specimens the full width of the binding used to cover the edges of the mattress to a length of 300 mm [12 in.]. Examples: 22.5 by 300 mm [0.875 by 12 in.]; 31.5 by 300 mm [1.25 by 12 in.]; and 36.5 by 300 mm [1.43 by 12 in.].

7.1.2.1 Apparatus as configured in Section 1615.4 will accommodate the listed edge bindings.

7.1.3 Test ten unwashed specimens and ten washed specimens.

7.1.3.1 Expose each of ten unwashed specimens to a 12 s vertical flame impingement. Specimens shall exhibit a char length no greater than 100 mm [4 in.].

7.1.3.2 Expose each of ten washed specimens to a 12 s vertical flame impingement. Specimens shall exhibit a char length no greater than 125 mm [5 in.].

8. Subassembly

8.1 Select a fire barrier fabric which has been tested using Test Method D7140.[8]

8.1.1 Make samples using the sewing thread shown to comply to Section 5 and edge binding tape shown to comply to Section 6.

8.1.1.1 Select the edge binding tape having the appropriate width to enclose the edge of the two sections.

8.1.2 Join two fire barrier sections. One section shall represent the fire barrier fabric used on the top panel of the mattress; one section shall represent the fire barrier fabric used on the side panel of the mattress.

8.1.2.1 Sew the fabric sections together using the same seam closing techniques used to manufacture mattresses.

8.1.3 Samples measure a minimum of 208 ± 0.50 cm [80 ± 0.75 in.] in width and 50 ± 0.50 cm [20 ± 0.75 in.] in length as shown in ~~Figs. 1 and 2~~Fig. 1 and Fig. 4.

8.2 Cut the samples into specimens for seam testing and open flame resistance testing.

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ASTM D7016/D7016M-20
https://standards.iteh.ai/catalog/standards/sist/63d8d7c4-cdeb-4006-a79f-b458605c0598/astm-d7016-d7016m-20

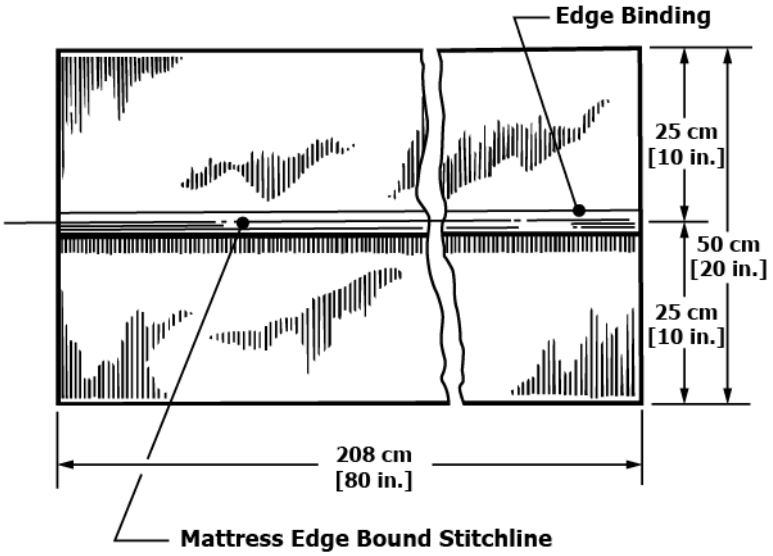


FIG. ~~1~~4 Mattress Edge Bound ~~Sample—Front~~ Sample – Front View

[8] Fire barrier fabrics are made using a variety of technologies. In addition to fabrics made of inherently flame resistant fibers, these structures can be made of multifiber hybrids and also treated fabrics. The fabrics are manufactured as both woven and nonwoven structures. The synergy of the sewing thread and edge binding tape is intended to work in conjunction with every type of fire barrier fabric which can be used to successfully pass the requirements of an open flame test, such as 16 CFR 1633.

8.2.1 For seam strength testing, before exposure to open flame test, cut five specimens in accordance with the requirements of Test Method D1683.

8.2.1.1 Test five specimens and determine average seam break strength.

8.2.2 For open flame resistance testing, cut seven specimens with a vertical dimension of 500 ± 6 mm [20 ± 0.25 in] and a horizontal dimension of 200 ± 6 mm [8 ± 0.25 in.] as shown in Figs. ~~2~~1 and ~~3~~5. The seam with the mattress edge binding should be horizontal and approximately midway between the top and bottom edge.

8.2.3 When evaluating specimens which are made using a fire barrier fabric, dress cover fabric, and foam, remove the foam layer except for that foam which is encapsulated by the edge binding and sewing thread. (See ~~Figs. 4-6~~Fig. 2~~.~~, Fig. 3, and Fig. 6)[9]

8.2.3.1 The perimeter of cut specimens which have an unfinished raw edge shall be finished using the same sewing thread as evaluated in Section 5. The edge finish of the specimen can be completed as noted in Chapter 5 of NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films (1999 Edition), with exception of vertical (fifth) stitch line.

8.3 Measure the open flame resistance of the subassembly using the 45 ± 1 s open flame exposure, of Test Method 1, NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films (1999 Edition) with following modifications:

8.3.1 A photographic, videographic, or digital camera can be used to record the behavior of the sample during the exposure to the open flame.

8.3.2 The mounting of the specimen as specified in Chapter 2 requires that the specimen be suspended from a pin bar near the top of the cabinet.

8.3.2.1 After securing specimen to pin-bar near top of test cabinet, attach a weight, having a mass of 2 kg ± 25 g [70 ± 1 oz], to the portion of the specimen below the seam, approximately 50 ± 6 mm [2 ± 0.25 in.] from the bottom edge. (See Fig. 7.)

NOTE 1—The attached weight keeps the specimen under tension, similar to that demonstrated by a composite structure.

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ASTM D7016-D7016M-20
https://standards.iteh.ai/catalog/standards/sist/63d8d7c4-cd0b-4906-a78f-b458605c0598/astm-d7016-d7016m-20

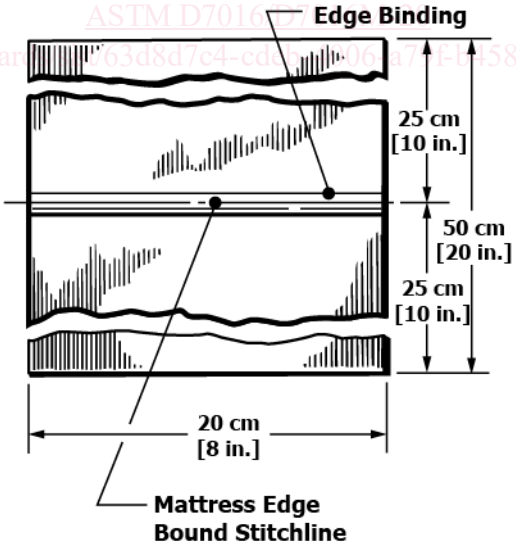


FIG. 3~~5~~ Mattress Edge Bound ~~Specimen—Front~~ Specimen – Front View

[9] In the manufacture of a mattress, the tape edge binding and stitching operations, when properly done by an experienced operator, performs three functions: *(1)* it secures the top or bottom perimeter of the mattress by joining the top panel component and the side panel component of the mattress, *(2)* it encapsulates the foam which is part of these structures, and *(3)* it keeps the fire barrier fabric positioned. A mattress is a "closed unit." As such, a fire barrier acts like a shield to prevent the flame from making contact with the encapsulated foam. Although the tape edge binding and stitching operation can effectively "close" the mattress, the spacing interval between each stitch, creates a potential point of entry for the open flame which can result in the encapsulated foam becoming a fuel source which supports combustion along the row of stitching until it self-extinguishes. Removal of all foam on the backside of the subassembly, except that foam which is encapsulated by the edge binding tape and sewing thread, creates a challenge which is similar to the hazard that these components are expected to overcome in a full scale mattress open flame test.