



Standard Test Method for Smoldering Combustion Potential of Cotton-Based Batting¹

This standard is issued under the fixed designation D5238; 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 test method covers the determination of smoldering combustion potential within cotton-based batting intended for use in mattresses and upholstered furniture. This test method is designed to evaluate batting containing at least 75 % cotton by weight, and it is intended to be used primarily as a quality control tool.

1.2 This test method 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.

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

1.4 Inadequate consideration of a subsystem, such as cotton batting, to resist smoldering is frequently the reason that finished mattress or upholstered furniture systems fail fire and smolder resistance tests. This test method may be used to evaluate this smolder resistance in the subsystem of cotton batting used in such products. The purpose of this test method is to aid end users in better determining the potential of cotton batting components to resist smoldering. It is recommended that those using this test method be familiar with cotton batting production and the use of cotton batting in mattresses and upholstered furniture.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *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.*

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.

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2. Referenced Documents

2.1 ASTM Standards:²

D123 Terminology Relating to Textiles

D1776 Practice for Conditioning and Testing Textiles

D2258 Practice for Sampling Yarn for Testing

D4391 Terminology Relating to The Burning Behavior of Textiles

E176 Terminology of Fire Standards

2.2 Government Standard:

Title 16 CFR Part 1632, Standard for the Flammability of Mattresses and Mattress Pads (FF 4-72 Amended)³

3. Terminology

3.1 *Definitions*—For definitions of terms relating to burning behavior, refer to Terminology D4391. For definitions of other textile terms, refer to Terminology D123.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *batting, n*—a textile filling material consisting of a continuous web of fibers formed by carding, garnetting, air layering, or other means.

3.2.1.1 *Discussion*—In the bedding, furniture, and futon industries, batting is made from a blend of fibers consisting primarily of cotton.

4. Summary of Test Method

4.1 A controlled heat source is positioned between two identical specimens of cotton batting. The heat source and specimens remain undisturbed until the specimens either are consumed or are no longer undergoing smoldering combustion. The resulting outward char distance from the initial heat source is determined.

5. Significance and Use

5.1 This test method provides a means for evaluating the smoldering combustion potential of cotton-based batting for use in mattresses and upholstered furniture. The degree of

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 *Federal Register*, Vol 49, No. 197, Wednesday, October 10, 1984.

correlation between the results of this test of a component material and actual end-use products has not been determined fully.

5.2 In this procedure, the specimens are subjected to one or more specific sets of laboratory test conditions. If different test conditions are substituted or the end-use conditions are changed, this test method cannot predict changes in the fire test response characteristics measured. The results are therefore valid only for the fire test exposure conditions described in this procedure.

5.3 In the case of a dispute arising from differences in the reported test results using this test method for acceptance testing of commercial shipments, the purchaser and the supplier are advised to conduct comparative tests to determine whether a statistical bias exists between their laboratories. Competent statistical assistance is recommended for the investigation of bias. An acceptable probability level is chosen by the two parties before testing begins. As a minimum, a group of test specimens that are as homogeneous as possible and that are from a lot of material of the type in question are taken. The test specimens are then randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories are compared using Student's *t*-test for unpaired data. If a bias is found, either its cause must be determined and corrected, or the purchaser and supplier must agree to interpret future test results in light of the known bias.

6. Apparatus and Materials

6.1 *Balance*, 200-g capacity open pan, with 0.1-g sensitivity.

6.2 *Draft Barrier*, as shown in Fig. 1.

6.3 *Test Room*, draft-protected and equipped with a suitable system for exhausting combustion emissions produced during testing.

6.4 *Heat Source*—Unfiltered cigarettes, each measuring 85 ± 2 mm (3.4 ± 0.1 in.) in length and weighing 1.1 ± 0.1 g.

6.4.1 *Discussion*—The ignition propensity has not been specified, as there is no standard method for measurement. Unfiltered Pall Mall cigarettes have been used by the federal government, testing laboratories and others for a number of years as the typical heat source for smoldering combustion. However, in 2007, cigarette companies, due to changes in fire safety laws, began to switch to “fire-safe” designs with lower ignition propensities. According to research at the National Institute of Standards and Technology (NIST), current “fire-safe” cigarettes do not provide the same ignition propensity as the original Pall Mall, which is still required by government regulation.⁴ An equivalent standard reference material is being developed by NIST.

6.5 *Ruler*—Standard 152-mm (6-in.) ruler.

⁴Gann, R. G., and Hnetkovsky, E. J., “Modification of ASTM E2187 for Measuring the Ignition Propensity of Conventional Cigarettes,” NIST Technical Note 1627, National Institute of Standards and Technology, Gaithersburg, June 2009.

APPENDIX

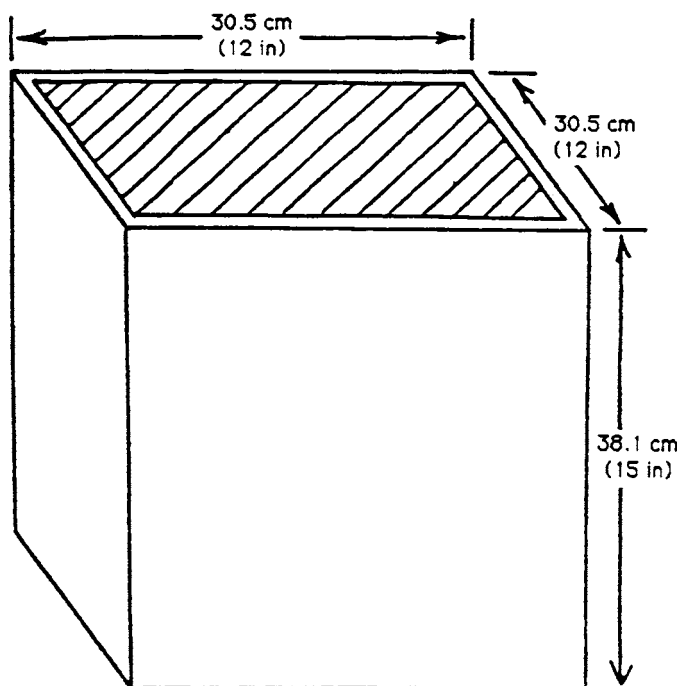


FIG. 1 Draft Barrier

7. Sampling

7.1 *Lot Sample*—Take a lot sample as specified in the applicable material specification, or as agreed upon by the two parties interested in the test results. In the absence of any specification or agreement, take a lot sample as directed in Recommended Practice D2258.

7.2 *Laboratory Sample*—As a laboratory sample for acceptance testing, take at random the number of packages from each primary sampling unit in the lot sample directed in an applicable material specification or other agreement between the purchaser and the supplier, such as an agreement to use Recommended Practice D2258. Sample packages cannot be rewound or transferred to another package.

8. Preparation of Specimens

8.1 Prepare two adjacent $18 \times 18 \pm 1$ -cm ($7 \times 7 \pm \frac{1}{4}$ -in.) specimens of cotton-based batting and one cigarette in triplicate for each test.

8.2 Weigh and record the initial weights of each specimen. Each cotton-based specimen must weigh not less than 54 ± 0.2 g (1.9 oz ± 0.007 oz) and not more than 57 g ± 0.2 g (2 oz ± 0.007 oz).

9. Conditioning

9.1 If the as-received sample has a moisture content above 10 %, follow the preconditioning and conditioning procedures as specified in Practice D1776 prior to testing.

9.2 It has been found that a moisture content of 10 % or less in the sample does not materially affect the results of this test method, and therefore no preconditioning or conditioning is required.

10. Procedure

10.1 On a wooden sheet having dimensions of 20 × 20 × 1.3 cm (8 × 8 × 0.5 in.), position one specimen as shown in Fig. 2.

10.2 *Test Start-Up:*

10.2.1 Within 5 min (± 1 min) of the initial weighing, light one cigarette, centering it on the surface of the positioned specimen, and record the time.

10.2.2 As soon as possible, cover the specimen and heat source with the second specimen. Make sure that both specimens are evenly aligned vertically.

10.2.3 Center the draft barrier, with open top and bottom, directly around the aligned test specimens.

10.2.4 Smoldering combustion is allowed to continue until the cigarette is burned completely. Do not disturb the specimens until combustion is completed.

NOTE 1—Smoke from the cigarette is generally not a visible indicator of when combustion has ceased. As a guideline, the test is generally complete within 30 min, but it is critical to not disturb the specimen as long as combustion is occurring. Waiting longer does not impact the char length once the cigarette has ceased burning, so longer waiting times are not an issue.

10.2.4.1 If the test specimens become engulfed in open flames, extinguish the burning specimens and record the results of the test as a failure.

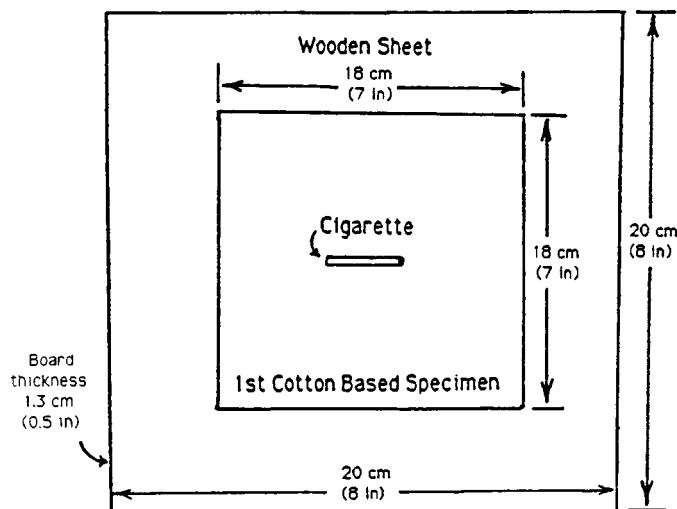


FIG. 2 Positioned Specimen

10.2.5 Carefully remove the top specimen, exposing the charred area.

10.2.6 With a ruler, measure and identify the greatest char distance from the edge of the cigarette ash outward along the upper surface of the lower specimen and the lower surface of the top specimen. Outward measurements are taken no farther than the point at which black char ends and brown discoloration begins. Record this char distance to the nearest 1 mm or 1/16 in.

11. Report

11.1 A char length measurement of any specimen exceeding 25 ± 1 mm (1 ± 0.06 in.) is identified as a failure.

11.2 If two or more of the three tests result in failure, the product is identified as failing the criterion for smoldering combustion.

11.3 If only one specimen fails, a referee test is allowed, in which the entire test is run again in triplicate, whereby all three specimens must pass in order for the product to be identified as passing the criterion for smoldering combustion.

12. Precision and Bias

12.1 *Interlaboratory Test Data*—An interlaboratory test was run in 1987 and 1988 in which replicate samples from three cotton-based batting manufacturers were sent to seven laboratories. Each laboratory used one operator who tested three specimens of each cotton-based sample.

12.1.1 *Within-Laboratory Precision*—The within-laboratory precision, at the 95 % probability level, of the average of three replicates is expected to be within ± 4.6 % of the average char length.

12.1.2 *Between-Laboratory Precision*—The precision, at the 95 % probability level, of the difference between seven laboratories, each making three measurements, is expected to be within ± 8.3 % of the average char length.

12.2 *Bias*—The bias of this method for testing smoldering combustion of cotton-based batting is dependent upon the weighing of the specimen and the precision of the measurement of the char length upon completion of the test. Within these limitations, the procedure in Test Method D5238 for determining the smoldering combustion potential of cotton-based batting has no known bias.

13. Keywords

13.1 batting; char; cotton; fire; mattresses; smoldering combustion; test method; upholstering furniture.

APPENDIX**(Nonmandatory Information)****X1. COMMENTARY**

X1.1 This commentary has been prepared to provide the user of this test method with background information on its development and use.

X1.2 Over the past 20 years, several test methods have been developed that address the fire and smoldering combustion potential of end-use products such as mattresses and upholstered furniture. Products that have not been found to be in compliance with the pass/fail criteria of these test methods may have serious legal ramifications to the producers of mattresses and upholstered furniture. This is particularly true for mattresses that must comply with Federal Regulation 16 CFR

1632. The ability to perform favorably with respect to fire and smoldering combustion is primarily dependent on the integrity of the component materials within these end-use products. A need was defined by end users and cotton batting manufacturers to better qualify the integrity of the component filling material prior to the assembly of end-use products. This voluntary test method was intended to aid in minimizing the possibility of fire and smoldering combustion failures in mattresses and upholstered furniture products. The test method additionally provides a suitable means for end users to qualify the fire and smolder potential of components prior to the assembly of their products.

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