

TECHNICAL BULLETIN



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FLAMMABILITY TESTING: A REVIEW BY COTTON INCORPORATED

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INTRODUCTION

This is a brief guide to the flammability tests that are widely practiced in the United States. For compliance with the individual standards, detailed copies should be obtained from applicable sources and tests made under stated conditions with proper test equipment.

For our review, tests are described under two categories.

1. Flammable Fabrics Act Standards - mandatory federal standards for different product categories.
2. Miscellaneous - including voluntary industry standards.

Many individual states have their own standards and tests. These are not included in this document, but most such tests are based on ones described herein.

FLAMMABLE FABRICS ACT STANDARDS

In 1953, the Flammable Fabrics Act was passed to regulate the manufacture of highly flammable clothing under the jurisdiction of the Federal Trade Commission. It was amended in 1967 to permit regulation of a wider range of clothing and interior furnishings. In 1972, the Consumer Product Safety Act was passed. This act created the Consumer Product Safety Commission (CPSC) with broad jurisdiction over product safety and transferred responsibilities under the Flammable Fabrics Act to the CPSC.

16 CFR¹ Part 1610 - Standard for the Flammability of Clothing Textiles (CS 191-53)

This standard became effective in 1954, when made mandatory by the Flammable Fabrics Act. It established a minimum flammability standard for wearing apparel, excluding interlining fabrics and certain hats, gloves and footwear. It was designed to keep highly flammable apparel out of the marketplace.

The test requires a fabric specimen (2" x 6") to be placed in a holder at a 45° angle and exposed to flame near the lower edge for 1.0 second. The flame should not spread up the length of the specimen in less than 3.5 seconds for non-raised surface fabrics or less than 4.0 seconds for raised surface fabrics when the base fabric ignites or fuses. The fabric specimens must also be tested after "refurbishing" according to a specific series of dry cleaning and laundering procedures. ASTM D1230 (Standard Test Method for the Flammability of Apparel Textiles) is a similar test method.

¹CFR= Code of Federal Regulations

16 CFR Part 1615 - Standard for the Flammability of Children's Sleepwear: Sizes 0 Through 6X (FF 3-71)

The children's sleepwear standard became effective in 1972 and includes any garment (sizes 0-6X) worn primarily for sleeping or activities related to sleeping such as nightgowns, pajamas, robes, etc., but excludes diapers and underwear. Fabrics intended or promoted for children's sleepwear must also meet this standard.

The test requires five specimens to be conditioned, individually hung, vertically, in a cabinet and exposed to a gas flame along the bottom edge for 3.0 seconds. The specimens cannot have an average char length greater than seven inches; no single specimen can have a char length of ten inches. This test is also required after the fabric or garment has been washed 50 times according to a specific procedure. ASTM D6545 (Standard Test Method for the Flammability of Textiles Used in Children's Sleepwear) is similar to 16 CFR1615.

16 CFR Part 1616 - Standard for the Flammability of Children's Sleepwear: Sizes 7 through 14 (FF 5-74)

This standard became effective in 1974 and includes the same clothing articles covered in Part 1615 in sizes 7-14.

The test specified in this standard is identical to the test in Part 1615. ASTM D6545 (Standard Test Method for the Flammability of Textiles Used in Children's Sleepwear) is similar to 16 CFR1616.

16 CFR Part 1630 - Standard for the Surface Flammability of Carpets and Rugs (FF 1-70)

This standard became effective in 1971 and includes carpets or rugs which have one dimension greater than six feet and a surface area greater than 24 square feet, but excludes linoleum, vinyl tile and asphalt tile.

In this test, eight (nine inch square) specimens are conditioned and individually exposed to a burning methenamine tablet, which is placed on the center of each specimen. The test requires that seven of the eight specimens must not char more than seven inches in any direction. If a flame retardant has been used, testing only takes place after washing as specified.

16 CFR Part 1631 - Standard for the Surface Flammability of Small Carpets and Rugs (FF 2-70)

This standard also became effective in 1971 and includes carpets with a surface area less than 24 square feet and no dimension greater than six feet, but excludes linoleum, vinyl tile and asphalt tile.

The test requires the same burning methenamine tablet test, which is used for large carpets and rugs. As an alternative to compliance, the standard provides for use of a warning label.

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

This standard became effective in 1973 and includes ticking filled with a resilient material intended or promoted for sleeping upon, including mattress pads. Pillows, boxsprings, and upholstered furniture are excluded.

The test requires that, after conditioning, the surfaces be exposed to a total of nine burning cigarettes on the bare mattress or pad and the char length on the mattress surface must not be more than two inches in any direction from any cigarette. Tests are also conducted with nine burning cigarettes placed between two sheets. Mattress pads that are treated with flame retardant chemicals must be laundered as specified before testing.

MISCELLANEOUS TESTS

ASTM D4151 Standard Test Method for Flammability of Blankets

The purpose of this test is to determine the ignitability of blankets. It is the result of industry anticipating mandatory standards and implementing voluntary standards.

The test requires ten conditioned specimens (2.75" x 2.75", positioned horizontally) to be subjected individually to a standard flame impinged on their surface for 1.0 second. The blanket passes if no individual specimen ignites, surface flashes, or burns enough to char or burn a paper monitor bordering the area.

ASTM D2863 Standard Test Method for Measuring Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index) (LOI)

This test provides a precise method for determining a numerical measure of the relative flammability of plastics, textiles and other materials. ASTM defines Oxygen Index to be the minimum concentration of oxygen (expressed as a percent by volume), which will just support combustion of a material in a mixture of oxygen and nitrogen.

ASTM F1060 Standard Test Method for Thermal Protective Performance (TPP) of Materials for Protective Clothing for Hot Surface Contact

This test rates textile materials for thermal resistance and insulation. Heat is applied to one side of the material, and the heat transfer through the material is measured. The thermal protective performance value is defined as the predicted time to second-degree burn in seconds multiplied by the heat flux.

NFPA 701 Standard Methods of Fire Tests for Flame Propagation of Textiles and Films - Small Scale

This test is used to determine if flame-resistant materials are comparatively difficult to ignite and

may propagate flame beyond the area exposed to the ignition source. It applies to flame resistant materials, which are used extensively in the interior of buildings and transportation, in protective clothing, and for tarpaulins and tents.

This test requires ten specimens (3.5" x 10") to be individually hung, vertically, in a cabinet and exposed to a gas flame (Bunsen or Tirrill burner at a 25° angle from vertical) for 12.0 seconds. ASTM D6413 (Standard Test Method for Flame Resistance of Textiles (Vertical Test)) is a similar test method.

UFAC Fabric Classification Test

The Upholstered Furniture Action Council (UFAC) Fabric Classification Test determines the ignition resistance of upholstered furniture when exposed to a lighted cigarette. It is also the result of industry anticipating mandatory standards and implementing voluntary standards. Cover fabrics are divided into two categories of ignition propensity. Fabrics with vertical char of less than 1.75 inches are Class I. All other fabrics are Class II.

California Technical Bulletin 133 – Flammability Test Procedure of Upholstered Furniture

TB 133 is a full-scale fire test for furniture manufactured for use in certain public buildings in California. The test measures the amount of heat generated and the rate at which it is generated. In addition, smoke opacity, carbon monoxide generation and temperature are measured in the test room, as well as the weight loss of the product being tested.

Many states are adopting TB 133 as a seating standard for public buildings, but the specific types of buildings and the definition of public buildings may vary from state to state. E1537 (Standard Test Method for Fire Testing of Upholstered Furniture) is similar to TB 133.

California Technical Bulletin 117 – Requirements, Test Procedures, and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture

TB 117 is a group of bench-scale tests designed to assess the flammability of various components of upholstered furniture - fabric, batting, foam, etc. Upholstered furniture that is sold in California must be tested according to each method that applies, depending on the type of filling. Some other states have adopted similar requirements.

These test methods are undergoing revisions designed to make the standard more stringent. A small-scale composite test similar to British Standard 5852 is also being incorporated into the test.

California Technical Bulletin 121 – Flammability Test Procedure for Mattresses for Use in High Risk Occupancies

This full-scale test procedure is designed to test mattresses for use in occupancies in California

that are identified as high risk. Temperature, carbon monoxide concentration, and mattress weight loss are monitored. Newspaper in a waste can is used as a large-scale ignition source. This test method is not applicable to ignition of mattresses by cigarettes. ASTM F1550 (a standard test method for furnishings in correctional facilities) is similar to TB 121.

California Technical Bulletin 129 – Standard Method for Room Fire Testing of Mattresses for Use in Public Occupancies

The purpose of TB 129 is to determine the burning behavior of mattresses used in public occupancies in California. It is applicable only to the finished article of mattresses and other complete bedding systems. A propane-gas T-burner is used to ignite the sample. Measurements to be made include rate of heat and smoke release, total amount of heat released, rates and concentrations of carbon oxides released, rates and amounts of mass of specimen lost. This test method is not applicable to ignition of mattresses by cigarettes. Many other states have adopted this standard, but may define public occupancy differently. ASTM E1590 (Standard Test Method for Fire Testing of Mattresses) is similar to TB 129.

California Technical Bulletin 603 – Requirements and Test Procedure for Resistance of a Mattress/Box Spring Set to a Large Open-Flame

TB 603 is a full-scale test to determine the burning behavior of mattress/foundation sets intended for any use by measuring the rate of heat release, which quantifies the energy generated by the fire. TB 603 utilizes a pair of propane burners, designed to mimic the heat flux levels and durations imposed on a mattress and foundation by burning bedclothes. These burners impose differing fluxes for differing times on the mattress top and on the sides of the mattress/foundation. This protocol does not apply to smoldering ignition by cigarettes.

A bench-scale test method for filled bedclothing (TB 604) is also under development.

The statements, recommendations and suggestions contained herein are based on experiments and information believed to be reliable only with regard to the products and/or processes involved at the time. No guarantee is made of their accuracy, however, and the information is given without warranty as to its accuracy or reproducibility either express or implied, and does not authorize use of the information for purposes of advertisement or product endorsement or certification. Likewise, no statement contained herein shall be construed as a permission or recommendation for the use of any information, product or process that may infringe any existing patents. The use of trade names does not constitute endorsement of any product mentioned, nor is permission granted to use the name Cotton Incorporated or any of its trademarks in conjunction with the products involved.

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- Agricultural research leads to improved agronomic practices, pest control, and fiber variants with properties required by the most modern textile processes and consumer preferences. Ginning development provides efficient and effective machines for preservation of fiber characteristics. Cottonseed value is enhanced with biotechnology research to improve nutritional qualities and expand the animal food market.
- Research in fiber quality leads to improved fiber testing methodology and seasonal fiber analyses to bring better value both to growers and then mill customers.
- Computerized fiber management techniques result from in-depth fiber processing research.
- Product Development and Implementation operates programs leading to the commercialization of new finishes and improved energy and water conserving dyeing and finishing systems. New cotton fabrics are engineered -- wovens, circular knits, warp knits, and nonwovens -- that meet today's standards for performance.
- Technology Implementation provides comprehensive and customized professional assistance to the cotton industry and its customers -- textile mills and manufacturers.
- A fiber-to-yarn pilot spinning center allows full exploration of alternative methods of producing yarn for various products from cotton with specific fiber profiles.
- The Company operates its own dyeing and finishing laboratory, knitting laboratory, and a laboratory for physical testing of yarn, fabric, and fiber properties including High Volume Instrument testing capable of measuring micronaire, staple length, strength, uniformity, color, and trash content.

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