



## Standard Test Method for Flammability of Apparel Textiles<sup>1</sup>

This standard is issued under the fixed designation D 1230; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers the evaluation of the flammability of textile fabrics as they reach the consumer for or from apparel other than children's sleepwear or protective clothing.

1.2 *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.*

NOTE 1—This test method is *not* identical to 16 CFR Part 1610, Flammability of Clothing Textiles. Consumer Product Safety Commission regulations require that fabrics introduced into commerce meet the requirements of 16 CFR Part 1610.

1.3 *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.* Specific precautionary information is found in 9.2.1.3.

1.4 The values stated in SI units are to be regarded as the standard; inch-pound units are provided for information only.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

D 123 Terminology Relating to Textiles<sup>2</sup>

D 484 Specification of Hydrocarbon Drycleaning Solvents<sup>3</sup>

D 2724 Test Methods for Bonded, Fused, and Laminated Apparel Fabrics<sup>2</sup>

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for Lot or Process<sup>4</sup>

#### 2.2 AATCC Test Method:

135 Dimensional Changes in Automatic Home Laundering

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.52 on Flammability.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 07.01.

<sup>3</sup> Discontinued—See 1983 *Annual Book of ASTM Standards*, Vol 06.03.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 14.02.

of Durable Press Woven or Knit Fabrics<sup>5</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *combustible textile, n*—a textile that will ignite and burn or that will give off vapors that ignite and burn when subjected to external sources of ignition.

3.1.2 *flame spread, n*—the propagation of a flame away from the source of ignition.

3.1.3 *flame-spread time, n*—the time taken by a flame on a burning material to travel a specified distance under specified conditions.

3.1.4 *flammability, n*—those characteristics of a material that pertain to its relative ease of ignition and relative ability to sustain combustion.

3.1.5 *flame retardant, n*—a chemical used to impart flame resistance.

3.1.6 *flame-retardant-treated, adj*—having received a flame-retardant treatment.

3.1.6.1 The term “flame-retardant-treated” does not apply to textiles that are inherently flame resistant due to the intrinsic properties of the material or the fiber-forming polymer.

3.1.7 *interlining, n*—any textile which is intended for incorporation into an article of wearing apparel as a layer between an outer shell and an inner lining.

3.1.8 *raised fiber surface, n*—*in textile fabrics*, intentionally lifted fibers or yarns such as pile, napped, tufted, flocked, or similar surfaces.

3.2 For definitions of other terms used in this test method, refer to Terminology D 123 and to the *Technical Manual of the American Association of Textile Chemists and Colorists*.

### 4. Summary of Test Method

4.1 The standard provides methods of testing the flammability of textiles from or intended to be used for apparel, explains three classes of flammability, sets forth the requirements for classifying textiles, and warns against the use of single or multilayer textile fabrics that have burning characteristics considered by the trade to make them unsuitable for apparel.

4.2 Specimens cut from the textile are prepared by brushing if they have a raised fiber surface, by drycleaning and laundering if they have been flame-retardant-treated. A dried

<sup>5</sup> Available from the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

specimen is inserted in a frame and held in a special apparatus at an angle of 45°, a standardized flame is applied to the surface near the lower end for 1 s, and the time required for the flame to proceed up the fabric a distance of 127 mm (5 in.) is recorded. Notation is made as to whether the base of a raised-surface fabric ignites, chars, or melts.

## 5. Uses and Significance

5.1 Test Method D 1230 for the determination of the flammability of apparel textiles cannot be recommended for the acceptance testing of commercial shipments since Federal regulations require apparel fabrics to meet the criteria of 16 CFR 1610 and correlation of test results with actual performance has not been established. Although Test Method D 1230 is not recommended for acceptance testing, it is useful because it provides a less expensive and time consuming research tool than 16 CFR 1610. Also, since the Consumer Product Safety Commission is presently considering action to allow alternate test methods to 16 CFR 1610, and has shown a willingness to consider changes to it, Test Method D 1230 should serve as the industry standard and as a guide for needed changes to federal regulations. See 1.2 and Note 1.

5.1.1 In case of a dispute arising from differences in reported test results when using Test Method D 1230 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 randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using a nonparametric test for unpaired data and an acceptable probability level chosen by the two parties before testing 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 in light of the known bias.

5.2 All fabrics made of natural or regenerated cellulose, as well as many made from other natural or man-made fibers, are combustible. Some combustible fabrics when used for clothing are potentially dangerous to the wearer because of such factors as ease of ignition, flame spread time, amount of heat released, and design of the garment. This test measures two such factors: ease of ignition and flame spread time.

5.3 In order to place fabrics in one of the three flammability classes, arbitrary limits have been selected for time of application of the flame and for time of flame spread. These limits are based on extensive testing experience and are believed to be a useful guide in judging the relative flammability of apparel textiles. It must be understood, however, that no guarantee can be given and none is implied that garments made from a fabric or product falling into any one of the flammability classes will not be hazardous under some conditions.

5.3.1 Because of the sensitivity of fabrics to ambient atmospheric conditions, technique of specimen preparation, and inherent variability in the cloth itself, test results are not always

closely reproducible either in the same laboratory or among several laboratories.

5.4 Finishes and fabric surface changes can exert a large effect on flammability. Therefore, some fabrics are tested before as well as after laundering or drycleaning or both (see Section 9).

5.5 This standard is not applicable to hats, gloves, footwear, or interlining fabrics.

## 6. Apparatus and Materials

6.1 *Flammability Tester*<sup>6</sup>, with a separate timer capable of providing flame impingement on the specimen for 1 + 0.05 s as shown in Fig. 1 or an equivalent electrically operated tester equipped with an automatic electric timer, as described in Annex A1. Testers are normally supplied with specimen holders.

6.2 *Brushing Device*<sup>6</sup>, as shown in Fig. 2, and described in Annex A1.

6.3 *Drycleaning Machine*—Single unit, coin-operated type capable of providing a complete automatic dry-to-dry cycle using perchlorethylene (see 6.1 of Test Methods D 2724).

6.4 *Laboratory Drying Oven*.

6.5 *Desiccator*, 250 mm (10 in.) diameter.

6.6 *Calcium Chloride*, anhydrous.

6.7 *Butane*, CP.<sup>7</sup>

6.8 *AATCC Standard Detergent 124*.<sup>5</sup>

6.9 *Perchlorethylene*, commercial grade.

6.10 *Drycleaning Detergent*<sup>8</sup>, amine sulfonate type.

6.11 *Cotton Sewing Thread*, No. 50, mercerized.

## 7. Sampling

7.1 *Lot Sample*—As a lot sample for testing, take at random the number of primary sampling units directed in an applicable material specification or other agreement between the purchaser and the supplier. For fabric, consider rolls of fabric to be the primary sampling units. For garments, consider shipping cartons to be the primary sampling units.

NOTE 2—A realistic specification or other agreement between the purchaser and the supplier requires taking into account the variability between primary sampling units and within primary sampling units so as to provide a sampling plan which has a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level. A lot sample normally consists of a very small fraction of the total primary sampling units.

7.2 *Laboratory Sample*—As a laboratory sample for testing, proceed as follows:

7.2.1 For fabric take a full-width swatch ½ m (½ yd) long from the end of each roll of fabric in the lot sample, after first discarding any fabric from the very outside of the roll that contains folds, creases, or any evidence of displaced weave.

<sup>6</sup> The Flammability Tester and Brushing Device can be obtained from U.S. Testing Co., Inc., 1415 Park Ave., Hoboken, NJ 07030; Custom Scientific Instruments, Inc., 13 Wing Drive, Whippany, NJ 07981; and The Govmark Organization, Inc., P.O. Box 807, Bellmore, NY 11710.

<sup>7</sup> Butane, cp. No. 4 cylinders, containing 2 lb may be obtained from Matheson Co., Inc., East Rutherford, NJ.

<sup>8</sup> Staticol, amine sulfonate type, available from R. R. Street, Inc., 561 W. Monroe St., Chicago, IL; or Perksheen 324, amine sulfonate type, available from Adco, Inc., 900 W. Main St., Sedalia MO, have been found suitable for this purpose.



FIG. 1 Flammability Tester

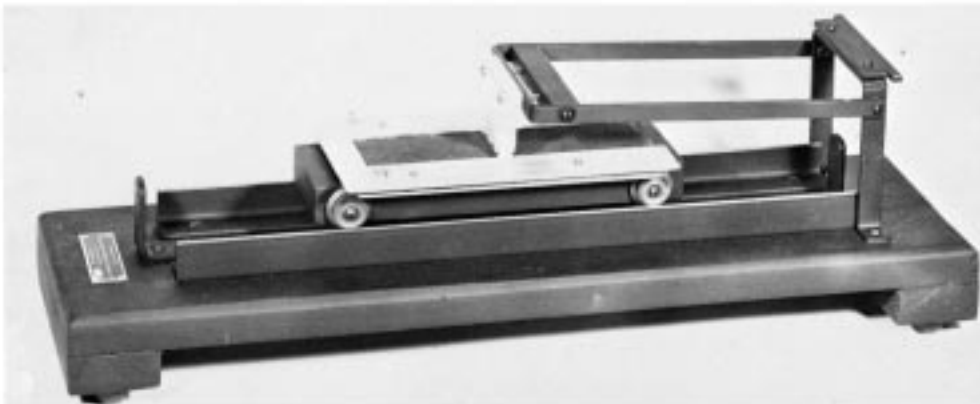


FIG. 2 Brushing Device

7.2.2 For garments, take the number of garments per shipping carton in the lot sample directed in an applicable material specification or other agreement between the purchaser and supplier.

*7.3 Test Specimens:*

7.3.1 Use exploratory tests as directed in 8.2 to select the orientation of specimens, the face of the fabric to be tested, and the part of any pattern to be tested so as to maximize the rate of flame spread.

7.3.2 For fabric, cut final test specimens from each swatch

in the laboratory sample as directed in 9.1. For fabrics that can be refurbished, cut additional final test specimens from each swatch in the lot sample after the swatches have been refurbished as directed in 9.2. Identify the specimens as coming from a swatch before or after refurbishing.

7.3.3 For garments, cut final test specimens from each garment in the laboratory sample as directed in 9.1. For garments that can be refurbished, cut additional final test specimens from each garment in the lot sample after the garments have been refurbished as directed in 9.2. Identify the

specimens as coming from a garment before or after refurbishing. Specimens from multi-layered garments should include all of the layers held in the same relative position they occupy in the garment. Test the outer surface of the garment unless the inner surface of the lining yields a faster flame spread in exploratory tests. See 7.3.1.

## 8. Preparation of Specimens

8.1 Perform tests on the fabric as it will reach the consumer. Process any partially finished fabrics first in accordance with a manufacturer's instructions.

8.2 Accomplish exploratory testing to determine the proper orientation of specimens, face of fabric and part of pattern to be tested by marking and cutting (see 8.3) a single 50 by 150 mm (2 by 6 in.) specimen for each fabric surface, direction, and pattern and testing according to Section 10.

NOTE 3—For fabric with a raised-fiber surface, it is usually found that the long dimension of the specimen should be parallel with the lay of the pile, and that flame spread is most rapid when progressing against the lay of the pile.

8.3 *Marking and Cutting, General Directions*—Mark out the required number of specimens (See Section 9) each 50 by 150 mm (2 by 6 in.) on the surface opposite that to be tested, with the long dimension in the direction in which burning is most rapid as established in the preliminary trials (See 8.2). Identify the end of each specimen toward which, and on the surface of which flame spread is most rapid by attaching a staple to it. Then cut specimens from the fabric. Any identification markings should be placed on the side and end opposite that to be tested.

## 9. Specimens for Final Testing

9.1 Test all fabrics as received per 9.1.1. If fabric is Class 3 as-received (See Sections 11 and 12) proceed to Section 13. If fabric is Class 1 or Class 2 as-received (See Sections 11 and 12) proceed to 9.1.2.

9.1.1 *Fabric as Received*—Cut four specimens (see, however, 11.1) as directed in 8.3, in addition to the one previously tested in the preliminary trials. The result from the specimen used in the preliminary trial can be combined with the results from the additional four specimens for the calculation.

9.1.2 *Refurbished Fabric*—Cut a swatch large enough to provide 5 or 10 specimens, as indicated in 11.1, with allowance for shrinkage in dry cleaning and washing, and subject the swatch to drycleaning and washing procedures as follows: If labeled “Dry Clean Only” use 9.2.1. If labeled “Washable” use 9.2.1 followed by 9.2.2 (unless labeled “Do Not Dry Clean,” then use 9.2.2 only). If labeled “Not Refurbishable” no cleaning procedure is necessary.

### 9.2 Refurbishing:

#### 9.2.1 Drycleaning:

9.2.1.1 *Option A*—Dryclean the fabric (one cycle) as directed in 9.2.1.2-9.2.1.4.

9.2.1.2 *Solvent Preparation*—Prepare the drycleaning solution by mixing 60 mL of the amine sulfonate detergent<sup>9</sup> and 4

mL of water for each gallon of perchlorethylene solvent required for the drycleaning machine. Put this solvent in the machine storage tank. The same solution may be used for repeated cleanings until it becomes dirty. The solution then should be replaced.

9.2.1.3 Perchlorethylene is toxic and a suspected carcinogen, and the usual precautions for handling chlorinated solvents should be taken. It should be used only under well-ventilated conditions. The solvent is nonflammable.

9.2.1.4 *Sample and Dummy Load Preparation*—Prepare a load consisting of all specimens to be tested and made up to 8 lb (3.6 kg) total with dummy load of approximately 380 by 380 mm (15 by 15 in.) fabric pieces of similar material.

9.2.1.5 *Drycleaning Procedure*—Run through the complete dry-to-dry cycle in the single unit coin-operated type drycleaning machine. Run the solvent phase of the drycleaning cycle with the solvent temperature no higher than 32°C (90°F). During the drying phase of the drycleaning cycle, either the air outlet temperature should not exceed 60°C (140°F) or the inlet air temperature should not exceed 80°C (175°F). If heat-sensitive fibers (for example, modacrylic fibers) are involved, the outlet air temperature should not exceed 40°C (105°F) or the inlet air temperature should not exceed 60°C (140°F). After the complete drycleaning cycle, remove the sample from machine.

9.2.1.6 *Option B*—Alternatively, fabric may be drycleaned one cycle in any commercial drycleaning operation.

9.2.2 Launder the fabric once in a home type washer as directed in AATCC Test Method 135 and dry using conditions appropriate for the fabric as recommended by the fabric or apparel manufacturer. If no care instructions are given, machine wash warm (120°) and tumble dry on the “normal” or “permanent press” setting.

9.2.3 Cut five or ten specimens (as indicated in 11.1) of refurbished fabric as directed in 8.3.

NOTE 4—Laundering or drycleaning is intended to remove additives which could affect the burning characteristics of the textile. In the event of disagreement between labs, drycleaning Option A should be used.

9.3 *Specimen Mounting*—Clamp the specimens individually in the specimen holders of the flammability tester. Insert the specimen in the frame so that the bottom edge of the specimen coincides exactly with the lower edge of the longest (top) frame. This can be accomplished by laying the specimen on the bottom (shorter) frame so that the top edge of the specimen coincides exactly with the top of the cut out portion of the frame. The stapled or marked end should be in the upper position during test. “Bull Dog” clips are usually used to hold the two halves of the specimen holder together, but other methods are acceptable. Double-faced tape is often used on the bottom half of the specimen holder to help hold the specimen taut and in place.

9.4 *Brushing*—Brush each specimen having a raised fiber surface with the specimen mounted in a specimen holder. The purpose of the metal plate or “template” on the carriage of the brushing device is to support the specimen above the level of the top surface of the specimen holder during the brushing operation. Accordingly, such template should be 3.2 mm (1/8 in.) thick.

<sup>9</sup> Supporting data are available from ASTM Headquarters, 1916 Race Street, Philadelphia, PA 19103. Request RR: D13-1082.

9.5 Dry the mounted specimens in a horizontal position in an oven for 30 min at 221°F (105°C), remove from the oven, and place over anhydrous calcium chloride or equivalent in a desiccator until cool, but for not less than 15 min.

NOTE 5—Oven drying discounts the effects of moisture content inherent in some fibers. Many fabrics have been shown to ignite in shorter exposures to ignition sources, and burn with higher flame spread rate when oven dried, than when tested at a higher moisture content. This is attributed to the moisture content in some fibers at higher relative humidity conditions. In 9.5, oven drying of specimens is specified because of test simplicity and reproducibility of test results.

## 10. Procedure

10.1 Adjust the position of the rack of the flammability tested (Fig. 1) with a holder and trial specimen (not a prepared specimen) in position, so that the tip of the indicator touches the face of the specimen. Place the specimen holder in the chamber so that the longest frame is on top. Adjust the burner and sample holder so that, with the indicator touching the face of the specimen, the flame is applied to the vertical center of the specimen, 19 mm ( $\frac{3}{4}$  in.) from the bottom of the specimen and with the burner face 8 mm ( $\frac{5}{16}$  in.) from the face of the specimen.

10.2 Open the control valve of the fuel supply and allow approximately 5 min for the air to be driven from the fuel line. Ignite the gas and adjust the flame to a length of 16 mm ( $\frac{5}{8}$  in.) measured from its tip to the opening in the gas nozzle.

10.2.1 Calibrate the accuracy of the timing mechanism for the flame impingement of  $1 \pm 0.05$  s without a test specimen in place, using an instrument capable of timing within 0.05 s.

10.3 Remove a mounted specimen from the desiccator and place it in position on the rack in the chamber of the apparatus (Fig. 1). Expose the test specimen to the flame within 45 s of the time it was removed from the desiccator. Place the stop cord 9.5 mm ( $\frac{3}{8}$  in.) above and parallel to the lower surface of the top plate of the specimen holder.

NOTE 6—This configuration can be achieved easily and reproducibly with the use of L-shaped guides on the specimen holder and an additional thread guide popularly referred to as a “sky hook.” The essential condition, however, is the uniform height of three-eighths of an inch for the stop cord and not the number, placement, or design of the thread guides.

10.4 Close the door of the apparatus. Set the stop watch at zero. Conduct the test in a draft-free room with the apparatus at room temperature.

10.5 Activate the starting lever or button. This starts the timing mechanism and applies the flame to the specimen for a period of 1 s. Timing is automatic, starting upon application of the flame and ending when the weight is released by the burning of the stop cord.

10.6 Record the time of flame spread for each specimen, and note whether the base of each specimen having a raised fiber surface is ignited, charred, or melted to a point where the damage is apparent on the reverse side of the specimen.

NOTE 7—Reference to base fabric charring or fusion for textiles having raised fiber surfaces refers to charring or fusion as a result of heat generated by surface burning or surface flash, and specifically excludes charring or fusion as a result of application of the igniting flame.

## 11. Calculations

11.1 Calculate the arithmetic mean flame-spread time of the five specimens. If this time is less than 3.5 s or if some of the specimens do not burn, test five additional specimens. The time of flame spread shall then be the average time for the ten specimens, or for as many of them that burn.

## 12. Interpretation of Results

12.1 The classes given in 12.2-12.4 are those used by the Consumer Product Safety Commission for interpreting the results of 16 CFR Part 1610, which is similar but not identical to this test. See 1.2.

12.2 *Class 1*—These textiles are considered by the trade to be generally acceptable for apparel and are limited to the following:

12.2.1 Textiles that do not have a raised fiber surface but have an average time of flame spread in the test of 3.5 s or more.

12.2.2 Textiles having a raised fiber surface that have an average time of flame spread in the test of more than 7 s or that burn with a surface flash (time of flame spread less than 7 s), provided the intensity of the flame is insufficient to ignite, char or melt the base fabric.

12.2.3 Textiles for which no specimen ignites.

12.3 *Class 2*—These textiles are considered by the trade to have flammability characteristics for apparel intermediate between Class I and Class III fabrics and are limited to the following:

12.3.1 Textiles having a raised fiber surface that have an average time of flame spread in the test of 4 to 7 s, inclusive, and in which the base fabric is ignited, charred or melted.

NOTE 8—Class 1 and Class 3 together cover the full range of time of flame spread for textiles that do not have a raised fiber surface.

12.4 *Class 3*—These textiles are considered by the trade to be unsuitable for apparel and are limited to the following:

12.4.1 Textiles that do not have a raised fiber surface that have an average time of flame spread in the test of less than 3.5 s.

12.4.2 Textiles having a raised fiber surface that have an average time of flame spread in the test of less than 4 s, and in which the base fabric is ignited, charred, or melted. See Note 7.

## 13. Report

13.1 Report that the specimens were tested as directed in ASTM Test Method D 1230. Describe the material or product sampled and the method of sampling used.

13.2 Report the following information:

13.2.1 Average time in seconds of flame spread for specimens of fabric which ignite as received. If no specimen ignites, report DNI (did not ignite).

13.2.2 For raised-surface fabrics, the number of specimens of fabric as received for which the base fabric ignited, charred, or melted.

13.2.3 The number of specimens tested of fabric as received.

13.2.4 When applicable, that the specimens were tested after washing and drycleaning, or drycleaning only, or washing

only, and whether drycleaning Option A or Option B was used.

13.2.5 When applicable, average time in seconds of flame spread for specimens of fabric which ignite after washing and drycleaning, or drycleaning only, or washing only. If no specimen ignites, report DNI (did not ignite).

13.2.6 When applicable for raised-fiber surface fabrics, the number of specimens of fabric after washing and drycleaning, or drycleaning only, or washing only, for which the base fabric ignited or fused.

13.2.7 When applicable, the number of specimens tested of fabric after washing and drycleaning, or drycleaning only, or washing only.

13.2.8 The classification of the fabric as directed in Section 12. The classification is based on the flammability before or after drycleaning and washing, or drycleaning only, or washing only, whichever produces the shortest flame spread time.

#### 14. Precision and Bias

14.1 *Interlaboratory Test Data*<sup>9</sup>—An interlaboratory test was conducted in 1991 in which randomly drawn samples of six materials were tested in each of five laboratories, with each laboratory using two operators. The purpose of the interlaboratory test was to determine whether the refurbishing tech-

niques of Test Method D 1230 affected the flammability ratings of fabrics relative to the manual refurbishing method specified in 16 CFR Part 1610. Calculations of components of variance were thought to be inappropriate due to the restricted rating scales.

14.2 *Precision*—No justifiable statements can be made on the precision of Test Method D 1230 measuring flammability since the test result merely states whether there is conformance to the criteria for classification as stated in the procedure. Based on the observations, described in 14.1 and summarized in Table I, the refurbishing techniques of Test Method D 1230 have been shown to be at least as stringent as the manual method specified in 16 CFR Part 1610 relative to the final flammability classification. Any laboratory considering the use of the refurbishing methods contained in Test Method D 1230 as an alternate to the procedure in 16 CFR Part 1610 must maintain appropriate records and should consult the Research Report.<sup>9</sup>

14.3 *Bias*—The true value of the flammability of apparel textiles can only be described in the terms of a test method. Within this limitation, Method D 1230 has no known bias.

#### 15. Keywords

15.1 apparel flammability; fabric flammability

## ANNEX

### (Mandatory Information)

#### A1. DESCRIPTION OF APPARATUS

##### A1.1 Flammability Tester

A1.1.1 The flammability tester (Fig. 1) consists of a draft-proof ventilated chamber enclosing a standardized ignition medium, a specimen rack, and an automatic timing device.

A1.1.2 The draft-proof metal chamber prevents air circulation around the specimen rack and flame, but permits free ventilation for rapid oxidation. The chamber is 368 mm (14½ in.) wide by 216 mm (8½ in.) deep by 356 mm (14 in.) high. There are twelve 12.7 mm (½ in.) holes equidistant along the rear of the top closure. A ventilating strip is provided at the base of the sliding glass door in the front of the chamber.

A1.1.3 The specimen rack provides support for the frames in which the specimens are mounted. The angle of inclination is 45°. This specimen rack is mounted to allow adjustment to be made for the thickness of the specimen in relation to the flame front. An indicating finger is provided, the fore part of which touches the specimen when the rack is correctly adjusted.

A1.1.4 The specimen holder consists of two 1.6 mm (⅙ in.) matched metal plates with clamps mounted along the sides, between which the specimen is fixed. The plates are slotted and loosely pinned for alignment. The two plates of the holder cover all but 38 mm (1½ in.) of the width of the specimen for its full length. The specimen holder is supported in the draft-proof chamber on the rack at an angle of 45°. Five specimen holders are provided.

A1.1.5 Design must allow specimen adjustment from out-

side of the flammability chamber.

A1.1.6 The ignition medium consists of a mechanism driven gas jet formed around a 26-gage hypodermic needle. The gas jet is protected by a shield.

A1.1.7 The stop cord is stretched from the spool through suitable thread guides provided on the specimen frame and chamber walls, permitting the lacing of the cord in the proper position (127 mm) 5 in. from the point where the center of the ignition flame impinges on the test specimen. The stop cord is a No. 50 mercerized sewing thread.

A1.1.8 A weight attached by means of a clip to the stop cord in dropping stops a timer.

A1.1.9 The glass door slides in grooves at the front of the chamber. The design shall incorporate a means of holding the sliding door in an open position for insertion of the test specimen holders.

A1.1.10 A sensitive fuel control valve regulates the fuel supply at the tank. The valve ends in a 12.7-mm (½-in.) male connection for attachment to the standard No. 4 butane cylinder of 0.9-kg (2-lb) capacity.

A1.1.11 The manometer consists of a U-shaped glass tube cut into the gas line to register the gas pressure delivered to the microburner.

A1.1.12 The design shall embody controls to facilitate the performance of the test, such as power controls and a start test control. The actuation mechanism moves the microburner to its forward most position and automatically starts the timer at

impingement. The weight, when released by severance of the cord, stops the timer.

### **A1.2 Brushing Device**

A1.2.1 The brushing device (Fig. 2) consists of a base board over which a small carriage is drawn. This carriage runs on parallel tracks attached to the edges of the upper surface of the base board. The brush is hinged with pin hinges at the rear edge of the base board and rests on the carriage vertically with a pressure of 150 gf (0.33 lbf).

A1.2.2 The brush consists of two rows of stiff nylon bristles mounted with the tufts in a staggered position. The bristles are

0.41 mm (0.016 in.) in diameter and 19 mm ( $\frac{3}{4}$  in.) in length. There are 20 bristles per tuft and 4 tufts per inch. A clamp is attached to the forward edge of the movable carriage to permit holding the specimen on the carriage during the brushing operation.

A1.2.3 After the specimen has been put in place on the carriage and fastened by means of the clamp, the brush is raised, the carriage pushed to the rear, and the brush lowered to the face of the specimen. The carriage is then drawn forward by hand at a uniform rate.

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