



Standard Test Method for Flammability of Apparel Textiles¹

This standard is issued under the fixed designation D1230; 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 evaluation of the flammability of textile fabrics as they reach the consumer for or from items other than children's sleepwear or protective clothing.

1.2 This test method measures and describes 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 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.

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.

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

1.5 *This test method 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 test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

D123 Terminology Relating to Textiles

E176 Terminology of Fire Standards

2.2 AATCC Test Method:³

124 - 2006 Smoothness Appearance of Fabrics after Repeated Home Laundering

2.3 CPSC Guidance Document:⁴

16 CFR Part 1610 Standard for the Flammability of Clothing Textiles October 2008

2.4 ISO Standards⁵

ISO 4880 Burning behaviour of textiles and textile products

ISO 13943 Fire safety

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method and associated with textile issues refer to the terminology contained in Terminology D123, the *Technical Manual of the American Association of Textile Chemists and Colorists*³ and ISO 4880. In case of conflict, the definitions given in Terminology D123 shall prevail. For definitions of terms used in this test method and associated with fire issues refer to the terminology contained in Terminology E176 and ISO 13943. In case of conflict, the definitions given in Terminology E176 shall prevail.

3.1.2 *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.

3.1.3 *dry cleaning, n*—the cleaning of samples in a commercial dry cleaning machine.

3.1.4 *flame application time, n*—the time for which the ignition flame is applied to a material.

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

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

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

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

3.1.8.1 *Discussion*—The term does not apply to textiles that are inherently flame resistant due to the intrinsic properties of the material or the fiber-forming polymer.

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 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 AATCC Technical Manual of the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

⁴ Available from the U.S. Consumer Product Safety Commission, www.cpsc.gov.

⁵ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

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

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

3.1.11 *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.

3.1.12 *laundering, n*—for this test method, in textile product care, a process intended to (washing) with an aqueous detergent solution (and possibly bleach) and include subsequent rinsing, extracting, and drying.

3.1.13 *refurbish, v*—as applied to textile products, to brighten or freshen up and restore to wearability or use by cleaning such as drycleaning, laundering, or steam cleaning.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *base burn, n*—the point at which the flame burns the ground (base) fabric of a raised surface textile fabric and provides a self-sustaining flame.

3.2.1.1 *Discussion*—Base burn is also known as base fabric ignition or fusing. The base burns used to establish a Class 3 fabric are those burns resulting from surface flash that occur on specimens in places other than the point of impingement when the warp and fill yarns of a raised surface textile fabric undergo combustion. Base burns can be identified by an opacity change, scorching on the reverse side of the fabric, or when a physical hole is evident.

3.2.2 *burn time, n*—the time elapsed from ignition until the stop thread is severed as measured by the timing mechanism of the test apparatus.

3.2.3 *plain surface textile fabric, n*—any textile fabric which does not have an intentionally raised fiber or yarn surface such as a pile, nap, or tuft, but shall include those fabrics that have fancy woven, knitted or flock-printed surfaces.

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

3.2.5 *surface flash, n*—the burning of the surface fibers, with no base fiber burning.

3.3 For definitions of other terms used in this test method, refer to Terminology **D123** and to the *Technical Manual of the American Association of Textile Chemists and Colorists*.³

4. Summary of Test Method

4.1 The test method 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. All textiles require testing before and after refurbishing. Refurbishing consists of one cycle of drycleaning followed by laundering of all textiles. A specimen is inserted in a frame, dried in an oven and placed in

a dessicator before testing. The framed specimen is held in the flammability tester at an angle of 45°, a standardized flame is applied to the surface near the lower end for 1 ± 0.1 s, and the time required for the flame to proceed up the fabric a distance of 127 ± 0.2 mm (5 ± 0.019 in.) is recorded. Notation is made as to whether the base of a raised-surface fabric ignites, chars, melts, or fuses.

5. Significance and Use

5.1 Test Method D1230 cannot be recommended for the acceptance testing of commercial shipments since Federal regulations require apparel fabrics to meet the criteria of 16 CFR Part 1610 and correlation of test results with actual performance has not been established. Although Test Method D1230 is not recommended for acceptance testing, it is useful because it provides a less expensive and time consuming research tool than 16 CFR Part 1610.

5.1.1 In case of a dispute arising from differences in reported test results when using Test Method D1230 for testing of commercial shipments, the purchaser and the supplier shall conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. At a minimum, the two parties shall 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 shall be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories shall 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, fabrics are tested before as well as after one cycle of drycleaning followed by laundering.

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

6. Apparatus and Materials

6.1 *Flammability Tester*, with a separate timer capable of providing flame impingement on the specimen for $1 + 0.01$ 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*, as shown in Fig. 2, Fig. 3 and Fig. 4 and described in Annex A1.

6.3 *Drycleaning Machine*—A commercial dry cleaning machine shall be capable of providing a complete automatic dry-to-dry cycle using perchloroethylene solvent and a cationic drycleaning detergent.

6.4 *Laboratory Drying Oven*.

6.5 *Desiccator*;

6.6 *Anhydrous Silica Gel*,

6.7 *Butane*, CP.

6.8 *AATCC 1993 Standard Reference Detergent*.³

6.9 *Perchloroethylene*, commercial grade.

6.10 *Drycleaning Detergent*, amine sulfonate type/ (catatonic).

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 $\frac{1}{2}$ m ($\frac{1}{2}$ yd) long from the end of each roll of fabric in the lot sample, after first

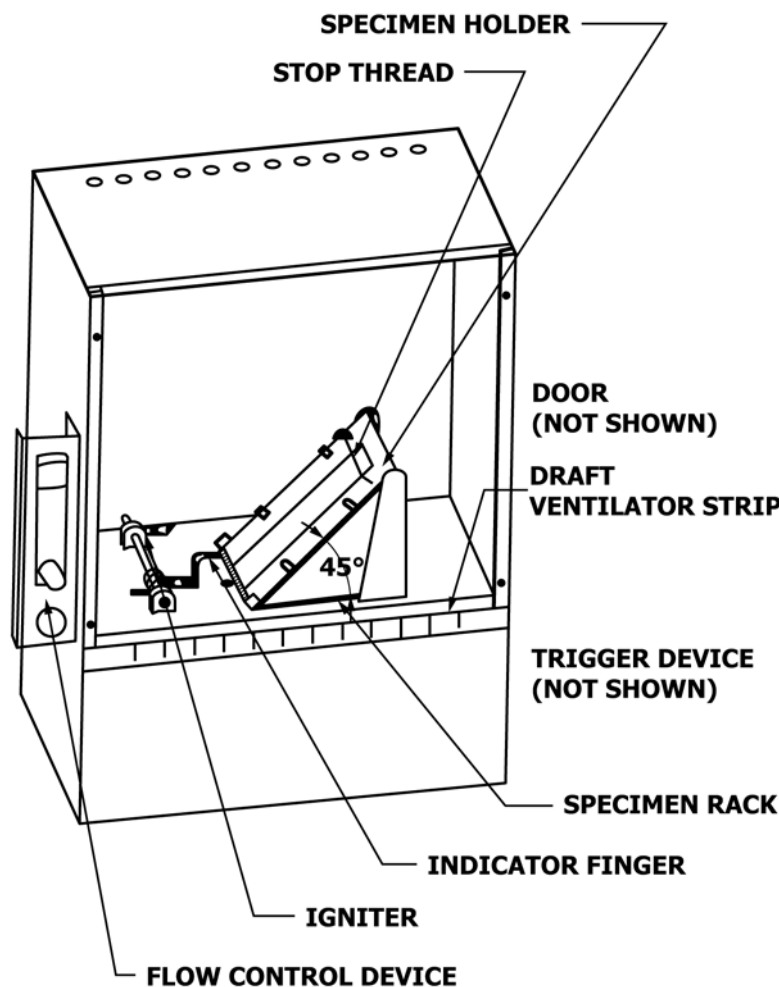
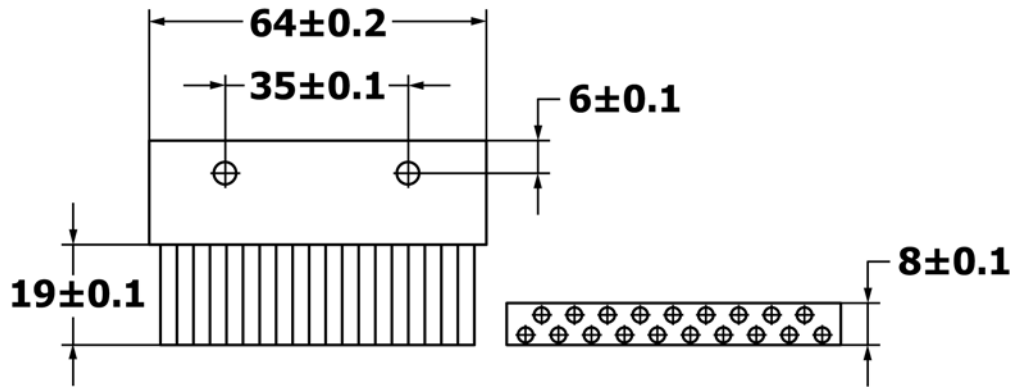


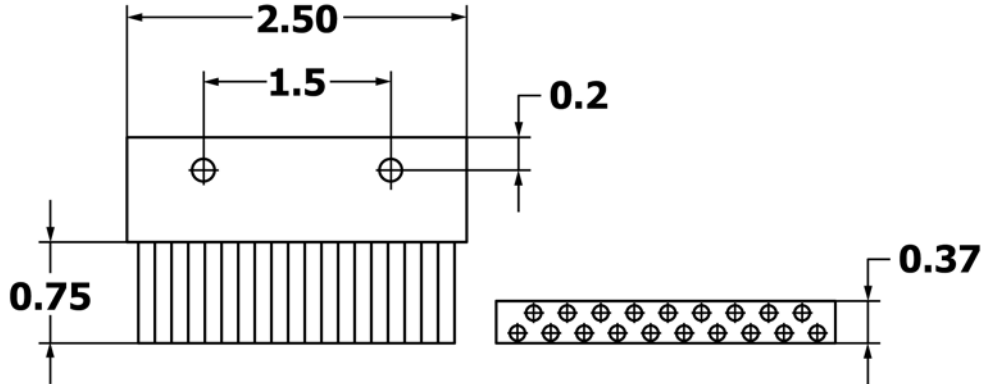
FIG. 1 Sketch of Flammability Apparatus



**BRUSH CONSISTS OF NYLON BRISTLES
0.04 DIAMETER $\pm$ 0.01
20 BRISTLES PER TUFT AND 4 TUFTS PER INCH**

**NOTE: DIMENSIONS IN
MILLIMETERS
TOLERANCE $\pm$ 0.5
UNLESS OTHERWISE NOTED**

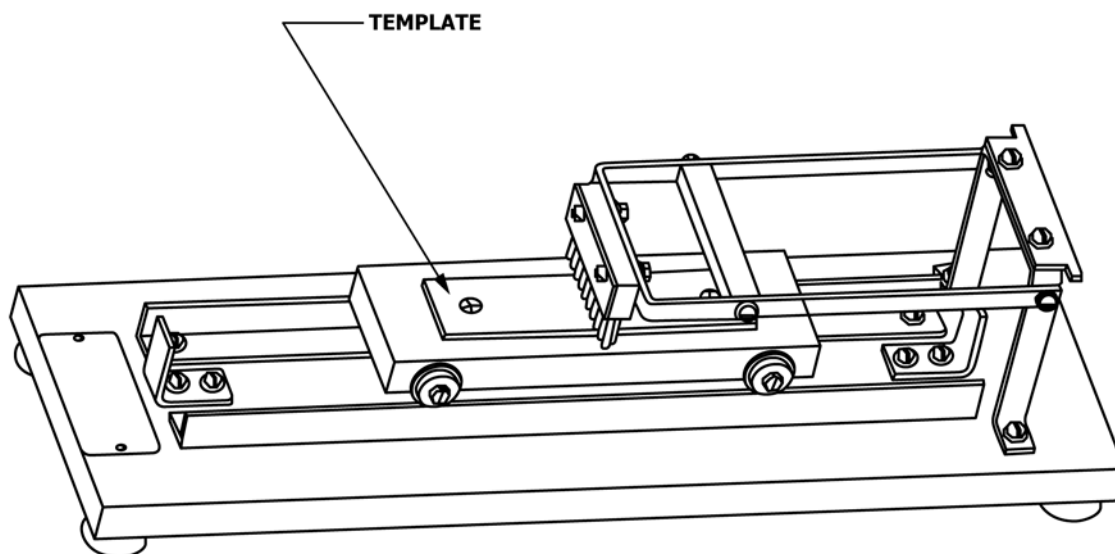
FIG. 2 Brush (SI)



**BRUSH CONSISTS OF NYLON BRISTLES
0.016 DIAMETER $\pm$ 0.004
20 BRISTLES PER TUFT AND 4 TUFTS PER INCH**

**NOTE: DIMENSIONS IN
INCHES
TOLERANCE $\pm$ 0.019
UNLESS OTHERWISE NOTED**

FIG. 3 Brush (in./lb)



NOTE 1—See Fig. 5 and Fig. 6.

FIG. 4 Brushing Device

discarding any fabric from the very outside of the roll that contains folds, creases, or any evidence of displaced weave.

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 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.

8. Preparation of Specimens

8.1 Perform tests on the fabric as it will reach the consumer. 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 8.2) 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 needs to be parallel with the lay of the pile, and that flame spread is most rapid when progressing against the lay of the pile.

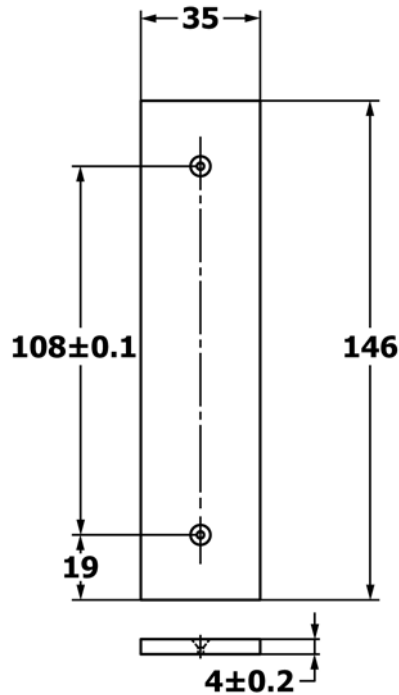
8.2 *Marking and Cutting, General Directions*—Mark out the required number of specimens (See Section 9) each 50 by 150 mm (2 by 6 in.) on the surface opposite that to be tested, with the long dimension in the direction in which burning is most rapid as established in the preliminary trials (See 8.1). Long dimension is the longer length of test specimen for purposes of this method. In cases where it is difficult to determine the direction of the lay of the nap, it is possible to identify it following the method stated in the CPSC Laboratory Manual: Laboratory Test Manual for 16 CFR Part 1610. 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. Place any identification markings on the side and end opposite of 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 five specimens (see, however, 11.1) as directed in 8.2, in addition to the one previously tested in the preliminary trials. *Specimen* is a section of sample to be tested having specific dimension. Five or ten specimens are required to be tested for a complete test. (Refer to Section 11 for additional information as to when an additional five specimens are required.)

9.1.2 *Refurbished Fabric*—Cut a swatch large enough to provide five or ten 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 per 9.2. *Specimen* is a section of sample to be tested having specific dimension. Five or ten specimens are required to be tested for a complete test. (Refer to Section 11 for additional information as to the need for an additional five specimens.)



NOTES:

- 1. TWO HOLES Ø1.6 COUNTERSINK FOR FLAT HEAD SCREW**
- 2. DIMENSIONS IN MILLIMETERS**
- 3. TOLERANCE ± 0.5 UNLESS OTHERWISE NOTED**

FIG. 5 Brushing Device Template (SI)

9.2 Refurbishing:

9.2.1 Drycleaning:

9.2.1.1 Solvent: Perchloroethylene, commercial grade

Detergent class: Cationic.

Cleaning time: 10 to 15 min.

Extraction time: 3 min.

Drying Temperature: 60 to 66°C (140 to 150°F).

Drying Time: 18 to 20 min.

Cool Down/Deodorization time: 5 min.

9.2.1.2 Perchloroethylene is toxic and a suspected carcinogen, and the usual precautions for handling chlorinated solvents need to be taken. Perchloroethylene is to be used only under well-ventilated conditions. The solvent is nonflammable.

9.2.1.3 Samples shall be dry cleaned in a load that is 80 % of the machine's capacity. If necessary, ballast of clean textile pieces or garments, white or light in color, and consisting of approximately 80 % of wool fabric pieces and 20 % cotton pieces shall be used.

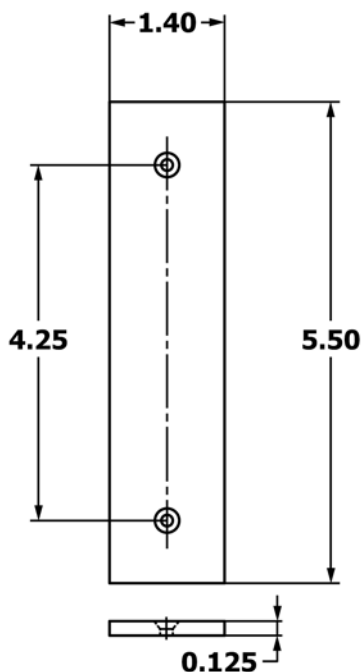
9.2.2 Wash and dry the fabric once in a home type washer in accordance with AATCC 124 - 2006 sections 8.2.2, 8.2.3 and 8.3.1(A). Use wash water temperature (IV), $49 \pm 3^\circ\text{C}$, ($120 \pm 5^\circ\text{F}$); Normal / Cotton Sturdy Cycle 18 ± 1 gal water level. A maximum wash load of 3.63 kg (8 lbs) shall be used. Tumble dry, Durable Press, using an exhaust temperature of $66 \pm 5^\circ\text{C}$ ($150 \pm 10^\circ\text{F}$), and a cool down time of 10 min.

9.2.3 Cut five or ten specimens (as indicated in 11.1) of refurbished fabric as directed in 8.2.

NOTE 4—Drycleaning followed by laundering is intended to remove additives which could affect the burning characteristics of the textile.

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 is placed 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 dimension needs to be as outlined in Fig. 5 and Fig. 6.



NOTES:

- 1. TWO HOLES Ø0.171 COUNTERSINK FOR FLAT HEAD SCREW**
- 2. DIMENSIONS IN INCHES**
- 3. TOLERANCE ± 0.019 UNLESS OTHERWISE NOTED**

FIG. 6 Brushing Device Template (in./lb)

9.5 Dry the mounted specimens in a horizontal position in an oven for 30 min at $105 \pm 5^\circ\text{C}$ ($221 \pm 3^\circ\text{F}$), remove from the oven, and place over anhydrous silica gel or equivalent in a desiccator until cool, but for not less than 15 min.

NOTE 5—Oven drying eliminates 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 tester (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 ± 0.2 mm ($3/4 \pm 0.019$ in.) from the bottom of the specimen and with the burner face 8 ± 0.2 mm ($5/16 \pm 0.019$ in.) from the face of the specimen. See Figs. 7-12

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 ($5/8$ in.) measured from its tip to the opening in the gas nozzle. See Fig. 13 and Fig. 14.

10.2.1 Verify the accuracy of the timing mechanism for the flame impingement of 1 ± 0.1 s without a test specimen in place, using an instrument capable of timing within 0.05 s.

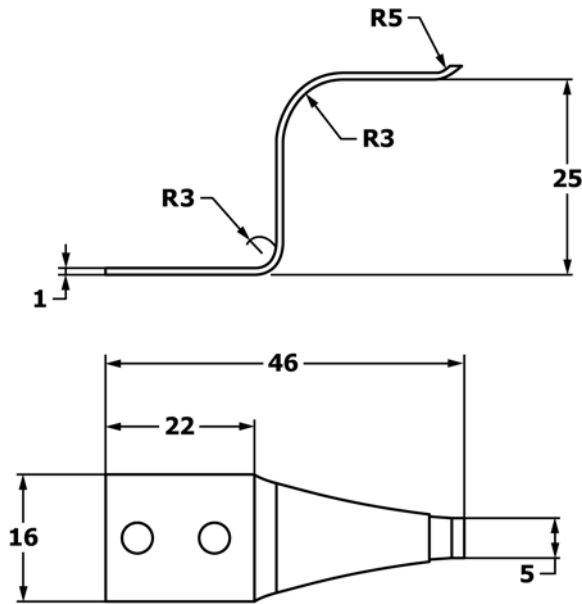
10.3 Remove a mounted specimen from the desiccator and place it in position on the rack in the chamber of the apparatus (Fig. 1). Place the stop cord 9.5 ± 0.2 mm ($3/8 \pm 0.019$ in.) above and parallel to the lower surface of the top plate of the specimen holder. Hook the stop weight in place close to and just below the stop weight thread guide. Expose the test specimen to the flame within 45 s of the time it was removed from the desiccator.

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 timer at zero. Conduct the test in a draft-free enclosure with the apparatus at room temperature.

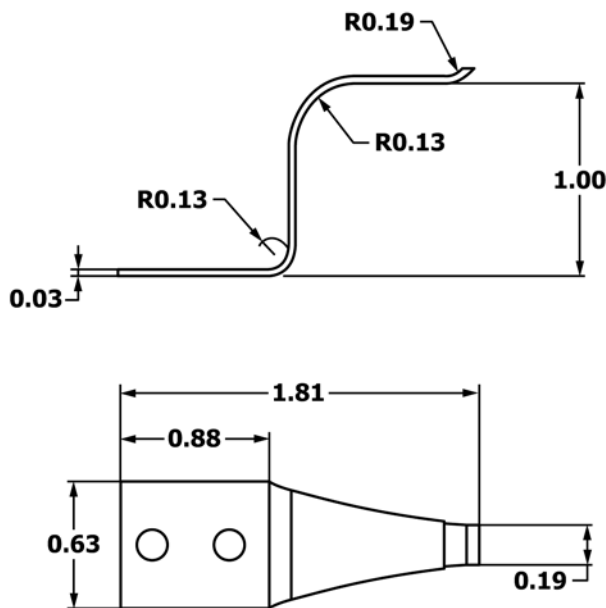
10.5 Activate the starting lever or button. This starts the timing mechanism and applies the flame to the specimen for a period of 1 s. Timing is automatic, starting upon application of the flame and ending when the weight is released by the burning of the stop cord.

10.6 Record the time of flame spread for each specimen, and note whether the base of each specimen having a raised fiber



**NOTE: DIMENSIONS IN
MILLIMETERS
TOLERANCE ± 0.5
UNLESS OTHERWISE NOTED**

FIG. 7 An Example of a Typical Indicator Finger (SI)



**NOTE: DIMENSIONS IN
INCHES
TOLERANCE ± 0.019
UNLESS OTHERWISE NOTED**

FIG. 8 An Example of a Typical Indicator Finger (in./lb)

surface is ignited, charred, melted, or fused 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.

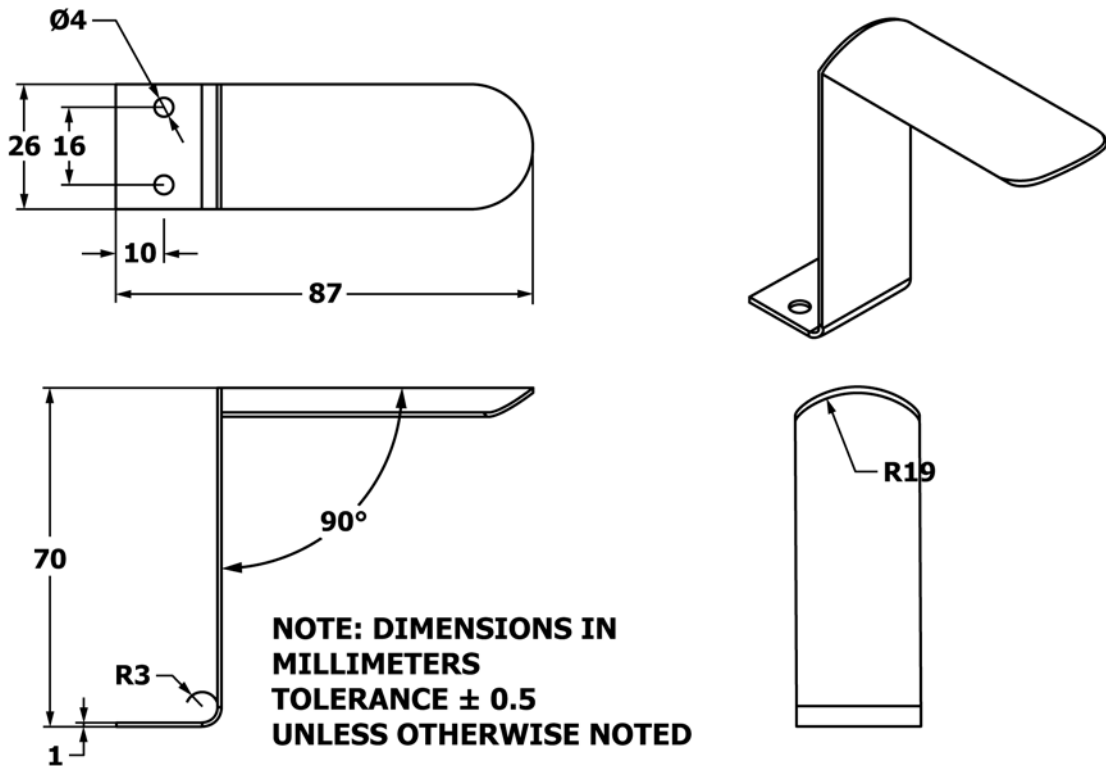


FIG. 9 An Example of a Typical Gas Shield (SI)

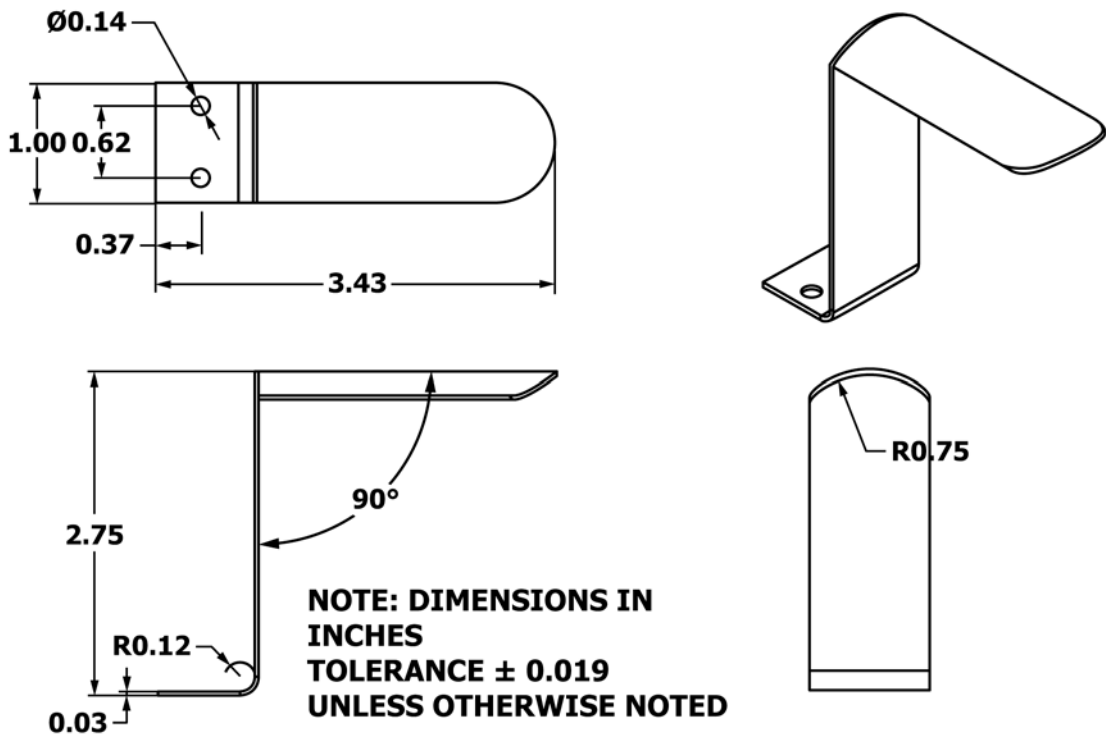
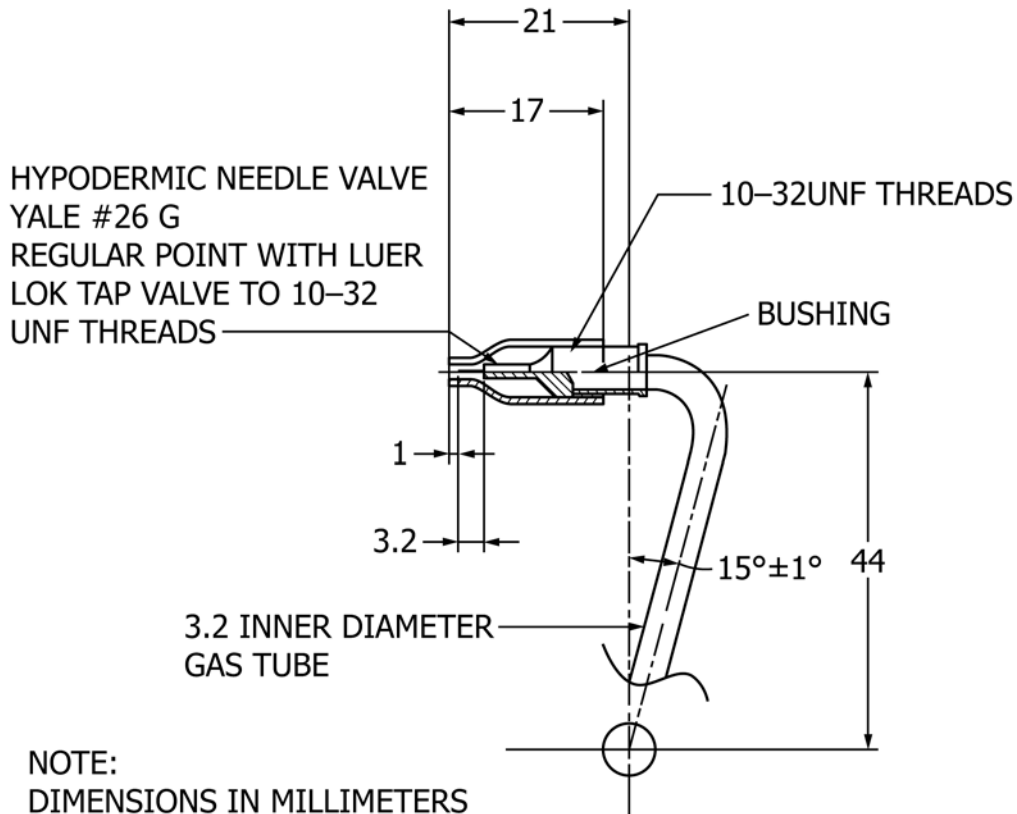


FIG. 10 An Example of a Typical Gas Shield (in./lb)

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.



NOTE:
DIMENSIONS IN MILLIMETERS
TOLERANCE ± 0.5
UNLESS OTHERWISE NOTED

FIG. 11 Typical Igniter (SI)

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 Test Method D1230. Describe the material or product sampled and the method of sampling used.

13.2 Report the following information:

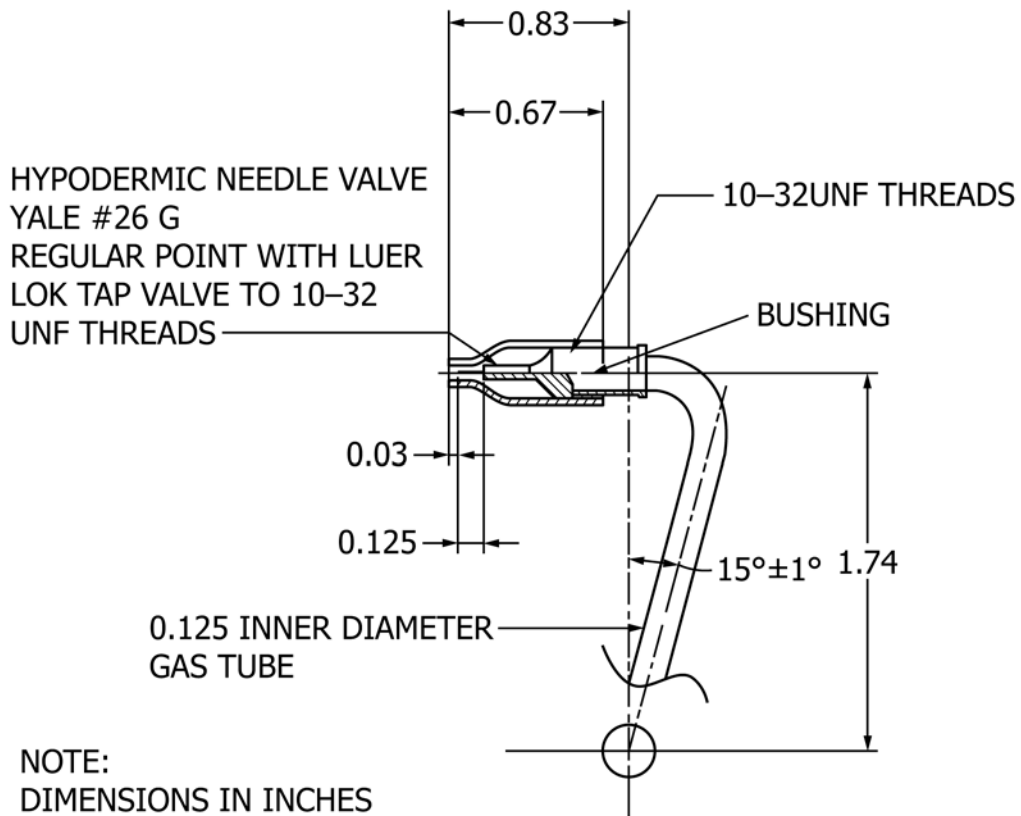
13.2.1 Average time in seconds of flame spread for specimens of fabric which ignite as received. If no specimen ignites, report DNI (did not ignite).

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

13.2.3 The number of specimens tested of fabric as received and after refurbishment.

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

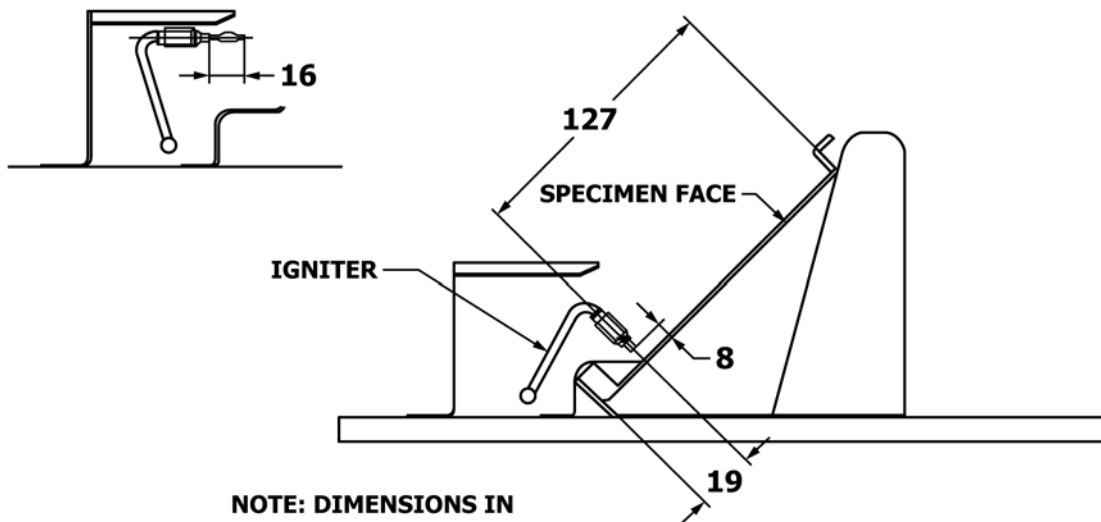
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NOTE:
DIMENSIONS IN INCHES
TOLERANCE ± 0.019
UNLESS OTHERWISE NOTED

FIG. 12 Typical Igniter (in./lb)

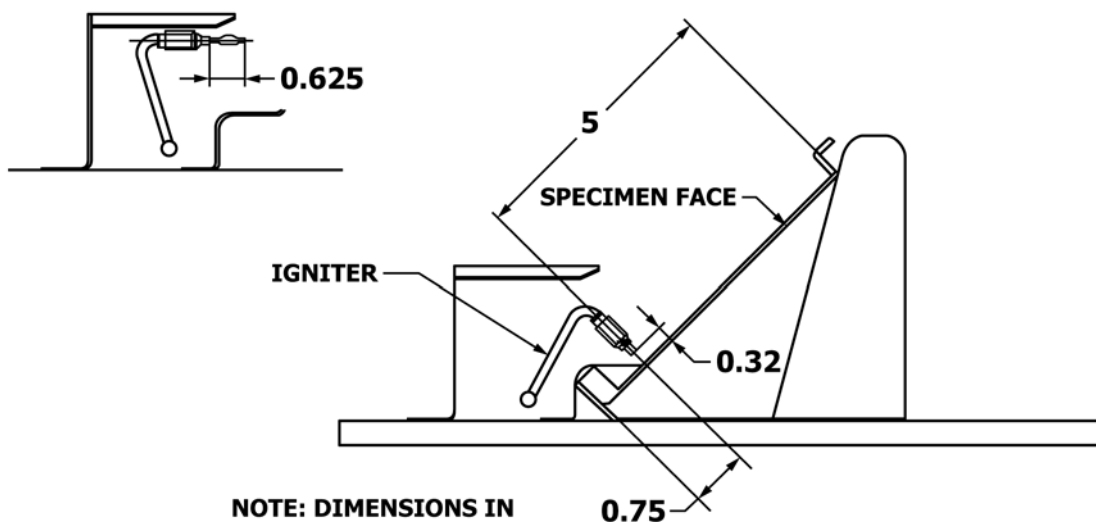
IGNITING FLAME LENGTH



NOTE: DIMENSIONS IN
MILLIMETERS
TOLERANCE ± 0.5
UNLESS OTHERWISE NOTED

FIG. 13 Igniter/Specimen Configuration (SI)

IGNITING FLAME LENGTH



NOTE: DIMENSIONS IN
INCHES
TOLERANCE ± 0.019
UNLESS OTHERWISE NOTED

FIG. 14 Igniter/Specimen Configuration (in./lb)

13.2.5 When applicable for raised-fiber surface fabrics, the number of specimens of fabric after drycleaning, and laundering, for which the base fabric ignited, charred, melted, or fused.

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

14. Precision and Bias

14.1 *Interlaboratory Test Data*⁶—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 interlabo-

ratory test was to determine whether the refurbishing techniques of Test Method D1230 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 D1230 measuring flammability since the test result merely states whether there is conformance to the criteria for classification as stated in the procedure.

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, Test Method D1230 has no known bias.

15. Keywords

15.1 apparel flammability; fabric flammability

ANNEX

(Mandatory Information)

A1. DESCRIPTION OF APPARATUS

A1.1 Flammability Tester

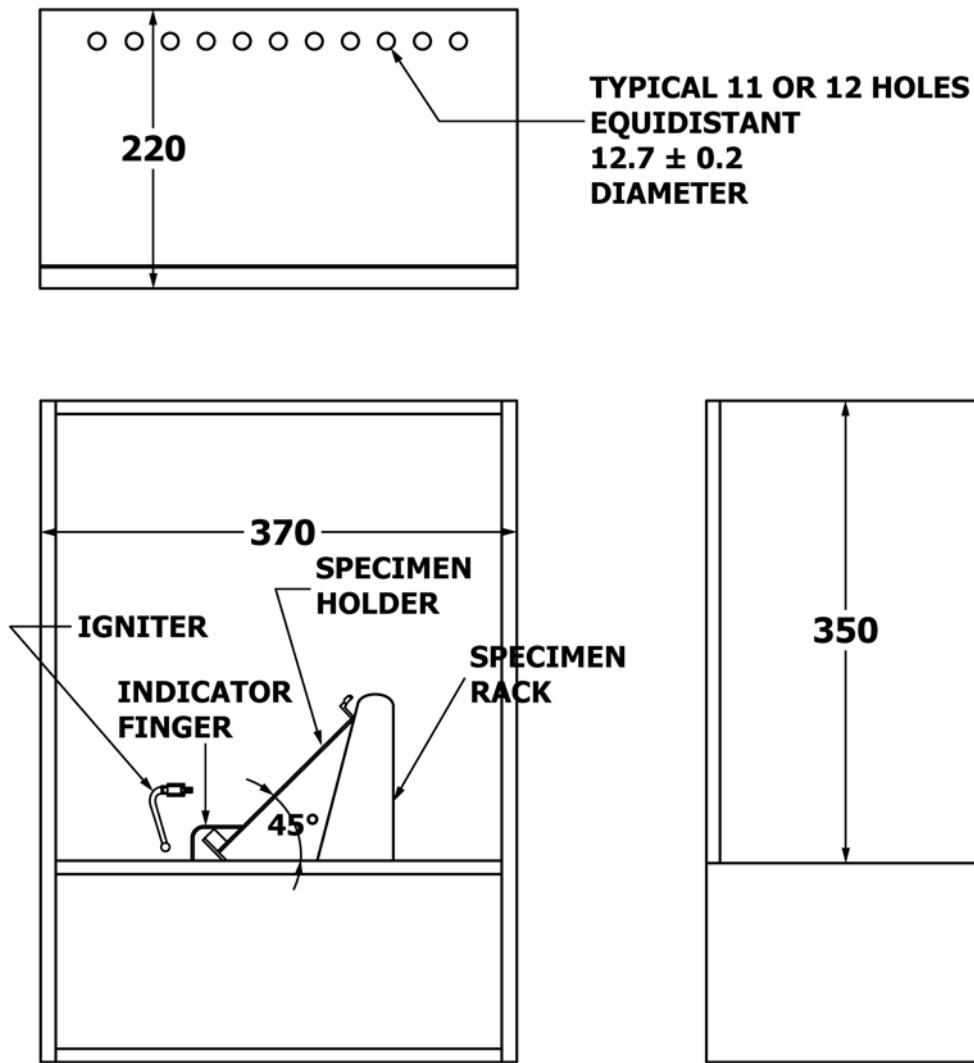
A1.1.1 The flammability tester (Fig. 1) consists of a draft-proof ventilated chamber enclosing a standardized ignition medium, a specimen rack, and an automatic timing device.

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 (Fig. A1.1, Fig. A1.2, Fig. A1.3 and Fig. A1.4) 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

⁶ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D13-1082.



**NOTE: DIMENSIONS IN
MILLIMETERS
TOLERANCE ± 10 MM
UNLESS OTHERWISE NOTED**

FIG. A1.1 Flammability Apparatus Views (SI)

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.

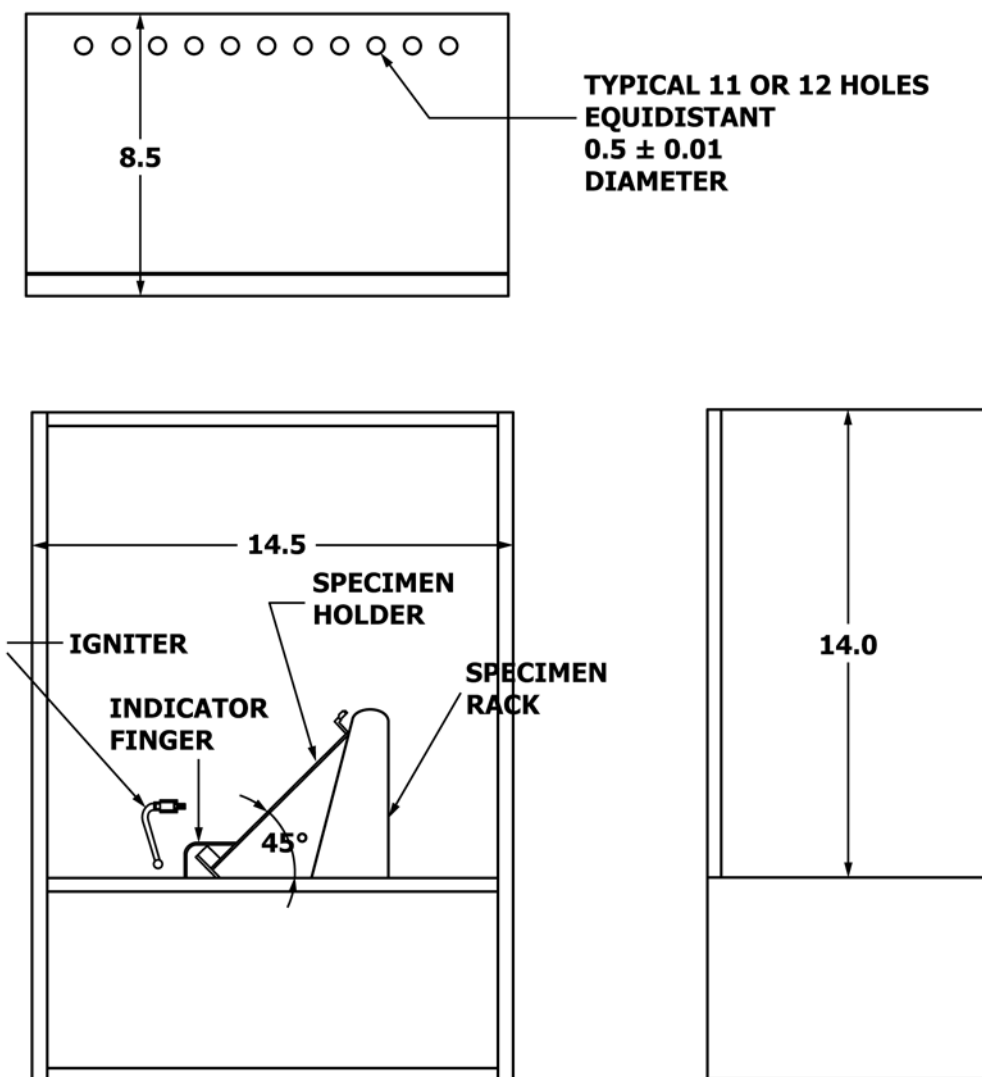
A1.1.4 The specimen holder (Fig. A1.3 and Fig. A1.4) consists of two 2 mm (0.06 in.) matched metal plates with clamps mounted along the sides, between which the specimen is fixed. The plates are slotted and loosely pinned for alignment. The two plates of the holder cover all but 38 mm (1½ in.) of the 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°.

A1.1.5 Design must allow specimen adjustment from outside of the flammability chamber.

A1.1.6 The ignition medium consists of a mechanism driven gas jet formed around a 26-gauge 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.



**NOTE: DIMENSIONS IN
INCHES
TOLERANCE ± 0.375 INCH.
UNLESS OTHERWISE NOTED**

FIG. A1.2 Flammability Apparatus Views (in./lb)

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.

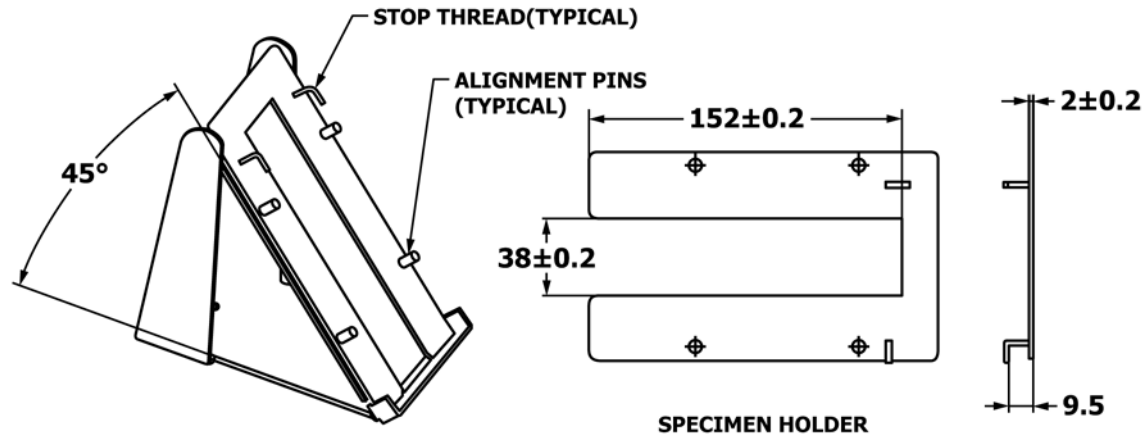
A1.1.10 A sensitive fuel control valve regulates the fuel supply at the tank. The valve ends in a 12.7-mm ($\frac{1}{2}$ -in.) male connection for attachment to the standard No. 4 butane cylinder of 0.9-kg (2-lb) capacity.

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.

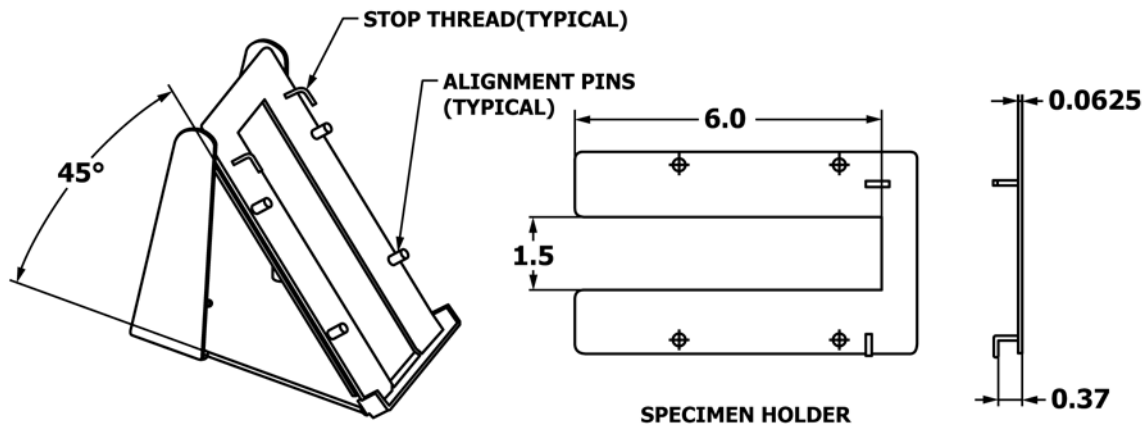
A1.1.13 The timing device consists of a timer, driving mechanism and weight. The timer, by means of special attachments, is actuated to start by connection with the gas jet. A trigger device activates the flame impingement, causing the driving mechanism to move the gas jet to its most forward position and automatically starts the timer at the moment of flame impact with the specimen. The falling weight, when caused to move by severance of the stop thread, stops the timer. Time shall be read directly and recorded as a burn time. Read



SPECIMEN HOLDER SUPPORTED IN SPECIMEN RACK

**NOTE: DIMENSIONS IN MILLIMETERS
TOLERANCE ± 0.5
UNLESS OTHERWISE NOTED**

FIG. A1.3 Specimen Holder (SI)



SPECIMEN HOLDER SUPPORTED IN SPECIMEN RACK

**NOTE: DIMENSIONS IN INCHES
TOLERANCE ± 0.019
UNLESS OTHERWISE NOTED**

FIG. A1.4 Specimen Holder (in./lb)

burn time to 0.1 s. An electronic or mechanical timer can be used to record the burn time, and electro-mechanical devices (that is, servo-motors, solenoids, micro-switches, and electronic circuits, in addition to miscellaneous custom made cams and rods, shock absorbing linkages, and various other mechanical components) can be used to control and apply the flame impingement.

A1.2 Brushing Device

A1.2.1 The brushing device (Fig. A1.1 and Fig. A1.2) 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 four 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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