



Designation: D1230 – 22

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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

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

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.

NOTE 1—This test method is not identical to 16 CFR Part 1610, Flammability of Clothing Textiles. Consumer Product Safety Commission regulations require that clothing 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 standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D123 Terminology Relating to Textiles

D3136 Terminology Relating to Care Labeling for Apparel, Textile, Home Furnishing, and Leather Products

D4391 Terminology Relating to The Burning Behavior of Textiles

E176 Terminology of Fire Standards

2.2 *AATCC Test Method:*³

124 - 2011 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 Standards*⁵

ISO 4880 Burning behaviour of textiles and textile products

ISO 13943 Fire safety

3. Terminology

3.1 The following terms are relevant to this standard: base burn, burn time, combustible textile, dry cleaning, flame application time, flame spread, flame-spread time, flame retardant, flame-retardant-treated, flammability, ignition, interlining, laundering, plain surface textile fabric, raised fiber surface, refurbish, surface flash.

3.2 For terms related to burning behavior of textiles, see Terminology **D4391**.

3.3 For terms related to fabric treatments and finishings, see Terminology **D3136**.

3.4 For terms related to fabric treatments and finishings, see Terminology in the referenced AATCC test method.

3.5 For terminology related to fire issues other than burning behavior of textiles, see Terminology **E176** and ISO 13943. In case of conflict, the terminology in **E176** will prevail.

3.6 For other terms related to textiles, see Terminology **D123** and the American Association of Textile Chemists and Colorists test method.

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.

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 $127 \text{ mm} \pm 0.2 \text{ mm}$ (5 in. ± 0.008 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 method to test general non-regulated textile fabrics.

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.

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 *Perchlorethylene*, 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

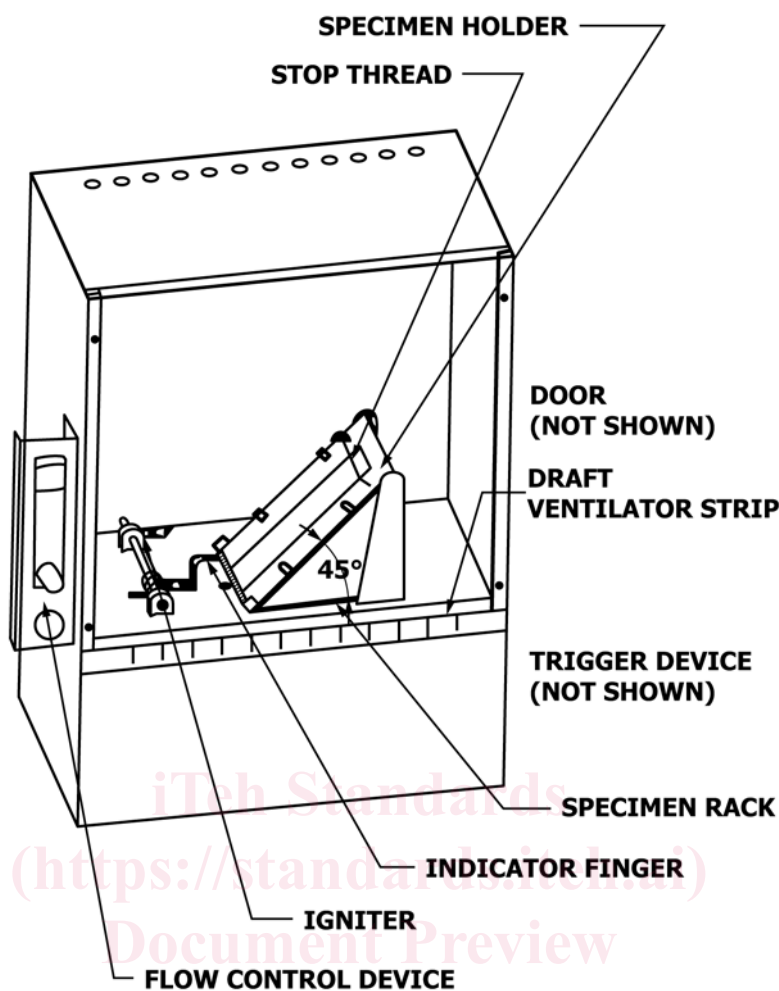


FIG. 1 Sketch of Typical Flammability Apparatus

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.

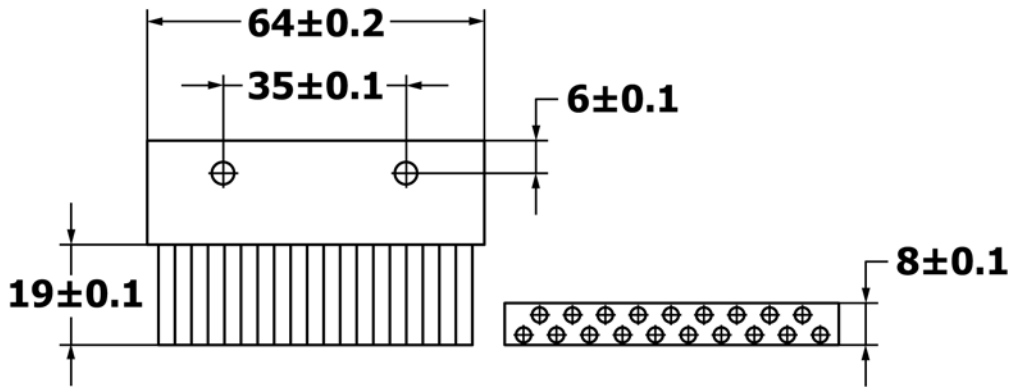
8. Preparation of Specimens

8.1 Perform tests on the finished production fabric or fabric taken from the finished apparel product. Perform preliminary testing to determine the proper orientation of specimens, which side of fabric, and which part of pattern to determine the fastest burning area.

8.1.1 Mark and cut (see 8.2) a single 50 mm by 150 mm (2 in. 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.

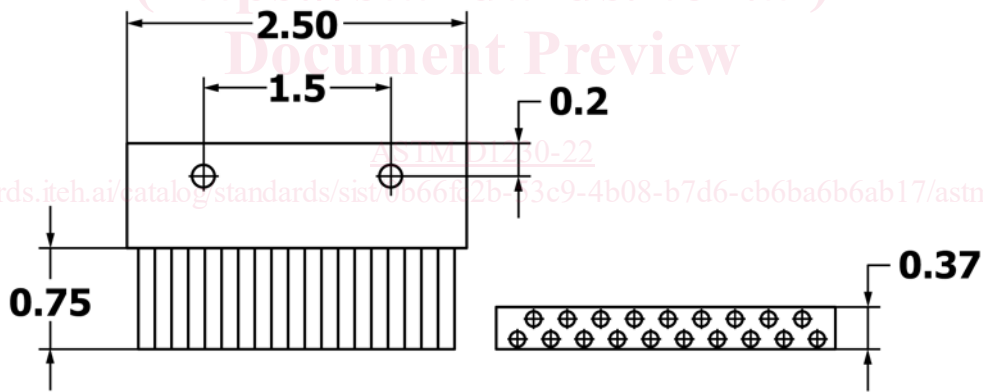
8.2 *Marking and Cutting, General Directions*—Mark out the required number of specimens (see Section 9) each 50 mm by 150 mm (2 in. by 6 in.) on the surface opposite that to be tested, with the long dimension in the direction in which burning is most rapid as established in the preliminary trials (see 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



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

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

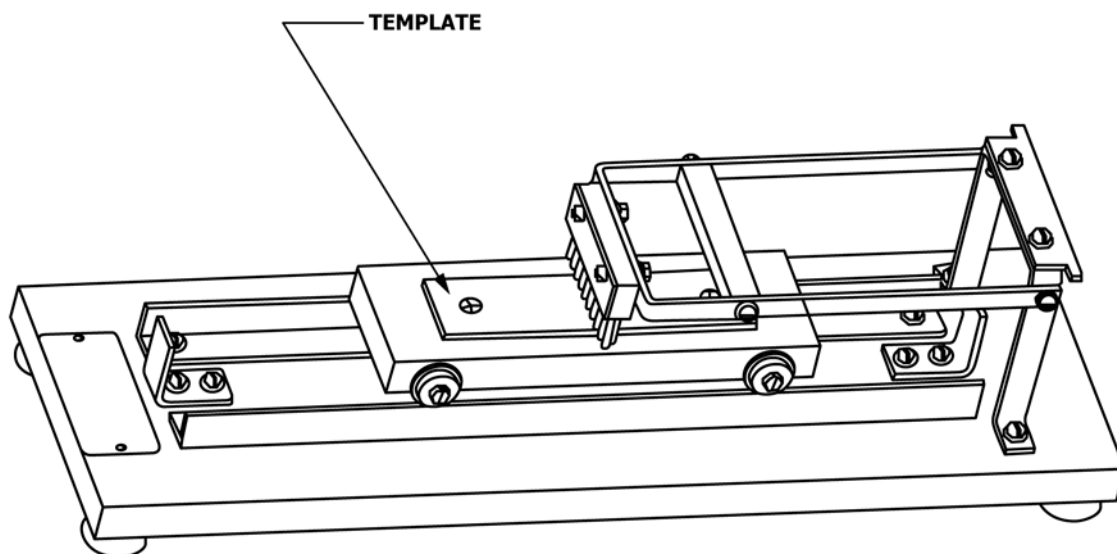
FIG. 2 Brush (SI)



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

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

FIG. 3 Brush (in./lb)



NOTE 1—See Fig. 5 and Fig. 6.
FIG. 4 Brushing Device

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.)

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 °C to 66 °C (140 °F 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.

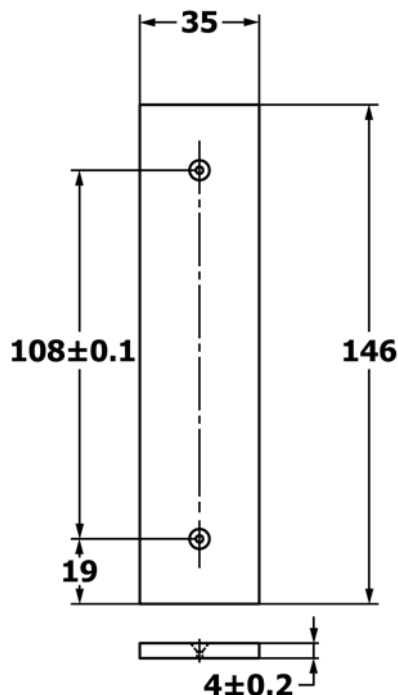
9.2.2 Wash and dry the fabric once in a home type washer in accordance with AATCC 124 - 2011 sections 8.2.2, 8.2.3 and 8.3.1(A). Use wash water temperature (IV), 49 °C ± 3 °C, (120 °F ± 5 °F); Normal / Cotton Sturdy Cycle 18 ± 1 gal water level. AATCC 1993 Standard Reference Detergent shall be used. A maximum wash load of 3.63 kg (8 lb) shall be used. Tumble dry, Durable Press, using an exhaust temperature of 66 °C ± 5 °C (150 °F ± 10 °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



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)

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.

9.5 Dry the mounted specimens in a horizontal position in an oven for 30 min at $105\text{ °C} \pm 5\text{ °C}$ ($221\text{ °F} \pm 3\text{ °F}$), 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, $19\text{ mm} \pm 0.2\text{ mm}$ ($0.75\text{ in.} \pm 0.008\text{ in.}$) from the

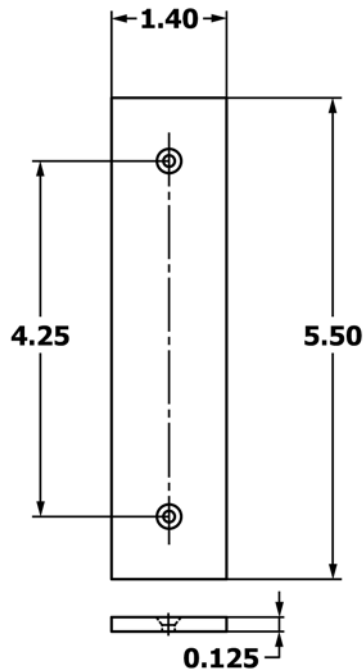
bottom of the specimen and with the burner face $8\text{ mm} \pm 0.2\text{ mm}$ ($0.315\text{ in.} \pm 0.008\text{ in.}$) from the face of the specimen. See Figs. 7-12.

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 ($\frac{5}{8}\text{ in.}$) 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 $1 \pm 0.1\text{ s}$ 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 $9.5\text{ mm} \pm 0.2\text{ mm}$ ($0.375\text{ in.} \pm 0.008\text{ in.}$) 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.

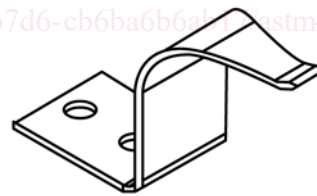
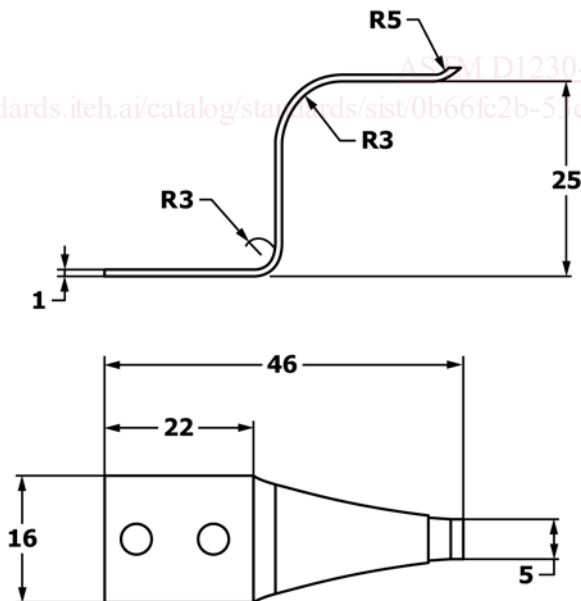
NOTE 6—This configuration can be achieved easily and reproducibly with the use of L-shaped guides on the specimen holder and an additional thread guide popularly referred to as a “sky hook.” The essential condition, however, is the uniform height of three-eighths of an inch for the stop cord and not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



NOTES:

1. TWO HOLES $\varnothing 0.171$ COUNTERSINK FOR FLAT HEAD SCREW
2. DIMENSIONS IN INCHES
3. TOLERANCE ± 0.019 UNLESS OTHERWISE NOTED

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



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

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

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