



Designation: D6545 – 22

Standard Test Method for Flammability of Textiles Used in Children’s Sleepwear¹

This standard is issued under the fixed designation D6545; 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 evaluates the relative flammability of textiles and garments intended for use in children’s sleepwear. The procedures of this test method follow testing and laundering procedures used to evaluate the flammability of children’s sleepwear contained in U.S. Federal Regulations 16 CFR 1615 and 1616.

1.2 A textile used in children’s sleepwear must be tested in its original state and after 50 laundering and drying cycles to assess the flame resistance of the textile relative to its use life.

1.3 This method is identical to the method outlined in the regulations 16 CFR 1615 or 1616. The regulation includes additional information such as sampling plans, record keeping requirements, and interpretations for compliance applicable to children’s sleepwear. Please consult 16 CFR 1615 and 1616 for these operations and interpretations.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.5 *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.*

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

1.7 *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 health practices and determines the applicability of regulatory limitations prior to use. Specific precautionary information is found in 8.5 and 9.5.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standard-*

ization 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

D1230 Test Method for Flammability of Apparel Textiles

D4391 Terminology Relating to The Burning Behavior of Textiles

E176 Terminology of Fire Standards

2.2 AATCC Test Method:³

AATCC Manual of International Test Methods and Procedures

LPI Home Laundering: Machine Washing

M11 Glossary of AATCC Standard Terminology

2.3 Federal Standards and Regulations:

16 CFR Part 1610 Standard for the Flammability of Clothing Textiles⁴

16 CFR Part 1611 Vinyl Plastic Film⁴

16 CFR Part 1615 Standard for the Flammability of Children’s Sleepwear: Sizes 0 through 6X⁴

16 CFR Part 1616 Standard for the Flammability of Children’s Sleepwear: Sizes 7 through 14⁴

Department of Commerce Voluntary Product Standard, previously identified as Commercial Standard, CS 151-50 “Body Measurements for the Sizing of Apparel for Infants, Babies, Toddlers, and Children”⁵

2.4 ISO Standard:⁶

ISO 13943 Fire Safety — Vocabulary

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 Available from American Association of Textile Chemists and Colorists (AATCC), P.O. Box 12215, Research Triangle Park, NC 27709-2215, <http://www.aatcc.org>. Reference from the 1970 edition of the manual.

⁴ Available from U.S. Government Publishing Office, 732 N. Capitol Street, NW, Washington, DC 20401, <http://www.gpo.gov>.

⁵ Available from National Technical Information Service (NTIS), 5301 Shawnee Rd., Alexandria, VA 22312, <http://www.ntis.gov>.

⁶ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

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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3. Terminology

3.1 *Definitions*—The following terms are relevant to this test method: char length; children’s sleepwear; fabric piece (piece); fabric production unit (unit); flame retardant; flame retardant treated; flammability; flammable textile; garment production unit (unit); infant garment; item.

3.2 For terms related to the burning behavior of textiles, see Terminology [D4391](#).

3.3 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.

3.4 For terms related to laundering and drycleaning, see Terminology in the referenced AATCC Manual of International Test Methods and Procedures and M11.

3.5 For other terms related to textiles, see Terminology [D123](#) and AATCC M11.

4. Summary of Test Method

4.1 This test method evaluates the extent of vertical flame spread of a textile after a flame is applied to the bottom edge of the specimen. The specimen is oriented vertically during the test and is exposed to a 38 mm (1.5-in.) flame for 3 s.

4.2 The extent of flame spread is determined by measuring the distance from the lower edge of the specimen to the point at which the specimen ceases to tear when subjected to a specified tearing load.

5. Significance and Use

5.1 This test method is suitable for evaluating flammability characteristics and laundering durability of textiles used in the manufacture of children’s sleepwear. It is not suitable for evaluating the flammability characteristics of textiles for other product applications or ignition scenarios.

5.2 The procedure for flammability testing used in this test method is technically equivalent to those used in 16 CFR 1615 and 1616. This test method does not include detailed specimen sampling plans, or the regulatory and record keeping requirements cited in the federal regulations. Please consult 16 CFR 1615 and 1616 for information for these operations.

5.3 This test method is suitable for training technicians to conduct the federal test and can serve as a laboratory reference.

5.4 Test Method D6545 is very different from 16 CFR 1610 and from Test Method [D1230](#).

6. Apparatus and Materials

6.1 *Test Chamber*—The test chamber shall be constructed of a steel or stainless steel cabinet with inside dimensions of 32.9 cm \pm 0.15 cm (12.94 in. \pm 0.06 in.) wide, 32.9 cm \pm 0.15 cm (12.94 in. \pm 0.06 in.) deep, and 76.2 cm \pm 0.15 cm (30 in. \pm 0.06 in.) high. The cabinet shall have a frame, perpendicular to the front of the cabinet, which permits the suspension of the specimen holder over the center of the base of the cabinet at such a height that the bottom of the specimen holder is 1.9 cm \pm 0.15 cm (0.75 in. \pm 0.06 in.) above the highest point of the barrel of the gas burner. The front of the cabinet shall be a

close-fitting door with a glass insert to permit observation of the entire test. The inside rear vertical surface of the cabinet will be painted flat black to improve visibility of the burning specimen during the test. The cabinet floor can be covered with a piece of noncombustible paper, fabric, or film whose length and width are approximately 2.5 cm (1 in.) less than the cabinet floor dimensions. The cabinet to be used in this test method is illustrated in [Fig. 1](#) and detailed in [Figs. 1-4](#). A suitable flame height indicator is shown in [Fig. 5](#).

6.2 *Specimen Holder, n*—The specimen holder is designed to permit suspension of the specimen in a fixed vertical position and to prevent curling of the specimen when the flame is applied. It shall consist of two U-shaped 0.19 cm (0.074 in.; 14-gauge USS) thick steel or stainless steel plates, 42.2 cm \pm 0.15 cm (16.62 in. \pm 0.06 in.) long, and 8.9 cm \pm 0.15 cm (3.5 in. \pm 0.06 in.) wide, with aligning pins. The openings in the plates shall be 35.6 cm (14 in. \pm 0.06 in.) long and 5.1 cm \pm 0.15 cm (2 in. \pm 0.06 in.) wide. The specimen is fixed between the plates, which shall be held together with side clamps. The holder to be used in this test method is illustrated in [Fig. 6](#).

6.3 *Burner, n*—The burner is substantially the same as that illustrated in [Figs. 7 and 8](#). The burner will have the inside tube diameter of 1.1 cm (0.437 in.). The input line to the burner shall be equipped with a needle valve to provide a variable orifice to adjust the height of the flame. The barrel of the burner is positioned at an angle of 25° from the vertical. The burner is equipped with an adjustable stop collar so that it is quickly located correctly under the test specimen. The burner is connected to the gas source by rubber or other flexible tubing.

6.4 *Gas Supply System, n*—A pressure regulator to furnish gas to the burner will deliver a pressure of 129 mm \pm 13 mm Hg (2½ lb/in.² \pm ¼ lb/in.²) at the burner inlet.

6.5 *Gas, n*—The gas is at least 97 % pure methane.

6.6 *Hooks and Weights, n*—Metal hooks and weights are used to produce a series of loads for char length determinations. Suitable metal hooks consist of 1.1 mm (0.043-in.; No. 19 gauge) diameter steel or stainless steel wire, or equivalent, made from 7.6 cm (3-in.) lengths of the wire, bent 1.3 cm (0.5 in.) from one end to a 45° angle hook. The longer end of the wire is fastened around the neck of the weight to be used and the other in the lower end of each burned specimen to one side of the burned area. The requisite loads are given in [Table 1](#).

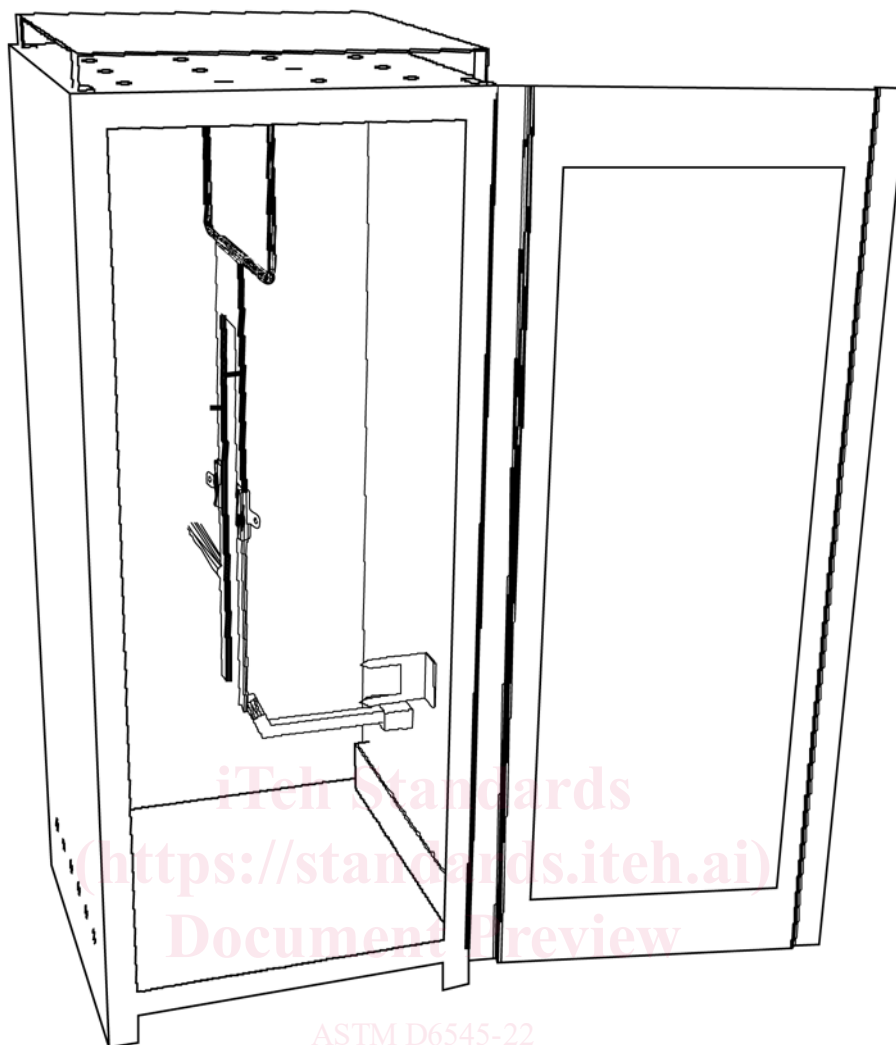
6.7 *Stopwatch*—A stopwatch or similar timing device is used to measure time to 0.1 s.

6.8 *Scale*—A linear scale graduated in millimetres or 0.1-in. divisions is used to measure char length.

6.9 *Circulating Air Oven*—A forced-circulation drying oven capable of maintaining the specimens at 105 °C \pm 2.8 °C (221 °F \pm 5 °F), is used to dry the specimen while mounted in the specimen holders.

6.10 *Desiccator*—An airtight and moisture-tight desiccating chamber is used for cooling mounted specimens after drying. Anhydrous silica gel will be used as the desiccant.

6.11 *Hood*—A hood or other suitable enclosures are used to provide a draft-free environment surrounding the test chamber.



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<https://standards.iteh.ai/catalog/standards/sist/48-8e33-beba86f6e1fd/astm-d6545-22> **FIG. 1 Test Apparatus**

The enclosure has a fan or other suitable means for exhausting smoke or toxic gases, or both, produced by testing.

7. Test Specimens and Sampling

7.1 *Test Specimen*—A section of fabric including prototype seams and prototype trims and production garments will be used for testing. The specimens will include a seam or trim.

7.2 *Sample*—Five test specimens cut from the appropriate fabric pieces, prototype seams or trims, or production garments, in accordance with the sampling plan in 16 CFR 1615 or 1616.

7.3 Test specimens are cut to a length of $254 \text{ mm} \pm 3 \text{ mm}$ ($10 \text{ in.} \pm 0.1 \text{ in.}$) and a width of $89 \text{ mm} \pm 3 \text{ mm}$ ($3.5 \text{ in.} \pm 0.1 \text{ in.}$).

7.4 Two or three specimens are cut with their long dimension in the machine direction and three or two are cut with their long dimension in the cross-machine direction. Each group of five specimens then constitutes one sample. Individual determinations for each specimen, and the average of the sample set constitute the test result.

7.5 Fabrics used in the manufacture of children's sleepwear are tested after the final stage of production and after the fabric has been laundered 50 times in accordance with the procedure in Section 10. Fabrics that have not been treated to be made flame-resistant, and where there will be multiple production runs of this fabric type, are not required to be tested after 50 launderings; provided that the first fabric production unit has met the flammability requirements of the federal standard both as produced and after 50 launderings.

7.6 Sampling of fabrics and garments for compliance to the federal regulation is not part of this test method. Refer to 16 CFR 1615 and 1616 for instructions on compliance sampling.

8. Preconditioning and Conditioning

8.1 Precondition all specimens at $20 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ ($68 \text{ }^\circ\text{F} \pm 4 \text{ }^\circ\text{F}$) for a minimum of 4 h before conditioning.

8.2 After preconditioning, mount each specimen in a specimen holder using a sufficient number of clamps or tape to ensure that the specimen cannot move within the specimen holder. Ensure that the specimen is as flat as is practical.

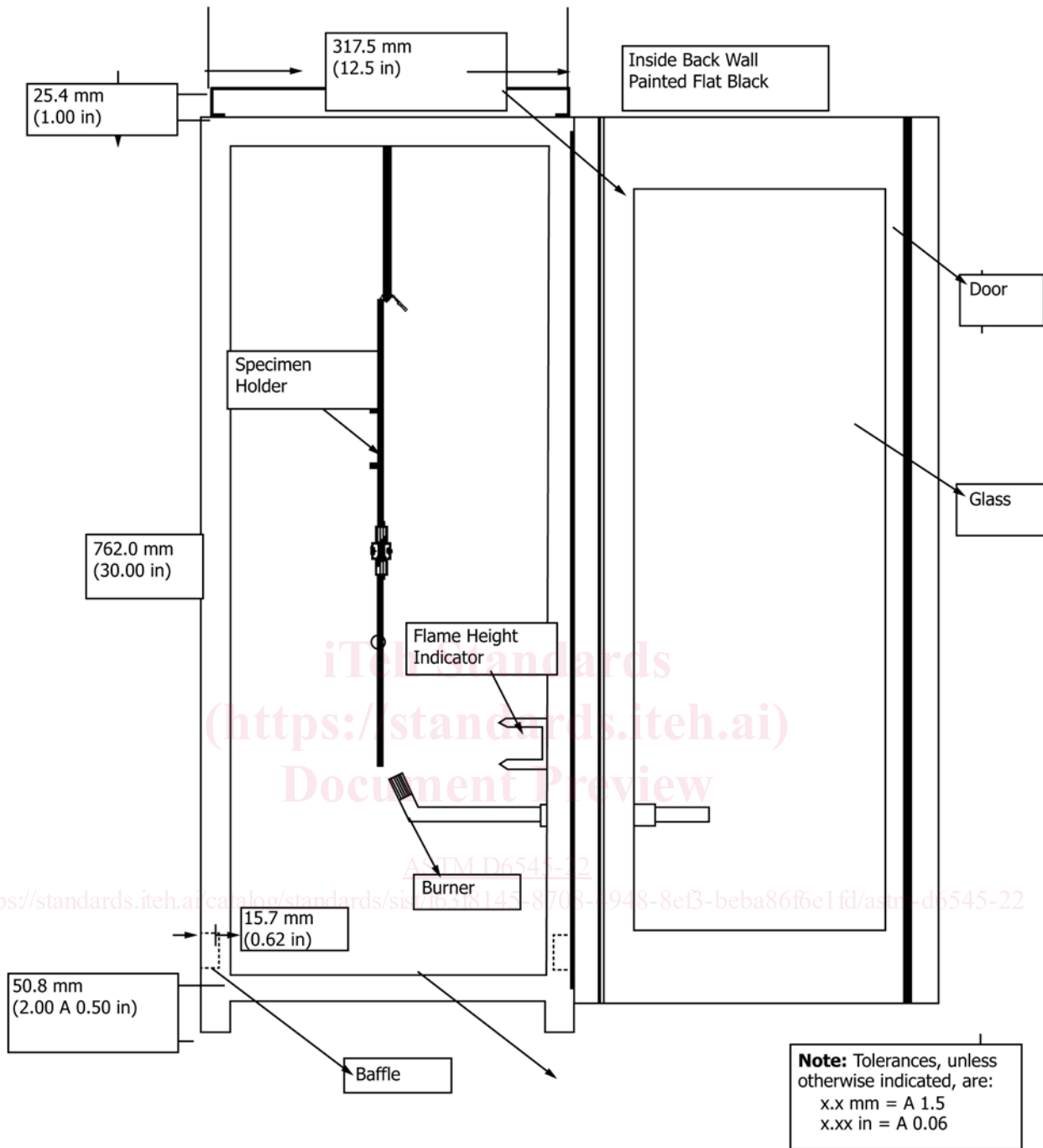


FIG. 2 Front View

8.3 Condition each specimen in a circulating oven at a temperature of $105\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ($221\text{ }^{\circ}\text{F} \pm 4\text{ }^{\circ}\text{F}$) for 30 min.

8.4 Remove the conditioned specimens from the conditioning oven and place them in the desiccator to cool for at least 30 min but not over 60 min. No more than five (5) specimens shall be placed in a desiccator at one time.

8.5 Handle the hot specimen holders with caution as they are placed into and removed from the conditioning oven. Use suitable gloves or tongs.

9. Procedure

9.1 With the hood fan turned off, turn on the gas supply and adjust the needle valve on the burner to obtain a flame height of approximately 38 mm (1.5 in.). Allow the burner to operate with the test cabinet door closed for at least 5 min. Upon completion of this operation, dim the room lights and adjust the flame height so that the distance from the uppermost edge of the burner to the tip of the visible portion of the flame is 38 mm

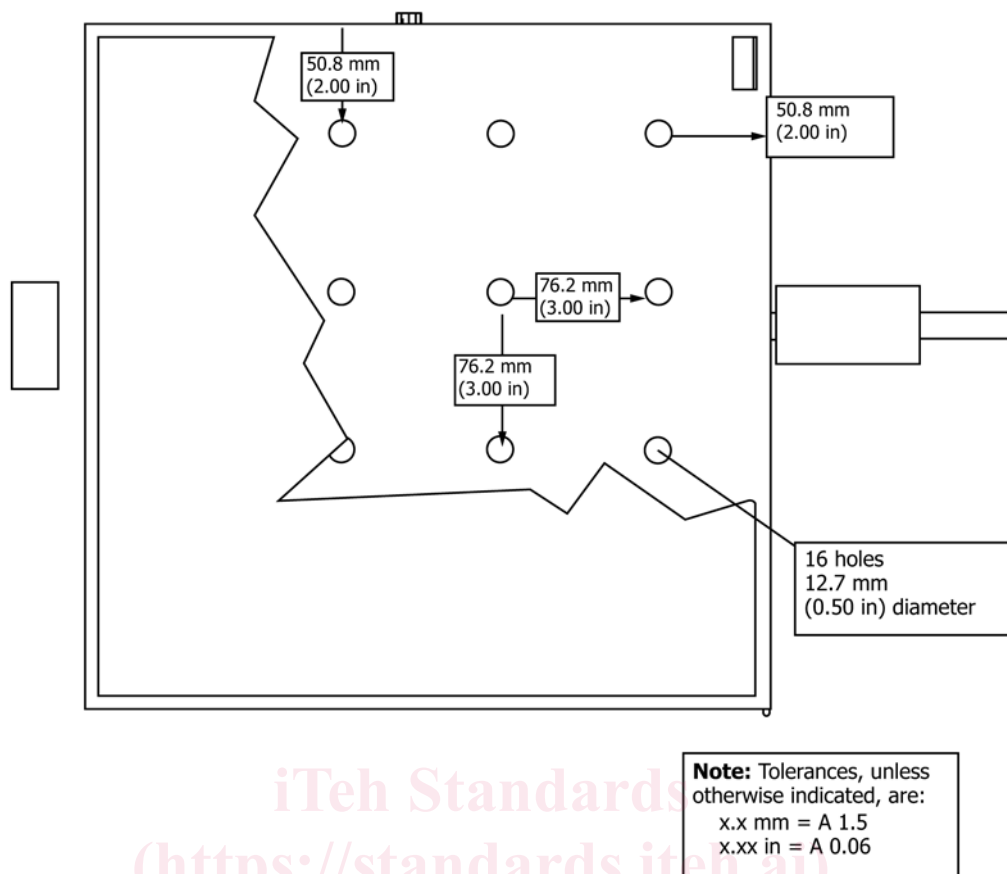


FIG. 3 Top View

± 2 mm (1.5 in. ± 0.1 in.). The flame height indicator shown in Fig. 6 has been found suitable for this purpose.

9.2 Remove a mounted specimen from the desiccator and place it on the interior test cabinet hanger and close the door. Move the flame into place so that the bottom edge of the specimen is located directly above the midpoint of the flame.

9.3 Ignite the specimen within 30 s of removing it from the desiccator. After the specimen is exposed to the igniting flame for 3.0 s \pm 0.2 s, pull the burner aside to terminate the exposure.

9.4 When all after flame and afterglow have extinguished, operate the hood fan for sufficient time to remove all combustion gases from the test cabinet and hood area. Also, be aware that fumes and combustion products in the test cabinet are noxious and potentially toxic. Avoid inhaling these fumes or use appropriate breathing apparatus.

9.5 Remove the specimen holder from the test cabinet. Use caution when handling the specimen holder and test specimen as it is possible that these articles will be hot to the touch.

9.6 Remove the specimen from the holder and crease it along a line through the highest peak of the charred or damaged area.

9.7 Unfold the specimen and insert one hook with the correct weight, as shown in Table 1, in the specimen on one side of the charred area 6.4 mm \pm 2.0 mm (0.25 in. \pm 0.1 in.) from the lower edge.

9.8 Gently lift the other corner of the specimen without the weight until the weight supported by the other hook is lifted above the work surface. This procedure causes the highly damaged areas to tear to the point that they will sustain the prescribed tensile load.

9.9 Using the scale, measure the char length as the distance from the end of the tear edge to the edge of the specimen exposed to the flame (see Fig. 9). Record this length on the test report.

9.10 Repeat 9.2 – 9.9 until the five specimens have been tested.

9.11 *Test Criteria*—The average of the char length values obtained for the five specimens and the maximum char lengths for each of the individual specimens constitute the test results.

10. Laundering

10.1 Launder and dry all sample fabrics through 50 complete laundering and drying cycles using the procedure specified in AATCC LP1 for the laundering machine being used.

10.1.1 Washing is performed using wash temperature 60 °C \pm 3 °C, 140 °F \pm 5 °F and the water level, agitator speed, washing time, spin speed and final spin cycled specified for “Normal/Cotton Sturdy”. A maximum washer load is 3.64 Kg (8 lb) and will consist of any combination of test samples and dummy pieces. Drying is performed in accordance with that

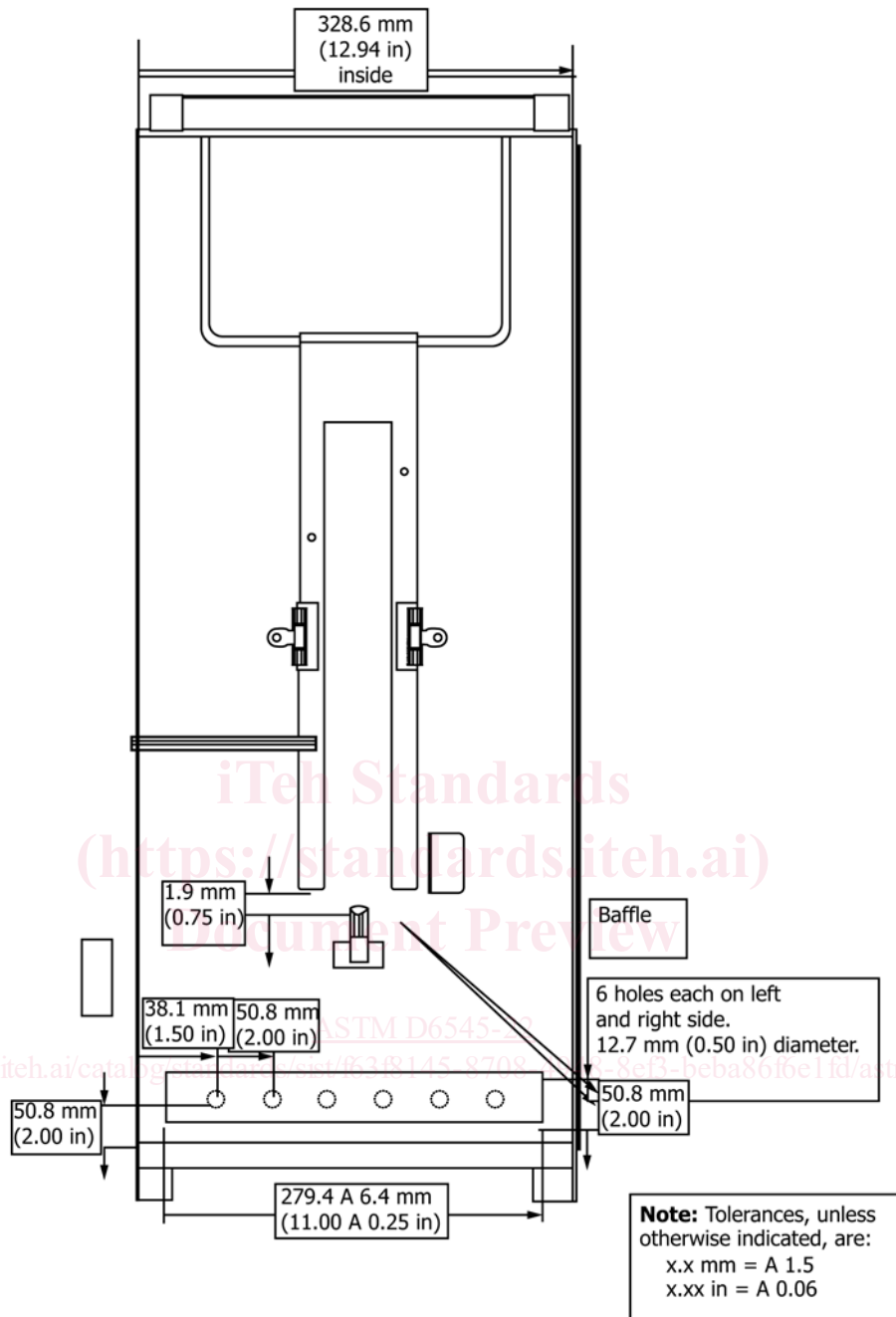


FIG. 4 Left-Side View (Left-Side Panel Removed)

test method, Tumble Dry, using temperature of $66\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$, $150\text{ }^{\circ}\text{F} \pm 10\text{ }^{\circ}\text{F}$ and cool down time of 10 min specified in the “Durable Press”.

10.2 From the laundered sample fabrics, cut, prepare, precondition, and condition the test specimens, in accordance with 9.2 – 9.10.

11. Report

11.1 Report the following information:

11.1.1 Date and time of test.

11.1.2 Name of testing technician.

11.1.3 Name of fabric manufacturer producing sample.

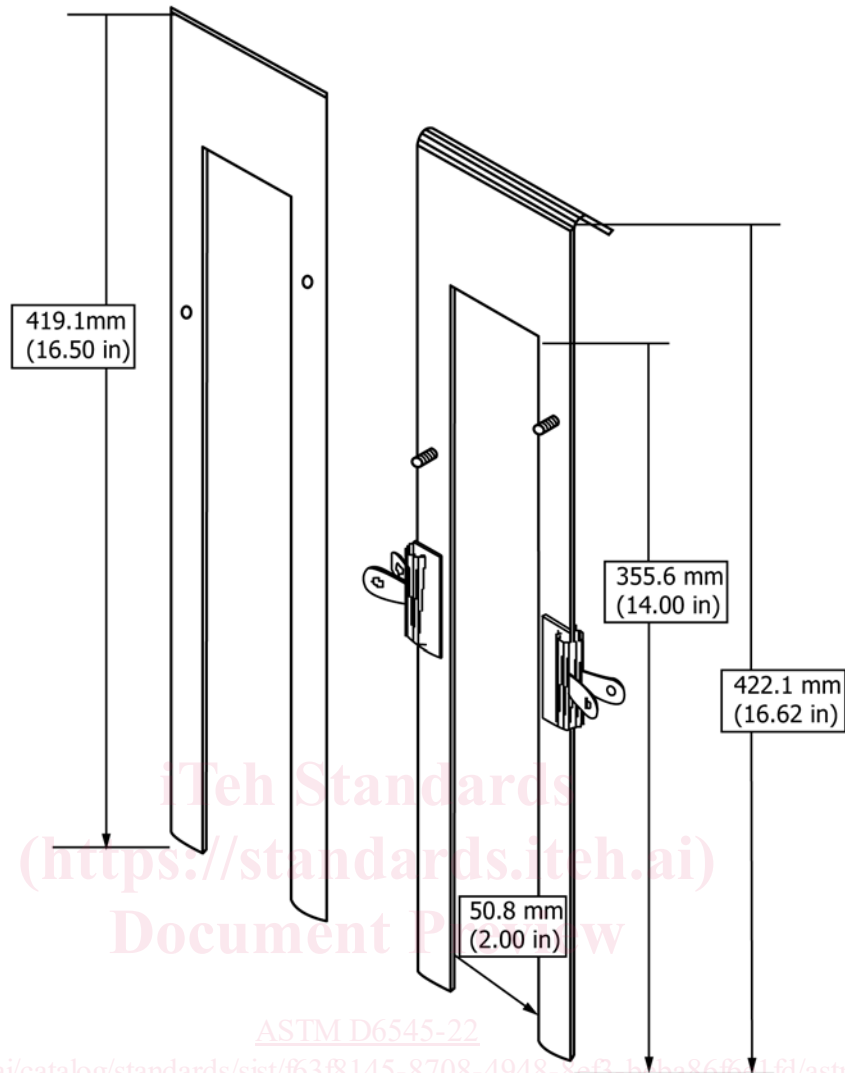
11.1.4 Style of fabric sample.

11.1.5 Color (or color number) of fabric sample.

11.1.6 If a print, print style and description of fabric sample.

11.1.7 Condition (as produced, after one laundering, after 50 launderings).

11.1.8 Laundering procedure used for the 50 launderings, if different than specified.



Material: Steel or stainless steel
Thickness: 1.9 mm, (0.074 in; 14 gauge USS)

Notes: Tolerances, unless otherwise indicated, are:
 x.x mm = A 1.5
 x.xx in = A 0.06

FIG. 5 Sample Holder, Plate (Left) and Frame with Clips

11.1.9 Char length of each of the five specimens, and the average of the five values.

12. Precision and Bias

12.1 *Single-Laboratory Study*⁷—In November, 1999, one laboratory tested two fabrics in accordance with this test method, reporting results for a number of samples taken from several manufacturing lots for each fabric style. Each sample contained five specimens, in which either three or two testing in the warp direction, with the remaining two of three in the fill direction. The average of the values from the five specimens was the test result.

⁷ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D13-1105.

12.1.1 Data for each fabric was analyzed separately, using analysis of variance. For each fabric style, neither lots, nor samples in lots, showed any significance in relation to error variance. Accordingly, the variance for each of the combined data sets was used to determine precision.

12.1.2 Average values and error variance for the two fabrics were different enough to warrant reporting precision for the fabrics separately.

12.2 *Temporary Precision*—On the basis of this single-laboratory determination, within-laboratory precision for each fabric is given as follows: