



Standard Performance Specification for Labeling Protective Clothing as Heat and Flame Resistant¹

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1. Scope

1.1 This specification provides minimum requirements for labeling protective clothing as heat and flame resistant for applications where the potential for flame contact or high heat exposure exist.

1.1.1 This specification includes requirements that define heat and flame resistance of materials used in protective clothing in a manner to limit the contribution of the clothing for causing injury to the wearer when exposed to high heat or flame.

1.1.2 This specification does not provide requirements that establish the level of protection provided by the clothing.

1.1.3 This specification does not include testing for the evaluation of the entire clothing item.

1.2 This specification does not pertain to materials and clothing that are addressed in other standards. See [Appendix X1](#) for a list of standards for heat and flame resistant protective clothing.

1.3 This specification does not pertain to applications where the conditions of potential flame contact or heat exposure are of an extended duration and/or are of a high intensity.

NOTE 1—Examples include fire fighting applications, exposure to high energy electrical arcs and exposures in flash fires.

1.4 The values stated in SI units or in other units shall be regarded separately as standard. The values stated in each system must be used independently of the other, without combining values in any way.

1.5 This standard 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 fire risk assessment of the materials, products, or assemblies under actual fire conditions.

1.6 The following precautionary caveat pertains only to the test methods portion, Section 8, of this specification: *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 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](#)

[D4391 Terminology Relating to The Burning Behavior of Textiles](#)

[D6413 Test Method for Flame Resistance of Textiles \(Vertical Test\)](#)

[E171 Practice for Conditioning and Testing Flexible Barrier Packaging](#)

[F1358 Test Method for Effects of Flame Impingement on Materials Used in Protective Clothing Not Designated Primarily for Flame Resistance](#)

[F1494 Terminology Relating to Protective Clothing](#)

2.2 AATCC Standards:³

[AATCC 132 Colorfastness to Drycleaning](#)

[AATCC 135 Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics](#)

2.3 ISO Standards:

[ISO 17493 Clothing for protection against heat and flame—Test method for convective heat resistance using a hot air circulating oven⁴](#)

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, related to the combustion of textiles, refer to the terminology contained in Terminology [D4391](#). For definitions of terms used in this test method, related to protective clothing, refer to the terminology contained in Terminology [F1494](#). For definitions of terms used in this test method, related to textile issues, refer to the terminology contained in Terminology [D123](#).

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, <http://www.aatcc.org>.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

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3.2 *afterflame, n*—persistent flaming of a material after the ignition source has been removed.

3.3 *afterflame time, n*—the length of time for which a material continues to flame after the ignition source has been removed.

3.4 *afterglow, n*—a glow in a material after the removal of an external ignition source, after the cessation (natural or induced) of flaming of the material (see also *glow*).

3.5 *burning behavior, n*—all the changes that take place when materials or products are exposed to a specified ignition source.

3.6 *burn distance, n*—the measurement from the bottom edge of the specimen to the farthest point that shows evidence of damage due to combustion.

3.6.1 *Discussion*—In this specification, burn distance is used when testing is performed in accordance with Test Method **F1358**.

3.7 *char length, n*—in measuring flame resistance of textiles, the distance from the fabric edge, which is directly exposed to the flame to the furthest point of visible fabric damage after a specified tearing force has been applied.

3.7.1 *Discussion*—In this specification, char length is reported when testing is performed in accordance with Test Method **D6413**.

3.8 *charring, n*—the formation of carbonaceous residue as the result of pyrolysis or incomplete combustion.

3.9 *combustion, n*—a chemical process of oxidation that occurs at a rate fast enough to produce heat and usually light either as glow or flames.

3.10 *dripping, n*—a material response evidenced by flowing of the polymer.

3.10.1 *Discussion*—In evaluating the effects of flame contact or heat exposure of materials used in protective clothing, dripping may be the formation of liquid droplets from melted surface or substrate material during flame impingement or high heat exposure.

3.11 *embrittlement, n*—the formation of a brittle residue as the result of pyrolysis or incomplete combustion.

3.12 *flame, n*—as related to ignition of textiles, a controlled hot luminous zone of gas or matter in gaseous suspension, or both, of constant size and shape that is undergoing combustion as evidenced by a low-intensity, heat source of less than 1 kW, such as a candle flame or match flame.

3.12.1 *Discussion*—Examples are flames from a match, candle, or bunsen burner. The burner flame in this test method produces relatively low heat flux and should be constant in size and shape.

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

3.14 *flame resistance, n*—the property of a material whereby flaming combustion is prevented, terminated, or inhibited following application of a flaming or nonflaming source of ignition, with or without the subsequent removal of the ignition source.

3.14.1 *Discussion*—In this specification, flame resistance is

demonstrated by testing to Test Method **D6413** or Test Method **F1358** and meeting specific performance criteria.

3.15 *flammability, n*—those characteristics of a material that pertain to its ignition and support of combustion.

3.16 *glow, n*—visible, flameless combustion of the solid phase of a material.

3.16.1 *Discussion*—Although a solid may glow, it can also produce combustible discharge that will cause a flame. These two phenomena are not necessarily interdependent.

3.17 *heat resistance, n*—the extent to which a material retains useful properties as measured after exposure of the material to a specified temperature and environment for a specified time.

3.17.1 *Discussion*—In this specification, heat resistance or the heat stability of the material is demonstrated by testing in accordance with ISO 14793 at a temperature of 260°C [500°F] for five minutes without ignition, melting, dripping, or separation of the material and without material shrinkage greater than 10 %.

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

3.18.1 *Discussion*—In evaluating the effects of flame contact or heat exposure of materials used in protective clothing, ignition is determined by the presence of afterflame after the removal of the burner flame or when observing the condition of the specimen(s) inside the oven after opening the oven door.

3.19 *melting, n*—a material response evidenced by softening of the polymer.

3.19.1 *Discussion*—In evaluating the effects of flame contact or heat exposure of materials used in protective clothing, melting may occur at surface layers or in combination with the substrate fabric(s) or other polymer layers. Melting may be observed for protective clothing materials that involve a polymer coating or laminate combined with a flame-resistant fabric or substrate.

3.20 *protective clothing, n*—an item of clothing that is specifically designed and constructed for the intended purpose of isolating all or part of the body from a potential hazard; or, isolating the external environment from contamination by the wearer of the clothing.

3.21 *separation, n*—in testing thermal protective clothing, the partial or full detachment of one or more layers comprising a material

3.21.1 *Discussion*—In evaluating the effects of heat exposure, separation occurs when the face cloth detaches from the batting for quilted material or if a film or coating lifts from a substrate fabric.

3.22 *shrinkage, n*—a decrease in one or more dimensions of an object or material.

3.22.1 *Discussion*—In evaluating the effects of flame contact or heat exposure, these changes in dimensions are caused by heat from the flame source or convection within the oven.

4. Significance and Use

4.1 This specification is used to establish the minimum requirements for labeling protective clothing as heat and flame resistant. Testing is performed on the product in both an “as

received” condition and after ten laundering or dry cleaning cycles using standardized procedures. Users of this specification are also permitted to use laundering or dry cleaning procedures for conditioning samples as specified in the manufacturer’s care instructions for a minimum of ten cycles.

4.2 This specification is not intended to replace standards that have already been developed for specific types of flame and heat resistant protective clothing, including clothing for protection from flash fire, clothing for protection against electric arc, and protective clothing for various fire fighting and emergency response applications. See [Appendix X1](#) for a list of specifications for specific types of heat and flame resistant protective clothing.

4.3 This specification does not address all areas of protective clothing performance for heat and flame exposure. For example, the specification does not address insulation provided by these garments. Rather this specification is designed to provide an assessment of the potential of the clothing itself to become a hazard to the wearer if exposed to flame and high heat.

4.4 This specification does not provide an overall evaluation of the clothing’s flame or heat resistance. Instead, heat and flame resistance tests of the primary materials used in the construction of the clothing are used to assess clothing heat and flame resistance. This specification permits excluding testing of clothing components that are not in direct contact with the body during normal wearing. Therefore, it is important that users of this specification recognize that certain components, based on their composition, size, and location could contribute to burn injury in the event of a high heat or flame exposure.

5. Requirements

5.1 Test the materials used in the construction of protective clothing items for heat and flame resistance as specified in Section 8. Elastic, hook and loop fastener, closures, labels, emblems, patches and other clothing components, when not in contact with the wearer’s body in the normal wearing of the garment, shall be permitted to be excluded from testing. All tested materials shall meet the minimum criteria provided in [Table 1](#).

NOTE 2—While this specification permits excluding elastic, hook and loop fastener, closures, labels, emblems, patches, and other clothing components from testing, users of the specification are cautioned that

TABLE 1

Property	Measurement	Requirement
Flame Resistance	Afterflame	≤2 s
	Char length ^A or burn distance ^B	≤ 150 mm [6 in.]
	Burning behavior	No melting and dripping
Heat Resistance	Observation of material condition	No ignition, melting, dripping, or separation
	Thermal shrinkage	≤ 10 %

^AChar length is provided when testing is conducted in accordance with Test Method [D6413](#).

^BBurn distance is provided when testing is conducted in accordance with Test Method [F1358](#) for materials that have different interior and exterior sides.

these components could contribute to burn injury depending on their composition, size, and location on the protective clothing item being labeled.

6. Sampling

6.1 Testing shall be performed on material specimens removed from manufactured protective clothing.

6.2 Testing shall also be permitted to be performed on material samples representative of the materials used in the construction of the garment.

7. Conditioning

7.1 *General*—Subject material samples to both room temperature and laundering (or dry cleaning) conditioning prior to testing. For disposable protective clothing or protective clothing intended only for a single use, do not launder or dry clean. For protective clothing indicated or labeled as washable, subject material samples to room temperature and laundering conditioning, specified in [7.2](#) and [7.3](#), respectively. For protective clothing indicated or labeled as dry clean only, subject material specimens to room temperature and dry cleaning conditioning, specified in [7.2](#) and [7.4](#), respectively. For protective clothing indicated or labeled for washing and dry cleaning, subject separate material samples to room temperature, laundering, and dry cleaning conditioning, specified in [7.2](#), [7.3](#), and [7.4](#), respectively.

7.2 *Room Temperature Conditioning*—Condition garment or material samples at a temperature of $21 \pm 3^\circ\text{C}$ [$70 \pm 5^\circ\text{F}$] and at a relative humidity of $65 \pm 5\%$ for at least 24 h in accordance with Specification [E171](#).

7.3 *Laundering Conditioning*—Launder garment or material samples in accordance with AATCC 135 using Machine Cycle 1, Washing Temperature III, and Drying Procedure Ai for a total of ten cycles. It shall also be permitted to launder garment or materials samples in accordance with the care instructions provided with the garment for at least ten laundering cycles or for the maximum number of laundering cycles that the manufacturer is claiming for this specification.

7.4 *Dry Cleaning Conditioning*—Dry clean garment or material samples in accordance with AATCC 132 for a total of ten cycles. It shall also be permitted to dry clean garment or material samples in accordance with the care instructions provided with the garment for at least ten dry cleaning cycles or the maximum number of laundering cycles that the manufacturer is claiming for this specification.

8. Test Methods

8.1 *Flame Resistance Test*—Measure material flame resistance in accordance with Test Method [D6413](#) using the conditions established in Section 7. Report afterflame time and char length, and for burning behavior, report whether melting and dripping occurs. Afterglow measurements are not used for compliance. Note other types of burning behavior, including charring, embrittlement, or other observations for information purposes only.

8.1.1 *Alternative Flame Resistance Test*—If the material to be tested has different interior and exterior surfaces, use flame

resistance in accordance with Test Method **F1358** using a flame application time of twelve seconds, following the conditions established in Section 7. Report afterflame time and burn distance, and for burning behavior, report whether melting and dripping occurs. Afterglow measurements are not used for compliance. Note other types of burning behavior, including charring, embrittlement, or other observations for information purposes only. If the alternative flame resistance test is used, identify that flame resistance testing was performed in accordance with Test Method **F1358** in the test report.

NOTE 3—Test Method **F1358** differs from Test Method **D6413** in that a folded edge of the material is exposed to the flame source instead of a cut edge and that burn distance is used in lieu of char length. Test Method **F1358** is considered more appropriate for materials where the interior surface is permitted to be substantially different than exterior surface. However, testing of these materials shall still be permitted to be performed using Test Method **D6413**.

8.1.2 *Flame Resistance Testing of Small Specimens*—If the material to be tested has a width that is less than 75 mm [3 in.] as required by either Test Method **D6413** or Test Method **F1358**, affix the smaller width material onto the base material used in the garment, in a manner representative of the normal construction methods used for the garment. Orient the smaller width material such that its long dimension is parallel with the length of the specimen holder.

8.2 *Heat Resistance Test*—Evaluate material heat resistance in accordance with ISO 17493 at 260°C for five minutes with observation of material condition and measurement of thermal shrinkage. Do not measure thermal shrinkage for ancillary materials such as reflective striping or other materials used as findings for the construction of the garment.

8.2.1 *Heat Resistance Testing of Small Specimens*—If the material to be tested is not of a sufficient size as required by

ISO 17493, affix the largest possible size of sample onto the base material used in the garment, in a manner representative of the normal construction methods used for the garment.

9. Labeling

9.1 Minimum information on label to include:

9.1.1 The name of the protective clothing manufacturer

9.1.2 The name or style number for the specific item of protective clothing

9.1.3 Care instructions for the protective clothing

9.1.4 If the garment is not intended to be reused, state “FOR SINGLE USE ONLY.”

9.1.5 A statement indicating compliance to this specification

9.1.6 Information related to the use and limitations of use for the item of protective clothing.

9.2 The manufacturer shall be permitted to provide information on the use and limitations of use for the item of protective clothing in separate user information if an indication is provided on the label to refer to the separate user information and the user information is provided with the protective clothing item.

10. Certification

10.1 When specified in the purchase order or contract, a producer’s or supplier’s certification shall be furnished to the purchaser that the material was sampled, conditioned and tested in accordance with this specification and has been found to meet the requirements.

10.2 If specified in the purchase order or contract, a report of the test results shall be furnished to the purchaser.

11. Keywords

11.1 flame resistant; FR; heat resistant; protective clothing

APPENDIX

(Nonmandatory Information)

X1. LIST OF STANDARDS FOR HEAT AND FLAME RESISTANT PROTECTIVE CLOTHING

X1.1 Referenced Documents

X1.1.1 *ASTM Standards*.²

F1002 Performance Specification for Protective Clothing for Use by Workers Exposed to Specific Molten Substances and Related Thermal Hazards

F1506 Performance Specification for Flame Resistant and Arc Rated Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards

F1891 Specification for Arc and Flame Resistant Rainwear

X1.1.2 *CGSB Standards*.⁵

CGSB 155.1 Firefighters’ Protective Clothing for Protection Against Heat and Flame

CGSB 155.20 Workwear for Protection Against Hydrocarbon Flash Fire

CGSB 155.22 Fireline Workwear for Forest Firefighters

X1.1.3 *NFPA Standards*.⁶

NFPA 1951 Standard on Protective Ensemble for Urban Search and Rescue Operations

NFPA 1975 Standard on Station/Work Uniforms

NFPA 1971 Standard on Protective Ensemble for Structural Fire Fighting

NFPA 1976 Standard on Protective Ensemble for Proximity Fire Fighting

⁵ Available from Canadian General Standards Board, CGSB Sales Centre, Ottawa, Ontario, Canada K1A 1G6

⁶ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

NFPA 1977 Standard on Protective Clothing and Equipment for Wildland Fire Fighting

NFPA 2112 Standard on Flame Resistant Garments for Protection against Accidental Flash Fire for Industrial Workers

NFPA 2113 Standard on Selection, Care, Use and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire

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