Designation: F1506 – 10

Standard Performance Specification for Flame Resistant Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards[1]

This standard is issued under the fixed designation F1506; 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 performance specification covers the flame resistance of textile materials to be used for wearing apparel for use by electrical workers exposed to momentary electric arc and related thermal hazards.

NOTE 1—This performance specification does not cover coated fabrics commonly used in rainwear.

NOTE 2—At present, a bench scale arc test for laboratory use is not available. It is the intent of the committee to continue the search for an acceptable laboratory test based on either an electric arc exposure or an acceptable alternative, which will form the basis of a modification of this performance specification.

1.2 Materials used for basic protection levels are covered.

1.3 Protective properties relate to thermal exposure from momentary arc and associated exposure to open flame and radiant heat. (See Appendix X1.)

1.4 This performance specification covers wearing apparel design characteristics that relate specifically to protection from exposure to momentary electric arc and that relate to the utility of the wearing apparel.

NOTE 3—A number of other thermal test methods are under consideration and development and, when evaluated and proved effective by Committee F18, will be incorporated in either this performance specification or an appropriate alternative test method or specification.

1.5 *This standard should be used to evaluate and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions. It should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions.*

1.5.1 The results of this evaluation may be used as elements of a fire-risk assessment that takes into account all of the factors that are pertinent to an assessment of the fire hazard of a particular end use.

1.6 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.7 The following precautionary caveat pertains only to the test methods portion, Section 7, of this performance 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

D434 Test Method for Resistance to Slippage of Yarns in Woven Fabrics Using a Standard Seam[3]

D1424 Test Method for Tearing Strength of Fabrics by Falling-Pendulum (Elmendorf-Type) Apparatus

D2262 Test Method for Tearing Strength of Woven Fabrics by the Tongue (Single Rip) Method (Constant-Rate-of-Traverse Tensile Testing Machine)[3]

D2724 Test Methods for Bonded, Fused, and Laminated Apparel Fabrics

D3786 Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method

D5034 Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)

D6413 Test Method for Flame Resistance of Textiles (Vertical Test)

F1449 Guide for Industrial Laundering of Flame, Thermal, and Arc Resistant Clothing

F1959/F1959M Test Method for Determining the Arc Rating of Materials for Clothing

[1] This performance specification is under the jurisdiction of ASTM Committee F18 on Electrical Protective Equipment for Workers and is the direct responsibility of Subcommittee F18.65 on Wearing Apparel.

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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] Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.

2.2 *AATCC Test Methods:*[4]
Method 61 Colorfastness to Washing, Domestic and Laundering, Commercial: Accelerated
Method 132 Colorfastness to Dry-Cleaning
Method 135 Dimensional Changes Automatic Home Laundering of Woven and Knitted Fabrics
Method 158 Dimensional Changes on Drycleaning in Perchloroethylene: Machine Method
2.3 *Federal Standard:*[5]
Test Method 191A, 1534

3. Terminology

3.1 *Definitions*—For definitions of textile terms used in this performance specification, refer to Terminology D123.

3.2 *Definitions of Terms Specific to This Standard:*

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

3.2.1.1 *Discussion*—In arc testing, a visible flaming on or near a test specimen which persists after the arc exposure has ended. The afterflame ceases when flaming is no longer visible.

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

3.2.2.1 *Discussion*—In arc testing, the length of time for which a specimen continues to exhibit a visible flaming as determined by a time display video recording of the specimen during arc testing.

3.2.3 *arc rating*, *n*—value attributed to materials that describes their performance to exposure to an electrical arc discharge.

3.2.3.1 *Discussion*—The arc rating is expressed in cal/cm^2 and is derived from the determined value of ATPV or E_{BT} (should a material system exhibit a breakopen response below the ATPV value).

3.2.4 *arc thermal performance value (ATPV)*, *n—in arc testing*, the incident energy on a material or a multilayer system of materials that results in a 50 % probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll[6] curve, cal/cm^2.

3.2.5 *basic protection level*—the level of protection provided by flame-resistant materials that do not continue to burn after exposure to and removal of a source of ignition (see 7.6).

3.2.6 *basic protection level wearing apparel*—clothing intended for continuous wear for work activities in designated locations in which exposure to momentary electric arc and related radiant heat and open-flame sources is possible.

3.2.7 *breakopen threshold energy (E_{BT})*, *n*—the incident energy on a material or material system that results in a 50 % probability of breakopen.

3.2.7.1 *Discussion*—This is the value in J/cm^2(cal/cm^2) determined by use of logistic regression analysis representing the energy at which breakopen of the layer occurred.

3.2.8 *design test*, *n*—for arc and flame resistant textile materials, one made on a sample treated as representative of an industrial product; these tests will not generally be repeated in quantity production.

3.2.8.1 *Discussion*—Perform the design test only when a new or modified textile material, that is, fabric, is used to manufacture apparel. A modification in the fabric could be, but is not limited to, any of the following: the supplier, composition, weave type, weight, or dyeing and finishing process.

3.2.9 *findings*—miscellaneous fabrics in garments such as zipper tapes, linings, pockets, waistbands, and facings.

3.2.10 *momentary electric arc*—a discharge of electricity through a gaseous media, normally characterized by a voltage drop in the immediate vicinity of the electrodes, approximately equal to the ionization potential of the gaseous media.

3.2.11 *radiant heat*—heat communicated by energy propagated through space and transmitted by electromagnetic waves.

3.2.12 *thermal hazard*—the heat energy sufficient to cause burn injury to human tissue subjected to a momentary electric arc.

3.2.13 *user*—the employer or entity purchasing the equipment to be utilized by workers for their protection; in the absence of such an employer or entity, the individual purchasing and utilizing the protective equipment.

4. Significance and Use

4.1 This performance specification provides performance properties for textile materials used in wearing apparel that represent initial minimum requirements for basic protection levels.

4.1.1 The performance properties have been selected based on materials in use and take into consideration durability requirements for specific apparel.

4.2 Work practices vary from user to user depending upon many factors. These may include, but are not limited to, operating system voltages, construction design, work procedure or techniques, and weather conditions. Therefore, except for the restrictions set forth in this performance specification because of design limitations, the use and maintenance of this equipment is beyond the scope of this performance specification.

4.2.1 It is common practice and the responsibility of the user of this type of protective equipment to prepare complete instructions and regulations to govern in detail the correct and safe use of such equipment.

5. Materials and Manufacture

5.1 Material tests shall be performed on textile materials as they are delivered to the clothing manufacturer.

5.1.1 Material tests may be performed on samples taken from finished garments.

5.2 Lot size for the initial (without laundering) flammability test shall be 4572 m (5000 yd) of manufactured fabric or the manufactured yardage, whichever is less. One sample of 1.0 m shall be taken from each lot.

[4] *AATCC Technical Manual*, available from American Association of Textile Chemists and Colorists, PO Box 12215, Research Triangle Park, NC 27709-2215.

[5] Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111–5094, Attn: NPODS.

[6] Derived from: Stoll, A. M., and Chianta, M. A., "Method and Rating System for Evaluations of Thermal Protection," *Aerospace Medicine*, Vol 40, 1969, pp. 1232-1238 and Stoll, A. M., and Chianta, M. A., "Heat Transfer through Fabrics as Related to Thermal Injury," *Transactions—New York Academy of Sciences*, Vol 33(7) , Nov. 1971, pp. 649-670.