Designation: F1358 – 16

Standard Test Method for Effects of Flame Impingement on Materials Used in Protective Clothing Not Designated Primarily for Flame Resistance[1]

This standard is issued under the fixed designation F1358; 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 establishes a small-scale laboratory screening procedure for comparing the ignition resistance and burning characteristics of materials used in protective clothing where flame resistance is not the primary form of protection provided by the clothing.

1.1.1 This test method shall not be used in application where flame resistance is the primary form of protection offered by the protective clothing. Other flammability test methods are more appropriate for those materials.

1.1.2 This test method provides a means for comparing ease of ignition and burning behavior of materials which include plastic or elastomeric films, coated fabrics, flexible laminates, multilayer-material systems, or other protective clothing materials that are not designated for offering flame resistance as their primary form of protection.

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.

1.4 The values stated in SI units or other units shall be regarded separately as standard. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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 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

D4723 Classification Index of and Descriptions of Textile Flammability Test Methods (Withdrawn 2016)[3]

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

F1494 Terminology Relating to Protective Clothing

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, 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.

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

3.3 *after-flame 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 or after the cessation (natural or induced) of flaming of the material (see also *glow*).

3.5 *anisotropic, adj*—having different values for a specific property in different directions.

[1] This test method is under the jurisdiction of ASTM Committee F23 on Personal Protective Clothing and Equipment and is the direct responsibility of Subcommittee F23.80 on Flame and Thermal.

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

3.5.1 *Discussion*—When this test method is used to evaluate textile-based materials, this term refers to warp (wale) and filling (course) directions. When this test method is used for nonwoven materials, this term refers to machine and cross-machine directions.

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

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

3.7.1 *Discussion*—In evaluating the effects of flame impingement of materials used in protective clothing, this measurement applies to the folded material specimen when pressed flat and includes all areas partially burned, charred, embrittled, or melted, but not including areas sooted, stained, distorted, or discolored. Damage due to mechanical delamination or splitting of the specimen is not included in the burn distance unless the delaminated or split area includes damage due to combustion.

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—in testing thermal protective material,* a material response evidenced by flowing of the polymer.

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

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*—The burner flame in this test method produces relatively low heat flux and should be constant in size and shape.

3.13 *flame impingement, n*—direct contact between a flame and a material.

3.13.1 *Discussion*—In testing flame impingement of materials used in protective clothing, the flame is of a specified type and duration.

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

3.14.1 *Discussion*—In evaluating the effects of flame impingement of materials used in protective clothing, flammability is based on the relative number of specimens that ignite when exposed to flame either for a period of 3 or 12 s.

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

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

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

3.16.1 *Discussion*—In evaluating the effects of flame impingement of material used in protective clothing, ignition is determined by the presence of after-flame after the removal of the burner flame.

3.17 *melting, n—in testing thermal protective material,* a material response evidenced by softening of the polymer.

3.17.1 *Discussion*—In evaluating the effects of flame impingement 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 which involve a polymer coating or laminate combined with a normally flame-resistant fabric or substrate.

3.18 *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.

3.18.1 *Discussion*—In this test method the potential hazard is *flame impingement* on protective clothing where flame resistance is not the primary form of protection offered by that clothing.

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

3.19.1 *Discussion*—In evaluating the effects of flame impingement, these changes in dimension are caused by heat from the flame source.

4. Summary of Test Method

4.1 A conditioned specimen of a protective clothing material is folded in half and placed in a sample holder with the folded edge suspended over a gas flame.

4.2 The specimen is exposed to the flame for a 3-s interval.

4.2.1 If the material ignites during this exposure, the after-flame time, afterglow time, and burn distance of the specimen are measured and reported. Any observations of burning behavior are also reported. The test is then terminated.

4.3 If the material does not ignite after the first exposure, the same specimen is exposed to the flame for a 12-s interval. The after-flame time, afterglow time, and burn distance of the specimen are measured and reported. Any observations of burning behavior are also reported.

4.4 Alternative procedures are provided for conducting the 3-s or 12-s exposures only.

5. Significance and Use

5.1 This test method is intended to determine the ignition resistance and burning characteristics of materials used in protective clothing, where flame resistance is not the primary form of protection designated.