Designation: F1002 – 15 (Reapproved 2021)

Standard Performance Specification for Protective Clothing and Materials for Use by Workers Exposed to Specific Molten Substances and Related Thermal Hazards[1]

This standard is issued under the fixed designation F1002; 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 establishes the minimum design and performance requirements for protective clothing and protective clothing materials for both primary and secondary protection from exposure to molten substances and related thermal hazards.

1.2 This performance specification is not intended to address protection from hot liquids or from specialized forms of heat and flame protection such as any fire fighting application.

1.3 This performance specification describes the properties of specific textile materials in their material or garment composite form as tested by laboratory methods and is not intended to be used to appraise the thermal hazard or risk under actual conditions. However, it is acceptable to use information on the thermal performance of clothing made from textile materials conforming to this specification as an element in thermal risk assessment which takes into account all factors pertinent to the thermal hazard of a particular end use.

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

1.5 *This performance specification does not purport to address all of the safety concerns, if any, associated with the use of compliant protective clothing or protective clothing materials. It is the responsibility of the persons or organizations that use this performance specification to conduct a hazard and risk assessment to determine the applicability of this performance specification to the intended application of the protective clothing or protective clothing materials, and to establish appropriate safety, health, and environmental practices.*

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

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

D2724 Test Method for Bond Strength of Bonded, Fused, and Laminated Apparel Fabrics

D4157 Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)

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

D5587 Test Method for Tearing Strength of Fabrics by Trapezoid Procedure

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

D7138 Test Method to Determine Melting Temperature of Synthetic Fibers

F955 Test Method for Evaluating Heat Transfer Through Materials for Protective Clothing Upon Contact with Molten Substances

F1494 Terminology Relating to Protective Clothing

F1939 Test Method for Radiant Heat Resistance of Flame Resistant Clothing Materials with Continuous Heating

2.2 *AATCC Test Method:*[3]

AATCC 135 Dimensional Changes in Automatic Home Laundering of Woven and Knitted Fabrics

[1] This specification 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] AATCC Technical Manual, Current Edition available from American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

2.3 *NFPA Standard:*[4]

NFPA 1971 Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting

2.4 *Federal Standard:*[5]

MIL-C-87076A Resistance of Materials to Radiant Heat Exposure, Adhesion of Coating, and Adhesion After Wet Flexing

2.5 *ISO Standards:*[6]

ISO 9185 Protective Clothing—Assessment of Resistance of Materials to Molten Metal Splash

EN ISO 11612 Protective Clothing—Clothing to Protect Against Heat and Flame

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this performance specification, use the following documents: If the terms are related to textiles, refer to Terminology D123; if the terms are related to protective clothing, refer to Terminology F1494.

3.1.2 *breakopen*—in testing thermal protective material, a response evidenced by the formation of a hole in the material which has the potential to allow molten substance to pass through the material.

3.1.3 *charring*—the formation of a carbonaceous residue as the result of pyrolysis or incomplete combustion.

3.1.3.1 *Discussion*—Charring can be accompanied by melting, dripping, or ignition, or combinations thereof.

3.1.4 *design test, n*—one made on a sample treated as representative of a protective material; these tests will not generally be repeated in quantity production.

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

3.1.5 *molten substances*—metals in their liquefied, elevated temperature state, as well as related non-metallic substances also handled at elevated temperatures such as slag, dross, and salt. Excluded are liquid hot substances that may be associated with metal processing such as water, oil, and caustic solutions.

3.1.5.1 *Discussion*—For the purposes of this specification, molten metals include liquefied metals such as iron, steel, aluminum, brass, and various alloys, and non-metallic substances liquefied at elevated temperatures such as slag, dross, and salt. Hot liquid substances such as water, oil, and caustic solutions are excluded from this specification.

3.1.6 *primary protective clothing*—protective clothing designed to be worn for work activities during which significant exposure to molten substance splash, radiant heat, and flame is likely to occur.

3.1.6.1 *Discussion*—Primary protective clothing is used in work activities that include charging, tapping, and pouring, during which work is carried out in close proximity to molten substances and hot surfaces where contact with either is likely.

3.1.7 *protective clothing*—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.

3.1.7.1 *Discussion*—For the purposes of this specification, protective clothing items include full-body garments such as coats, jackets, pants, overalls, and coveralls, and partial-body clothing such as aprons, hoods, sleeves, leggings, chaps, and spats.

3.1.8 *protective clothing material*—any element, constituent, or substance from which protective clothing is composed or can be made.

3.1.8.1 *Discussion*—For the purposes of this specification, protective clothing materials include the principal material used in the construction of either primary or secondary protective clothing, and may include more than one separable layer.

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

3.1.9.1 *Discussion*—For the purposes of this specification, radiant heat exposure occurs from close proximity to molten substances or hot surfaces containing molten substances.

3.1.10 *radiant heat resistance (RHR)*—in testing of thermal protective materials, the cumulative amount of thermal exposure energy identified by the intersection of the measured time-dependent heat transfer response through the subject material to a time-dependent, empirical performance curve, expressed as a rating or value: kJ/m^2 (cal/cm^2).

3.1.11 *secondary protective clothing*—protective clothing designed for continuous wear for work activities in designated locations in which intermittent and incidental exposure to molten substance splash, radiant heat, and flame sources is possible.

3.1.11.1 *Discussion*—Secondary protective clothing is designed so that it will not continue to burn after exposure to and removal of a source of ignition that includes incidental contact with a molten substance. Limited protection against a molten substance splash and high levels of radiant heat are secondary in intent and are dependent on the extent, duration, and other circumstances related to the exposure. Primary protective clothing must supplement secondary protective clothing where more severe exposures are encountered.

3.1.12 *thermal hazard*—relates to the laboratory test methods employed to measure thermal characteristics and to predict burn injury potential for burn injury involving exposure to flame or high heat as may be encountered in the workplace.

3.1.12.1 *Discussion*—For the purposes of this specification, thermal hazards include exposure high levels of radiant heat or contact with hot surfaces.

[4] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101.

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

[6] Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.