



Designation: F 1002 – 05

Standard Performance Specification for Protective Clothing for Use by Workers Exposed to Specific Molten Substances and Related Thermal Hazards¹

This standard is issued under the fixed designation F 1002; 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 textile materials to be used for protective clothing.

1.2 Materials used for both primary protection and for secondary protection are covered.

1.3 Protective properties relate to contact with molten substances and hot surfaces, and exposure to open flame and radiant heat.

1.4 This performance specification covers clothing design characteristics that relate to the unique protective requirements of working with molten substances.

1.5 This performance specification describes the properties of specific textile materials in their fabric or garment composite form as tested by laboratory methods and is not intended to be used to appraise the thermal hazard or fire risk under actual conditions. However, information on the thermal performance of clothing made from textile materials conforming to this specification may be used as an element in thermal risk assessment which takes into account all factors pertinent to the thermal 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 brackets are for information only.

1.7 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

D 1424 Test Method for Tearing Strength of Fabrics by Falling Pendulum (Elmendorf) Apparatus

D 2262 Test Method for Tearing Strength of Woven Fabrics by the Tongue (Single Rip) Method (Constant-Rate-of-Traverse Tensile Testing Machine)³

D 2724 Test Methods for Bonded, Fused, and Laminated Apparel Fabrics

D 4157 Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)

D 5034 Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)

D 6413 Test Method for Flame Resistance of Textiles Vertical Test

F 955 Test Method for Evaluating Heat Transfer Through Materials for Protective Clothing Upon Contact with Molten Substances

2.2 AATCC Test Methods:⁴

61 Colorfastness to Washing, Domestic and Laundering, Commercial: Accelerated

132 Colorfastness to Drycleaning

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

2.3 NFPA Standard:⁵

NFPA 2112 Standard on Flame Resistant Garments for Protection of Industrial Personnel Against Flash Fire

2.4 Federal Standard:⁶

Fed. Std. No. 191A, Method 5903.1, Flame Resistance of Cloth, Vertical

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

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *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

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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.

⁴ AATCC Technical Manual, Current Edition available from American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

⁵ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101.

⁶ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

salt. Excluded are liquid hot substances that may be associated with metal processing such as water, oil, and caustic solutions.

3.1.2 *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.

NOTE 1—Such work activities include charging, tapping, and pouring, during which work is carried out in close proximity to molten substances and hot surfaces and contact with either is likely.

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

NOTE 2—Secondary protective clothing is designed so that it will not continue to burn after exposure to and removal of a source of ignition. Protection against metal splash and radiant heat are secondary in intent.

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

3.1.5 *thermal hazard*—relates to the laboratory test methods employed to measure thermal characteristics and to predict burn injury potential.

4. Significance and Use

4.1 This specification provides performance properties for textile material and design characteristics for clothing that represent minimum initial requirements for primary and secondary protective clothing.

4.1.1 The initial performance properties have been selected based on state-of-the-art materials in use and have been

compared with commercial standards which take into consideration durability in use for specific apparel items.

4.2 Although the specifications for primary protective clothing are written for outer garments, it is recognized that optimum protective performance to severe exposure involves the use of an appropriate system including work clothing underlayers and undergarments.

4.3 It is permissible for one or more of the requirements in **Table 1** to be modified upon agreement between the buyer and seller.

4.3.1 In such cases, any references to the specification shall specify that: “This fabric meets Performance Specification F 1002 except for the following characteristic(s).”

5. Design and Materials

5.1 Clothing design shall be such to cover potentially exposed areas as completely as possible by proper interfacing of related items.

5.2 Garment design shall permit easy and rapid removal.

5.3 Garment design shall be such as to interfere the least with work function and still provide the necessary protection.

5.4 *Closures:*

5.4.1 Design closure so as to be appropriate for easy removal of garment (see 5.2).

5.4.2 Materials for closures shall be compatible with thermal resistance of fabric used and the protective characteristics required.

TABLE 1 Specification Requirements, Woven Fabrics

Characteristic	Primary		Secondary		Section Reference
	Non-Coated	Coated	Shirt	Pants	
Breaking strength, min, N [lbf]	223 [50]	334 [75]	134 [30]	223 [50]	8.1
Tearing strength, N [lbf], min	22 [5.0]	45 [10.0]	11 [2.5]	22 [5.0]	8.2
Colorfastness					
Laundering shade change, min	...	...	Class 3	Class 3	8.3.1
Dry cleaning shade change, min	...	...	Class 3	Class 3	8.3.2
Dimensional change, max	...	...	3.0 %	3.0 %	8.4
Reflectivity after abrasion	...	no discoloration of blotting paper; no aluminum flaking	...	...	8.5
Adhesion	...	no evidence of separation	...	...	8.6
Adhesion after wet flexing	...	no delamination or cracking	...	...	8.7
Flammability					
Initial					
Char length, max, mm [in.]	127 [5.0]	127 [5.0]	152 [6.0]	152 [6.0]	8.8
After flame, max, s	3	3	5	5	
After 25 washes/dry cleaning					
Char length, max, mm [in.]	127 [5.0]	127 [5.0]	152 [6.0]	152 [6.0]	8.8
After flame, max, s	3	3	5	5	8.8

Note—Certain treated fabrics exhibit afterglow during the flammability test. This has been judged not a serious hazard. When afterglow occurs, extinguish it after 10 s. Then measure char length and note either the actual time or greater than 10 s for afterglow on the report.