



Designation: F1930–99 Designation: F 1930 – 00 (Reapproved 2008)

Standard Test Method for Evaluation of Flame Resistant Clothing for Protection Against Flash Fire Simulations Using an Instrumented Manikin¹

This standard is issued under the fixed designation F 1930; 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 covers quantitative measurements and subjective observations that characterize the performance of single layer garments or protective clothing ensembles in a simulated flash fire environment having controlled heat flux, flame distribution, and duration. This test method is extremely complex and requires a high degree of technical expertise in both the test setup and operation.

1.1.1 Heat transmitted to each sensor location on the surface of an instrumented manikin is converted to show the corresponding predicted degree of burn injury to human tissue.

1.1.2 The sum of these values can then be converted to a percentage to show the total area of predicted burn injury.

1.1.2.1 Use of the predicted burn injury to evaluate the heat transferred to the manikin does not constitute a material's performance specification.

1.1.3 The visual and physical changes to the single layer garment or protective clothing ensemble are recorded to aid in understanding how the burn injury results can be interpreted.

1.2 The measurements obtained and observations noted can only apply to the particular garment(s) or ensemble(s) tested using the specified heat flux, duration, and flame distribution.

1.3 This standard should be used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions and should not be used to describe or appraise the fire-hazard or fire-risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire-hazard assessment or a fire-risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard or fire risk of a particular end use.

1.4 This test method is a fire-test-response test method.

1.5 The values stated in customary units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units.

1.6 *This standard does not purport to address 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 123 [Terminology Relating to Textiles](#)

D 1835 [Specification for Liquefied Petroleum \(LP\) Gases](#)

F 1494 [Terminology Relating to Protective Clothing](#)

2.2 *AATCC Standard:*

Test Method 135 [Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics](#)³

¹ This test method is under the jurisdiction of ASTM Committee F-23 on Protective Clothing and is the direct responsibility of Subcommittee F23.80 on Instrumented Manikin Test.

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² 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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³ 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*, Vol 07-03, volume information, refer to the standard's Document Summary page on the ASTM website.

⁴ *Annual Book of ASTM Standards*, Vol 05.01.

⁵ Available from American Association of Textile Chemists and Colorists (AATCC), P.O. Box 12215, Research Triangle Park, NC 27709, <http://www.aatcc.org>.

2.3 *Canadian Standards*:⁴

CAN/CGSB-4.2 No. 58-M90 Textile Test Methods Colourfastness and Dimensional Change in Domestic Laundering of Textiles

CAN/CGSB-3.14 M88 ~~Liquefied Petroleum Gas (Propane)~~⁶ Liquefied Petroleum Gas (Propane)

3. Terminology

3.1 Definitions:

3.1.1 *burn injury, n*—burn damage that occurs at various levels of depth within human tissue.

3.1.1.1 *Discussion*—burn injury in human tissue occurs when the tissue is heated and kept at an elevated temperature for a critical period of time. The amount of burn injury, first, second, or third-degree, depends upon both the level of the elevated temperature and the duration of time.

3.1.2 *flame distribution, n*— *in the flash fire testing of clothing*, a spatial distribution of incident flames from test facility burners to provide a controlled heat flux over the manikin surface.

3.1.3 *instrumented manikin, n*—a model representing an adult-size human and fitted with sensors on the surface for use in testing.

3.1.3.1 *Discussion*—The instrumented manikin used in flash fire testing of clothing is fitted with at least 100 heat sensors, excluding hands and feet.

3.1.4 *predicted total area of burn injury, n*—*in the flash fire testing of clothing*, the sum of areas represented by the sensors that calculate at least a second degree burn injury.

3.1.5 *second-degree burn injury, n*—irreversible burn damage at the epidermis/dermis interface in human tissue. (Synonym second-degree burn)

3.1.6 *second-degree burn injury area, n*—*in the flash fire testing of clothing*, the sum of the areas represented by sensors that calculate a burn injury at the epidermis/dermis interface in human tissue. (Synonym second-degree burn area)

3.1.7 *heat sensor, n*—a device capable of measuring incident heat to the manikin's surface under test conditions and creating data that can be processed by a computer program to assess burn injury.

3.1.8 *thermal protection, n*—the property that characterizes the overall performance of a garment or protective clothing ensemble relative to how it prevents the transfer of heat that is sufficient enough to cause burn injury.

3.1.8.1 *Discussion*—In flash fire testing of clothing, thermal protection of a garment or ensemble and the consequential predicted burn injury (second-degree or third-degree), can be quantified by the measured sensor response that indicates how well the garment or protective clothing ensemble blocks heat from the manikin surface. In addition to the measured sensor response, the physical response and degradation is an observable phenomenon that can be correlated to the sensor calculations and is useful in understanding garment or protective clothing ensemble thermal protection.

3.1.9 *third-degree burn injury, n*—the irreversible burn damage at the dermis/subcutaneous interface in human tissue (Synonym third-degree burn).

3.1.10 *third-degree burn injury area, n*—*in the flash fire testing of clothing*, the sum of the areas represented by sensors that calculate a burn injury at the dermis/subcutaneous interface in human tissue. (Synonym third-degree burn area)

3.1.11 For definitions of other protective clothing related terms used in this test method, refer to Terminology F 1494. For definitions for other textile related terms used in this test method, refer to Terminology D 123.

4. Summary of Test Method

4.1 The test method evaluates the protective performance of the materials of construction and design of the test specimen, which is either a garment or an ensemble. The test specimen is placed on an adult-size manikin at ambient atmospheric conditions and exposed to a laboratory flash fire simulation with controlled heat flux, duration, and flame distribution. The test procedure, data acquisition, results calculations, and preparation of the test report are performed with computer hardware and software programs. Heat, which is transferred through the test specimen during and after the exposure, is measured by sensors. These measurements are used to calculate the second-degree, third-degree, and total burn injury areas resulting from the flash fire exposure. Identification of the test specimen, test conditions, comments and remarks about the test purpose, and response of the test specimen to the exposure are recorded and are included as part of the report. The performance of the test specimen is indicated by the calculated burn injury area and the way the specimen responds to the test exposure.

5. Significance and Use

5.1 This test method can be used to measure and compare the thermal protection provided by different materials, garments, clothing ensembles, and systems.

5.2 This test method provides a measurement of garment and clothing ensemble performance on a stationary upright manikin.

5.2.1 This test method is not intended to be a quality assurance test.

⁴Annual Book of ASTM Standards, Vol 11.03.

⁶Available from Standards Council of Canada (SCC), 270 Albert Street, Suite 200, Ottawa ON K1P 6N7, Canada, <http://www.scc.ca>.