

NFPA 2112

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

2007 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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Standard on

Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire

2007 Edition

This edition of NFPA 2112, *Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire*, was prepared by the Technical Committee on Flash Fire Protective Garments. It was issued by the Standards Council on July 28, 2006, with an effective date of August 17, 2006, and supersedes all previous editions.

This edition of NFPA 2112 was approved as an American National Standard on August 17, 2006.

Origin and Development of NFPA 2112

The NFPA Standards Council established the Technical Committee on Flash Fire Protective Garments in 1998. Between February and August of 1999, the Technical Committee developed two draft standards: NFPA 2112 and NFPA 2113, *Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire*, which were then released for public proposals and comments. NFPA 2112 specifies the minimum design, performance, certification requirements, and test methods for flame-resistant garments for use in areas at risk from flash fires. The first editions of NFPA 2112 and NFPA 2113 were approved by the NFPA membership at the May 2001 NFPA World Fire Safety Congress and were issued by the Standards Council in July 2001.

The 2007 edition revises the scope to clarify that it applies to the performance of fabrics and components of garments and not the garment itself. The scope was also modified to indicate that NFPA 2112 does not apply to single-use or limited-use garments. The Committee is pursuing the development of separate documents to address the design, testing, certification, selection, and use of those garments. This revision also incorporates updates to reference test methods and the method for calculating total heat flux.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the manufacture, selection, care, and use of garments and equipment used for protection of industrial personnel where there is potential for flash fire. Industrial personnel include workers who are potentially or may accidentally be exposed to hydrocarbon or combustible dust flash fires, and not electrical flashes. These documents do not cover fire fighters and other emergency services personnel.



Contents

Chapter 1 Administration	2112- 4	Chapter 6 Design Requirements	2112- 9
1.1 Scope	2112- 4	6.1 Hardware Finishes	2112- 9
1.2 Purpose	2112- 4	6.2 Metal Components	2112- 9
1.3 Application	2112- 4	Chapter 7 Performance Requirements	2112- 9
1.4 Retroactivity	2112- 4	7.1 Fabric Requirements	2112- 9
1.5 Equivalency	2112- 4	7.2 Thread Requirements	2112- 9
1.6 Units	2112- 4	7.3 Hardware Requirement	2112- 9
Chapter 2 Referenced Publications	2112- 4	7.4 Label Requirement	2112-10
2.1 General	2112- 4	Chapter 8 Test Methods	2112-10
2.2 NFPA Publications	2112- 4	8.1 Sample Preparation Procedures	2112-10
2.3 Other Publications	2112- 4	8.2 Thermal Protective Performance (TPP) Test	2112-11
2.4 References for Extracts in Mandatory Sections	2112- 5	8.3 Flame Resistance Test	2112-15
Chapter 3 Definitions	2112- 5	8.4 Heat and Thermal Shrinkage Resistance Test	2112-16
3.1 General	2112- 5	8.5 Manikin Test	2112-17
3.2 NFPA Official Definitions	2112- 5	8.6 Thread Heat Resistance Test	2112-18
3.3 General Definitions	2112- 5	8.7 Label Print Durability Test	2112-18
Chapter 4 Certification	2112- 6	Annex A Explanatory Material	2112-18
4.1 General	2112- 6	Annex B Properties for Evaluating Flame-Resistant Garments	2112-20
4.2 Certification Program	2112- 7	Annex C Informational References	2112-24
4.3 Inspection and Testing	2112- 7	Index	2112-25
4.4 Manufacturer's Quality Assurance Program	2112- 8		
Chapter 5 Labeling and Information	2112- 8		
5.1 Product Label Requirements	2112- 8		
5.2 User Information	2112- 9		

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Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex C. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex C.

Chapter 1 Administration

1.1 Scope. The standard shall specify the minimum performance requirements and test methods for flame-resistant fabrics and components and the design and certification requirements for garments for use in areas at risk from flash fires.

1.2 Purpose.

1.2.1* This standard shall provide minimum requirements for the design, construction, evaluation, and certification of flame-resistant garments for use by industrial personnel, with the intent of not contributing to the burn injury of the wearer, providing a degree of protection to the wearer, and reducing the severity of burn injuries resulting from accidental exposure to hydrocarbon flash fires.

1.2.2* Controlled laboratory tests used to determine compliance with the performance requirements of this standard shall not be deemed as establishing performance levels for all situations to which personnel can be exposed.

1.2.3* This standard shall not be intended to be utilized as a detailed manufacturing or purchasing specification but shall be intended to be referenced in purchase specifications as minimum requirements.

1.3 Application.

1.3.1 This standard shall apply to the design, manufacturing, and certification of new flame-resistant garments.

1.3.2* This standard shall not apply to protective clothing for wildland fire fighting, technical rescue, structural fire fighting, proximity fire fighting, or any other fire-fighting operations or hazardous materials emergencies. This standard shall not apply to single-use or limited-use garments. This standard shall not apply to protection from electrical flashes, radiological agents, biological agents, or hazardous materials.

1.3.3 Certification of flame-resistant garments to the requirements of this standard shall not preclude certification to additional appropriate standards where the garment meets all the applicable requirements of each standard.

1.3.4 The requirements of this standard shall not apply to accessories that might be attached to flame-resistant garments unless specifically addressed herein.

1.3.5 The minimum requirements identified in this standard are not intended to meet all the protection needs of a user in areas at risk from flash fires. Users shall refer to NFPA 2113, *Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire*, for conducting the appropriate hazard assessment to identify the in-use area's minimum protection requirements.

1.4 Retroactivity. This standard shall only apply to garments manufactured on or after the effective date of the standard.

1.5 Equivalency. Nothing herein shall restrict any jurisdiction or manufacturer from exceeding these minimum requirements.

1.6 Units. In this standard, values for measurement are followed by an equivalent in parentheses, but only the first stated value shall be regarded as the requirement. Equivalent values in parentheses shall not be considered as the requirement, as these values might be approximate.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 2113, *Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire*, 2007 edition.

2.3 Other Publications.

2.3.1 AATCC Publications. American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*, 2003.

AATCC 158, *Dimensional Changes in Dry-Cleaning in Perchloroethylene: Machine Method*, 2000.



2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D 6413, *Test Method for Flame Resistance of Textiles (Vertical Test)*, 1999.

ASTM F 1930, *Test Method for Evaluation of Flame Resistant Clothing for Protection Against Flash Fire Simulations Using an Instrumented Manikin*, 2000.

2.3.3 GSA Publications. U.S. General Services Administration, 1800 F Street, N.W., Washington, DC 20405.

Federal Test Method Standard 191A, *Textile Test Methods*, July 20, 1978.

2.3.4 ISO Publications. International Organization for Standardization, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland.

ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, 2005.

ISO/IEC Guide 65, *General Requirements for Bodies Operating Product Certification Systems*, 1996.

ISO 9001, *Quality Management Systems — Requirements*, 2000.

2.3.5 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

Stoll, A. M. and M. A. Chianta, "Heat Transfer through Fabrics as Related to Thermal Injury," *Transactions-New York Academy of Sciences*, Vol. 33(7), Nov. 1971, pp. 649–670.

Stoll, A. M. and M. A. Chianta, "Method and Rating System for Evaluations of Thermal Protection," *Aerospace Medicine*, Vol. 40, 1969, pp. 1232–1238.

2.4 References for Extracts in Mandatory Sections.

NFPA 270, *Standard Test Method for Measurement of Smoke Obscuration Using a Conical Radiant Source in a Single Closed Chamber*, 2002 edition.

NFPA 921, *Guide for Fire and Explosion Investigations*, 2004 edition.

NFPA 1914, *Standard for Testing Fire Department Aerial Devices*, 2002 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2007 edition.

NFPA 1975, *Standard on Station/Work Uniforms for Fire and Emergency Services*, 2004 edition.

NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting*, 2005 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*, 2006 edition.

NFPA 1991, *Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies*, 2005 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction. An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Accreditation/Accredited. A system whereby a certification organization determines that a laboratory has demonstrated the ability to conduct tests in an accurate and precise manner consistent with the requirements of this standard, accepts the laboratory's test data, and continues to monitor laboratory practices to ensure accurate and precise testing consistent with the requirements of this standard.

3.3.2 Agents.

3.3.2.1 Biological Agents. Biological materials that are capable of causing an acute disease or long-term damage to the human body. [1991, 2005]

3.3.2.2 Radiological Agents. Radiation associated with x-rays, alpha, beta, and gamma emissions from radioactive isotopes, or other materials in excess of normal background radiation levels. [1991, 2005]

3.3.3 Body.

3.3.3.1 Lower Body. The area of the body below the waist including the legs but excluding the ankles and feet.

3.3.3.2 Upper Body. The area of body above the waist and extending to the shoulder, including the arms and wrists but excluding the hands.

3.3.4 Certification/Certified. A system whereby a certification organization determines that a manufacturer has demonstrated the ability to produce a product that complies with the

requirements of this standard, authorizes the manufacturer to use a label on listed products that comply with the requirements of this standard, and establishes a follow-up program conducted by the certification organization as a check on the methods the manufacturer uses to determine continued compliance with the requirements of this standard. [1971, 2007]

3.3.5 Certification Organization. An independent, third-party organization that determines product compliance with the requirements of this standard with a labeling/listing/follow-up program. [1971, 2007]

3.3.6 Compliance/Compliant. Meeting or exceeding all applicable requirements of this standard. [1971, 2007]

3.3.7 Component. Any material, part, or subassembly used in the construction of the protective ensemble or any element of the protective ensemble. [1971, 2007]

3.3.8 Drip. A flow of liquid that lacks sufficient quantity or pressure to form a continuous stream. [1914, 2002]

3.3.9 Emblem(s). Shields, heraldry, or printing that designates a governmental entity or a specific organization; rank, title, position, or other professional status that is painted, screened, embroidered, sewn, glued, bonded, or otherwise attached in a permanent manner.

3.3.10 Fabric. The one or more layers of textile material(s) used in the primary construction of protective garments.

3.3.10.1 Textile Fabric. A planar structure consisting of yarns or fibers. [1977, 2005]

3.3.11* Flame Resistance. The property of a material whereby combustion is prevented, terminated, or inhibited following the application of a flaming or nonflaming source of ignition, with or without subsequent removal of the ignition source.

3.3.12* Flash Fire. A fire that spreads rapidly through a diffuse fuel, such as dust, gas, or the vapors of an ignitable liquid, without the production of damaging pressure. [921, 2004]

3.3.13 Follow-Up Program. The sampling, inspections, tests, or other measures conducted by the certification organization on a periodic basis to determine the continued compliance of labeled and listed products that are being produced by the manufacturer to the requirements of this standard. [1977, 2005]

3.3.14 Garments. Clothing including, but not limited to, coveralls, trousers, shirts, outerwear, and rainwear.

3.3.14.1 Limited-Use Garment. A garment whose service life is limited by the manufacturer to a specified number of wear cycles and does not meet the testing requirements of this standard.

3.3.14.2* Single-Use Garment. A garment that is designed to be used one time and then disposed of.

3.3.15 Hardware. Nonfabric components of the protective garment including, but not limited to, those made of metal or plastic.

3.3.16 Hazardous Material. Any solid, liquid, gas, or mixture thereof that can potentially cause harm to the human body through respiration, ingestion, skin absorption, or contact.

3.3.17 Hazardous Materials Emergencies. Incidents involving the release or potential release of hazardous chemicals into the environment that can cause loss of life, personnel injury, or damage to property and the environment. [1971, 2007]

3.3.18 Industrial Personnel. Workers who might be exposed to flash fire.

3.3.19 Interlining. Any textile that is intended for incorporation into any article of wearing apparel as a layer between outer and inner layers. [1975, 2004]

3.3.20 Lining. Any material that is attached and used to cover or partially cover the inside surface of a flame-resistant garment.

3.3.21 Melt. A response to heat by a material resulting in evidence of flowing or dripping. [1983, 2006]

3.3.22 Model. The collective term used to identify a group of individual elements of the same basic design and components from a single manufacturer produced by the same manufacturing and quality assurance procedures that are covered by the same certification. [1971, 2007]

3.3.23 Product. The compliant flame-resistant garment.

3.3.24* Product Label. A label or marking affixed to a product by the manufacturer that provides general information, warnings, instructions for care and maintenance, and other information. [1971, 2007]

3.3.25 Reflective Striping. Material added to the exterior of the garment to enhance nighttime or daytime visibility.

3.3.26 Reinforcement. An additional layer of a textile material applied to a specific area of the protective garment to make that portion of the protective garment more resistant to wear.

3.3.27 Sample. An amount of the material, product, or assembly to be tested that is representative of the item as a whole. [270, 2002]

3.3.28 Seam. Any permanent attachment of two or more protective garment fabrics in a line formed by joining the separate material pieces.

3.3.28.1 Sewn Seam. A series of stitches joining two or more separate plies of material(s) of planar structure, such as textiles. [1975, 2004]

3.3.29 Separate. A material response evidenced by splitting or delaminating. [1971, 2007]

3.3.30 Specimen. The item that undergoes testing; in some cases, the specimen is also the sample. [1971, 2007]

3.3.31 Trouser. A garment that is designed to provide minimum protection to the lower torso and legs, excluding the ankles and feet.

Chapter 4 Certification

4.1 General.

4.1.1 All flame-resistant garments that are labeled as being compliant with this standard shall meet or exceed all applicable requirements specified in this standard and shall be certified.

4.1.2 All test data used to determine compliance of flame-resistant garments with this standard shall be provided by an accredited testing laboratory.

4.1.3 All flame-resistant garments shall be labeled and listed.

4.1.4 All flame-resistant garments shall have a product label, which shall meet the requirements of Section 5.1.



4.1.5* The certification organization's label, symbol, or identifying mark shall be attached to the product label, be part of the product label, or be immediately adjacent to the product label.

4.1.6 Manufacturers shall not claim compliance with a portion(s) or segment(s) of the requirements of this standard and shall not use the name or identification of this standard, NFPA 2112, in any statements about their respective product(s) unless the product(s) is certified as compliant to this standard.

4.1.7 The certification organization shall not certify any flame-resistant garments to the 2001 edition of this standard on or after 1 August 2007.

4.1.8 The certification organization shall not permit any manufacturer to label any flame-resistant garments as compliant with the 2001 edition of this standard on or after 1 August 2007.

4.2 Certification Program.

4.2.1* The certification organization shall not be owned or controlled by manufacturers or vendors of the product being certified.

4.2.2 The certification organization shall be primarily engaged in certification work and shall not have a monetary interest in the product's ultimate profitability.

4.2.3 The certification organization shall be accredited for personal protective equipment in accordance with ISO/IEC Guide 65, *General Requirements for Bodies Operating Product Certification Systems*.

4.2.4 The certification organization shall refuse to certify products to this standard that do not comply with all applicable requirements of this standard.

4.2.5* The contractual provisions between the certification organization and the manufacturer shall specify that certification is contingent on compliance with all applicable requirements of this standard.

4.2.5.1 There shall be no conditional, temporary, or partial certifications.

4.2.5.2 Manufacturers shall not be authorized to use any label or reference to the certification organization on products that are not manufactured in compliance with all applicable requirements of this standard.

4.2.6 The certification organization shall have a program to accredit laboratories to perform the tests required by this standard.

4.2.6.1 The accredited laboratory shall conduct the required tests and maintain documentation of test results.

4.2.6.2 The accredited laboratory shall have laboratory facilities and equipment available for conducting required tests.

4.2.7 A program for calibration of all instruments shall be in place and operating, and procedures shall be in use to ensure proper control of all testing.

4.2.8 In the absence of an accredited laboratory, the certification organization shall be permitted to have its own laboratory facilities and equipment available for conducting required tests.

4.2.9* The certification organization shall require the manufacturer to establish and maintain a program of production inspection and testing that meets the requirements of Section 4.4.

4.2.9.1 The certification organization shall ensure that the audit assurance program provides continued product compliance with this standard.

4.2.9.2 The certification organization shall permit the manufacturer to be registered to ISO 9001, *Quality Management Systems — Requirements*, in lieu of meeting the requirements of Section 4.4.

4.2.10 The certification organization and the manufacturer shall evaluate any changes affecting the form, fit, or function of the certified product to determine its continued certification to this standard.

4.2.11* The certification organization shall have a follow-up inspection program of the manufacturing facilities of the certified product, with a minimum of one visit per 12-month period.

4.2.12 As part of the follow-up inspection program, the certification organization shall review the manufacturer's records and sample product to ensure the following:

- (1) Garments conform with the requirements of this standard
- (2) The manufacturer has documentation that the fabric and components used in the garment were tested by an accredited laboratory and comply with this standard
- (3) A manufacturing quality assurance plan meeting the requirements of this standard is in place

4.2.13 The certification organization shall also have a follow-up inspection program of the accredited testing laboratory(ies).

4.2.13.1 The certification organization shall conduct a minimum of one visit per 12-month period.

4.2.13.2 The certification organization shall review the accredited laboratory's records and facilities to ensure required documentation is maintained and to ensure conformance with testing requirements.

4.2.14 The certification organization shall have a program for investigating field reports alleging malperformance or failure of listed products.

4.2.15* The certification organization shall require the manufacturer to have a product recall system as part of the manufacturer's quality assurance program.

4.2.16 The certification organization's operating procedures shall provide a mechanism for the manufacturer to appeal decisions, which shall include the presentation of information from both sides of a controversy to a designated appeals panel.

4.2.17 The certification organization shall be in a position to use legal means to protect the integrity of its name and label, which shall be registered and legally defended.

4.3 Inspection and Testing.

4.3.1 For the certification of flame-resistant garments, the certification organization shall conduct inspections of the manufacturing facility and the accredited laboratory, as specified in 4.3.2 through 4.3.9.

4.3.2 All inspections, evaluations, conditioning, and testing for certification or for recertification shall be conducted by the certification organization or a facility accredited for inspections, evaluations, conditioning, and testing in accordance with all requirements pertaining to testing laboratories in ISO 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.