



DEMYSTIFYING FR CLAIMS

AN ERGODYNE WHITE PAPER

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DEMYSTIFYING FR

Each year, hundreds of burn injuries and deaths are recorded from workers encountering open flame and high heat or exposure to flash fires and electrical arc flashes without proper personal protective equipment (PPE). In 2017, the U.S. Department of Labor Bureau of Labor Statistics reported approximately 123 worker fatalities and 3,120 injuries due to fire and explosions. During the same year, nearly 15,400 workers sustained lost-time injuries because of heat burns.

If the on the job risk can't be eliminated, it is mission critical that the supplied or chosen work wear and PPE can withstand the intense heat and protect against the real risks of arc flash or flash fire hazards in the electrical/utilities or petrochemical industries.

// WATCH WHAT YOU WEAR

Dozens of individual workers each year are accidentally exposed to flash fires causing severe burn injuries, in some cases caused by the continued burning of their clothing. One of the real dangers of wearing ordinary non-flame resistant clothing is that regular fabrics can easily catch on fire and continue to burn even following the initial exposure to petrochemical flash fire or electrical arc.

Employers are required by OSHA regulations to assess the risks in their workplace and select appropriate PPE, including clothing that protects against identified hazards.

Selection of clothing that conforms to recognized industry specifications is one way of ensuring that these regulations are followed. At the same time, it is important to be cognizant of the specific claims being made by manufacturers of protective clothing and ensure that the claims are based on appropriate standards and can be verified by accepted testing or other documentation.



// MIND THE STANDARDS

Every day, as many as 5 to 10 arc explosions occur from electric equipment. To mitigate these risks, regulatory bodies have created a number of standard test methods and specifications that discriminate amongst the different fabrics that are protective against flame and heat exposure, as well as specific types of industrial exposures.

Different standards are set in the industry to address a variety of applications where flame and heat resistant protective clothing may be needed. Four examples of these standards include:

- » ASTM F1506, Standard Performance Specification for Flame Resistant and Arc Rated Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards, defines a series of requirements for clothing intended for use by workers in the electrical utilities industries. This standard includes the same requirements for flame resistance as applied in ASTM F2302 but requires testing before and after 25 laundering cycles. In addition, there are tests for fabric physical strength, colorfastness and laundering shrinkage. One of the most important requirements is the arc-resistance test, for which the value must be provided on the garment label (either ATPV or EBT). The test, described in ASTM F1959, Standard Test Method for Determining the Arc Rating of Materials for Clothing, provides an arc rating, which is a measure of the insulation time provided by the clothing in preventing a second-degree burn injury under very specific exposure conditions. The arc rating can either be reported as arc thermal protective value (ATPV) or estimated break-open threshold (EBT). ATPV is the energy level on a fabric or material that results in sufficient heat transfer through the fabric or material to cause the onset of a second-degree burn. EBT is used when the material breaks open and represents the energy that causes fabric break-open. When looking at the ATPV and EBT, these values will usually be represented by a single number and the higher the number, the better the protection.
- » NFPA 70E, Standard for Electrical Safety in the Workplace, is primarily an electrical safety standard aimed at companies that operate in the electrical utility industry and is primarily directed towards end users. A portion of the standard addresses safety-related work practices including gloves, sleeves, footwear, head protection, face and eye protection as well as protective apparel. A key part of the standard establishes CAT categories, formally hazard-risk categories (HRCs), which define the level of arc rating needed by clothing to perform specific hazardous tasks where the potential for an arc flash exists. The standard identifies a specific category for each type of work normally performed by electrical workers. See the table on the following page to summarize this rating system.



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| CAT | TYPICAL CLOTHING DESCRIPTION | MINIMUM ARC RATING (ATPV OR EBT) OF PPE IN CAL/CM ² |
|-----|---|--|
| 1 | Arc-rated FR shirt and FR pants or FR coverall | 4 |
| 2 | Arc-rated FR shirt and FR pants or FR coverall | 8 |
| 3 | Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum | 25 |
| 4 | Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum | 40 |

- » OSHA sets specific regulations in Title 29 Code of Federal Regulations Part 1910.269 for Electric Power Generation, Transmission, and Distribution. These regulations prohibit the use of certain material either alone or in blend for apparel that include acetate, nylon, polyester, rayon, and polypropylene unless demonstrated by the employer as offering adequate protection. OSHA further requires that employers specify and provide clothing that is arc-rated and flame-resistant under specific conditions of exposure. Nevertheless, protective clothing does not set specific criteria for clothing. OSHA recognizes that the provision of clothing that complies with industry consensus standards is one way of demonstrating that appropriate PPE has been provided by employers to their employees.
- » NFPA 2112, Standard on Flame-Resistant Clothing for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire, provides criteria for clothing materials that addresses accidental flash fires. This standard is for clothing used as protection from the industrial flash fire hazard, typically seen in petrochemical and oil and gas industries, and related chemical-processing facilities. Flash fires are characterized as a sudden, intense fire that are of short duration but severe in potential danger. All flash fire clothing that is compliant with NFPA 2112 has to meet extremely stringent requirements and must be tested and certified by a third party organization. Materials used in garments must not ignite, melt, drip, separate, or shrink more than 10% when tested for heat resistance at 500°F for five minutes both before and after at least 3 industrial laundering cycles, and must have after-flame times of 2 seconds or less, char lengths of 4 inches or less, and not melt or drip, when tested for vertical flame resistance both before and after 100 industrial laundering

cycles. Garment materials must further demonstrate adequate thermal insulation in a heat transfer performance (HTP) test requiring HTP rating of at least 3.0 cal/cm² for contact testing and at least 6.0 cal/cm² for spacer testing. Thread used in the garments cannot melt at 500°F. Representative garments made of the base material are subjected to 3-second simulated flash fire on an instrumented manikin that measures the heat energy passing through the garment. Based on these data, garments must show 50% or less predicted second-degree and third-degree body burn over the manikin skin surface. This performance level was set based on human survival rates for burn injuries. Unlike the 70E, which is expressed in calories, the NFPA 2112 data is expressed as a percent body burn, and the lower the number, the better the protection.

// READ THE LABELS

Unfortunately, despite the existence and promotion for using standards to qualify clothing in the workplace, incorrect information provided is still provided to end users. Some tests are used to represent products as flame resistant or protective in ways that are outside the scope of their intended use and may, in some cases, be a complete misrepresentation of the product's protective capabilities. Two common examples include:

- » Some manufacturers infer that clothing meeting the Consumer Product Safety Commission requirements in Title 16, CFR 1610 (Standard for Flammability of Clothing Textiles) is protective against flame exposure. This regulation applies to ALL clothing sold in the United States and simply helps organize textiles into classes based on how quickly they burn. Textiles that have a flame spread between 3.5 - 7 seconds are considered normal flammability and are acceptable for use in clothing. Moreover, the Title 16 CFR 1610 test only involves a 1-second exposure to inclined surface of the test fabric. In contrast, vertical flame resistance testing used a 12-second exposure to the bottom cut edge of the fabric specimen. Thus the standards described in this paper only allow for a 2-second maximum after flame, which means the fabric will essentially self-extinguish once contacted by flame. And when every second means precious escape time for a worker, which standard do you want your FR workwear to pass? Limits are set to exclude unreasonably dangerous fabrics from being used in the general U.S. clothing industry.
- » Other manufacturers may cite an incorrect standard, such as NFPA 701 (Standard Methods of Fire Tests for Flame Propagation of Textiles and Films) or NFPA 702 (Standard on Flammability of Wearing Apparel), to base claims of their product's flame resistance characteristics. NFPA 701 clearly is intended to address home and industrial furnishings such as draperies and wall coverings. NFPA 702 was withdrawn in 1986 and was never intended to represent clothing for use in flame protection



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applications (the test method was similar to Title 16 CFR 1610 testing but with some modification).

It is always best to check with the manufacturer to see what claims are being made and, if there is a question, to ask for documentation that demonstrates the claim of a particular product meeting a standard or specification. In the case of products claiming compliance with NFPA 2112, the certification organization will list compliant products on their website (at www.ul.com or www.seinet.org). The product label should clearly state the compliance with the respective standards.

// REMEMBER THIS

When exposed to flame or high heat, ordinary clothing can quickly ignite, burn, melt or degrade causing serious burn injury and potentially, death. For those applications where exposure may occur, it is critical that workers are provided with and correctly wear proper PPE. Available standards clearly state the varying levels of protection and applications:

- » ASTM F2302: Standard Performance Specification for Labeling Protective Clothing as Heat and Flame Resistant – clothing meets requirements after at least 10 laundering cycles for applications not covered by other standards.
- » ASTM F1506: Standard Performance Specification for Flame Resistant and Arc Rated Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards – clothing for potential arc-flash exposure that meets requirements after at least 25 laundering cycles.
- » NFPA 70E: Standard for Electrical Safety in the Workplace – establishes important PPE Categories for choosing proper PPE against arc-flash and related thermal hazards.
- » NFPA 2112: Standard on Flame-Resistant Clothing for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire -- provides criteria for clothing protection against flash fire with rated flame protection after at least 100 industrial wash cycles.

Education and compliance are critical to outsmarting the daily risks faced in these flame-friendly environments.

// RESOURCES

U.S. Department of Labor, Bureau of Labor Statistics:
<http://www.bls.gov/iif/data.htm>

CapSchell statistics on electrical arc incidents, accidents, and injuries: <http://www.capschell.com/FARProject1999.htm>

Jeffrey O. Stull and Salvatore A. Chines, “Fibers and Textiles,” Section 6, Chapter 5, in Fire Protection Handbook, 20th Edition, Volume 1, National Fire Protection Association, Quincy, MA 2008.

Copies of Regulations and Standards

29 CFR 1910.132: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10118

28 CFR 1910.269: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=98_68

ASTM D 6413: <http://www.astm.org/Standards/D6413.htm>

ASTM F 1506: <http://www.astm.org/Standards/F1506.htm>

ASTM F 2302: <http://www.astm.org/Standards/F2302.htm>

ASTM F 2894: <http://www.astm.org/Standards/F2894.htm>

NFPA 70E: <http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=70E>



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THIS DOESN'T HAVE TO BE THE END OF THE ROAD, DEAR FRIEND.

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MORE QUESTIONS?



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