

An e-Hazard.com White Paper



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## Using Disposable Garments in Arc Flash Exposures

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### **Arc-rated (AR) disposables?**

Many applications require disposable garments including chemical, biohazard, nuclear and just plain grease and dirt exposures. Some of these exposures are hazards in their own right (i.e. nuclear, biohazards and chemical hazards) others create new hazards (oil, grease combustible dust and other combustible contaminants) and nuisances (dirt, non-hazardous and non-combustible contaminants). Petrochemical workers and electricians exposed to an electric arc or flash fire hazard have something in common with a meth lab cleanup team. When they arrive on the job site, they may not know exactly what hazards they'll be exposed to, but they do know the potential for fire and chemical exposure exists. Ethanol, acids, oils, ammonia, and other chemicals may be the standard issue, but fire is always a possibility.

The hazmat team, the electrician in a petrochemical plant, and a meatpacking company electrician all have something else in common: "hydrocarbon loading" potential on their clothing. When arc-rated clothing has substantial hydrocarbon loading, ignition sources, such as potential flash fires or electric arcs, can make the garment less effective. In this type of situation, the worker must be cognizant of his or her surroundings and use personal protective equipment (PPE) made for those types of exposures. Under these circumstances, disposable FR garments are often the best solution. Let's take a quick look at the evolution of these garments for background.

**Flame resistant (FR) disposables' history**

Disposables have improved significantly

these *test methods* is false. You can report the results of *test methods* but even that can be misleading.

**Table 1: Test Methods for Flame Resistance and their Limits**

Test Methods (No pass/fail)	Flame Test	Heat Test	Full Scale Test	Use
FTMS 191 A.5901/5903 (delisted)	Y	N	N	One test method inappropriate alone. Clothing. Misused.
NFPA 701 (most will cite the 1989 version or earlier which didn't exclude clothing)	Y	N	N	"Curtains, draperies, or other window treatments" Misused.
ASTM D6413	Y	N	N	Clothing
ASTM F1959	Y	Y	Y, Electric arc	Clothing Arc Rating. No melting and dripping.
ASTM F1930	Y	Y	Y, flash fire	% body burn. No melting and dripping..

from the first polyester spun-laced, throw-away garments that changed the chemical protection world just a decade ago. Those garments were resistant to many chemicals but were not adequate if a flash fire or electric arc ensued. They did — and still do — make many low-level chemical exposures less hazardous for workers at a reasonable cost. Newer coated and sealed seam garments on the chemical protection side have made even higher-level exposures, like chemical warfare, more survivable for first responders and soldiers. However, the flame-resistant side of the equation is still fraught with misunderstanding, especially when it comes to disposable garments. Many companies sell “FR” garments which meet no real applicable standard. They make claims based on the *test methods* in Table 1 but these claims are not substantiated. All the *test methods* in Table 1 are good methods but they must be understood and used in conjunction with a *specification* before the garment can truly be called PPE. None of the *test methods* in Table 1 have pass/fail criteria so claiming to “meet”

In 1994, the first arc- and flame-resistant raingear was developed. A difficult battle was fought to get folks out of “FR”-labeled garments that passed small-scale tests but would melt onto workers in a 1- to 3-second flash fire exposure or electric arc event. This campaign was successful. Now, another industry has a similar need. There are flame-resistant, chemical-resistant garments that have been flash fire and arc tested, but many garments on the market should not be used in a flame or arc exposure. How can you tell the difference?

**Melting makes the difference**

Any material that melts and drips in an electric arc or flash fire should not be used, even in low-risk potentials. The NFPA 70E standard requires that no melting materials be worn by a worker in any arc potential. Shouldn't this same interpretation be used in potential flame exposures? The most effective way to remedy this misunderstanding is to educate the market.

Cleaning up potentially hazardous materials is often part of the job. In electrical work, it could be oil containing small amounts of PCBs. This oil could also add hydrocarbon loading to the FR clothing. Cleaning up these materials requires a system of safety PPE that can be difficult to balance. It begs the question, “Do I need FR, chemical protection, or both?”

With a garment to be worn over FR clothing and disposed of readily when soiled, this standard's requirements may create a garment with a lower value proposition. NFPA 2112 disposable garments make sense in some specific applications, particularly when the FR disposable can be worn longer or in lieu of FR clothing, such as an inexpensive coverall for a supervisor, engineer, or

**Table 2: Test Methods for Flame Resistance and their Limits**

Standard Specifications	Flame Test	Heat Test	Full Scale Test	Use
ASTM F1506	Y	Y	Y, ASTM F1959	Arc and flame clothing (tear strength portions have kept out disposables, committee voting 10/09)
NFPA 2112	Y	Y	Y, ASTM F1930	Flash Fire clothing. Allows disposables. Third party certified testing but some requirements make disposable more expensive than needed for some uses.
CGSB 155.20	Y	Y	N, Does not include F1930	Some cite only meeting the flame portion. Misused.
ASTM F2302	Y	Y	N	For clothing NOT exposed to flame or arc. Some thick rainwear materials will pass but burn badly in arc or flash fire.

Market confusion about FR disposables and the meaning of some test methods is also a problem. Table 1 includes a list of the primary *test method* standards with an explanation of their proper uses. The first standard to address FR disposable garments was NFPA 2112, which added the allowance for FR disposable materials as “non-woven” materials. Some materials have been tested against this standard, but most specification writers are unaware of it. In addition, the standard also has some disadvantage to the end-user who wants a disposable garment. The disposable must meet a minimum body burn percentage and other tests make the non-woven “disposable” beneficial in some jobs but less disposable from a cost perspective.

visitor, or as outerwear in a higher potential threat. Most FR disposable garments in the past would have been tested with a vertical flame test to differentiate them from a non-FR garment. Researchers now know this is not sufficient. This and other small-scale tests alone are inadequate to predict flash fire or arc burn protection. Full-scale tests (such as ASTM F1959 Electric Arc or ASTM F1930 Flash Fire) are best for these evaluations. Because these full-scale tests entered the scene in the mid-1990s, the small-scale tests have been seen as less predictive of performance and usually are reserved for quality control only. A garment passing a vertical flame test may still be life-threatening even in medial level flash

fires or electric arcs, especially if the

not acceptable even if labeled FR. (Note:

Available Materials			
Material	Flame Resistant Arc or Flash Fire Rated	Launderable	Retail Price Comparison
<b>Single Use</b>			
Spun laced polyester, polyethylene, olefin, nylon, poly vinyl alcohol	N, Do not use in arc or flash fire potential	N	\$6+
Kimberly-Clark Professional* KleenGuard* A65 Flame Resistant Apparel; DuPont Temproware®, Lakeland Pyrolon® Plus 2; Magid Econowear®, Excel™ Extend FR™ (FR Sontara), Pyrolon XT FR Sontara More (durable FR Sontara with light weight nylon mesh on the surface).	Vertical flammability. Does not melt Y, Some have F1930, F1959 tested. No ratings.	N	\$6-15
Pyrolon DTP, SoftGuard DTP (Heavier FR Sontara)	Y, Arc Rated ~14 cal/cm <sup>2</sup>	N	\$29
<b>Multi-use</b>			
Limited Use Nomex (Spun laced Nomex)	Y, Meets NFPA 2112, Arc Rated ~6 cal/cm <sup>2</sup>	5X	\$37.50
<b>Multi-Threat</b>			
Pyrolon CRFR (Coated FR Sontara)	Y, F1930, F1959	N	\$27
TyChem® ThermoPro®	Y, F1930	N	No retail price found

material is a melting material. There is no standard for low-cost FR disposable garments. While FR raingear manufacturers are changing their claims on flame resistance based on these full-scale tests and better knowledge, the FR disposable market has not kept up because there is no real specification using the available full-scale test methods. Melting materials such as polyethylene, olefin, polyester, nylon are

A small percentage of these types of materials may be in full-scale tested FR materials and can add value to their performance.)

**Practical solutions**

How do you know you're purchasing the right product for the potential hazards? Here are some factors to look for when selecting appropriate FR disposable garments.

- Passes vertical flammability.
- Passes heat resistance.
- No melting and dripping in full-scale tests.
- Has some protective value from a full-scale test (ASTM F1930 or ASTM F1959).
- Must not melt and drip in your exposure potential.
- Lighter weight materials may not meet 50 percent body burn or have a high arc rating, but they should be evaluated by a full-scale test method. Other FR clothing should be worn underneath the disposable unless its full-scale rating is adequate for the task.
- A disposable that can be decontaminated or incinerated might be desirable in some applications.

In upcoming years, the industry will likely demand a disposable FR standard either from ASTM F1506, ISEA, or NFPA. Until that happens, examine the choices carefully. Look for full-scale data and evaluate the clothing system for the desired characteristics.

### Summary

All the basic standards for arc flash and flash fire exposures prohibit melting materials:

- OSHA 29 CFR 1910.269
- NFPA 70E
- IEEE NESC (National Electric Safety Code)
- ASTM F2733 flash fire protective rainwear
- F1891 arc flash rainwear
- NFPA 2112 flash fire clothing

Most of these standards specifically prohibit all melting materials (i.e. polyester, nylon, acetate, polyethylene, polypropylene) from being worn as apparel for workers exposed to electric arc and flash fire respectively. Even when these materials are “treated,” they are not made truly non-contributory to injury when they can come in contact with skin (as under-layers or outer layers). Some instances exist where light weight inner layers have been used for “wind breaks” and some small amounts of these fibers have successfully been blended into true flame resistant clothing which meets flash fire standards or arc rating standards. Use **ONLY** approved specifications when looking for garments and be certain the garment has been tested to a reasonable method for arc-rating or flash fire rating if exposed to any of these hazards.

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### Looking Forward

Future Specs	ANSI/ISEA 101	ASTM F1506	NFPA 2112 or CGSB 155.20
	Considering disposable FR option	Voting Oct 09 to add NEW disposable FR category	No current plans for disposable FR.