



Arc Flash White Paper

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WHAT IS AN ARC FLASH AND WHY IS IT DANGEROUS?

What on earth is an Arc Flash, and how do I choose the right PPE?

Arc Flash clothing and PPE is not an easy product to select. Whilst most electrical PPE (insulated gloves, mats, sleeves) is chosen based on working voltage, Arc Flash is not. Arc flash calculations are complex, time consuming, costly and usually performed by an electrical engineer. Not all organisations have those resources, and some contractors work on 10's if not 100's of sites, making it physically impossible to do arc flash calculations on all of the equipment they work on. Here's a short guide on what all the Arc Flash lingo means, and how to estimate the protection level you need.

What does Flame Resistant (Flame Retardant) mean?

Flame Resistant or Flame Retardant is the property of a material whereby combustion is prevented, terminated, or inhibited. Flame resistance can be an inherent property of a material, or it can be imparted by a specific treatment applied to the material.

What does Arc Rating (Arc Rated) mean?

Arc Resistance or Arc Rating is the maximum Arc Flash incident energy resistance demonstrated by a material prior to break open (a hole in the material) or necessary to pass through and cause with 50% probability a second or third degree burn.

Arc Rating is normally expressed in cal/cm² (or small calories of heat energy per square centimetre).

What's the difference between Flame Resistant and Arc Rated?

All Arc Rated garments must be flame resistant to pass the arc rating test. Not all Flame Resistant garments would pass an Arc Rated test. Flame Resistance is about resistant to heat, fire and flame. Arc Resistance is about resistance to an exploding switchboard or other electrical apparatus.

What's the difference between Inherent Flame Resistance and Treatments?

Inherently flame resistant fibers contain an essential characteristic that protects the wearer from an ignition source. Treatments or treated fibers have an applied chemical treatment that changes the original level of flame resistance. These may wash out with laundering, depending the type and quality.

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WHICH IS THE CORRECT ARC FLASH STANDARD TO FOLLOW

What is IEE1584?

IEEE1584 is the industry accepted 'Guide for Performing Arc-Flash Hazard Calculations'. This guide provides mathematical models for designers and facility operators to apply in determining the arc-flash hazard distance and the incident energy to which workers could be exposed during their work on or near electrical equipment.

What is NFPA70E?

The National Fire Protection Agency's (NFPA) 70E is the Standard for Electrical Safety Requirements for Employee Workplaces is the industry accepted standard in North America, AUstralia and New Zealand that helps decide how to protect workers based on the arc flash rating of equipment, as calculated from IEEE 1584.

NFPA70E requires employees to wear flame resistant protective clothing wherever there is a risk of exposure to electric arc flash. Although it is a voluntary standard, NFPA70E is considered a generally accepted industry standard in the USA, and even in Australia and New Zealand throughout general manufacturing as well as the electrical industries.

What is AS4836?

AS4836 is an Australian Standard written for when electrical workers are working on or near live parts. AS/NZS 4836:2011, specifies Arc Flash PPE that must be used in certain situations. The Arc Flash PPE specified is of American Standards rating (NFPA 70E). AS/NZS 4836:2011 specifies certain cal/cm² (or simply 'cal') ratings certain pieces of PPE are now required to have for various tasks (when working on or near live parts). As one would expect, higher risk tasks require higher rating pieces of PPE.

What is an Arc Rating?

An Arc Rating is the maximum incident energy resistance demonstrated by a material (or a layered system of materials) prior to break-open or at the onset of a second-degree skin burn. Arc rating is normally expressed in cal/cm² (0.5 to 1 cal/cm² = hottest part of lighter in 1 sec). An exposure of only 1-2 calories will cause second degree burns on human skin. Typical non-Flame Retardant workwear can ignite at energies as low as 2 calories.

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The categories of PPE as described in NFPA 70E are as follows:

Hazard Risk Category	Required Minimum Arc Rating for PPE		Clothing Description
	Cal/cm2	J/cm2	
0	n/a	n/a	Untreated Cotton
1	≥4	16.74	Arc Rated Flame retardant (FR) shirt, FR trousers or FR coverall
2	≥8	33.47	Arc Rated Flame retardant (FR) shirt, FR trousers or FR coverall
3	≥25	104.6	Arc Rated Flame retardant (FR) shirt, FR trousers or FR coverall, and arc flash suit selected so that the system arc rating complies with the required minimum
4	≥40	167.36	Arc Rated Flame retardant (FR) shirt, FR trousers or FR coverall, and arc flash suit selected so that the system arc rating complies with the required minimum

Note that a hard hat with full-face shield and the appropriate gloves are required also.

What is Arc Thermal Performance Value (ATPV)?

Arc Thermal Performance Value is the incident energy on a material that results in sufficient heat transfer through the material for a 50% probability of the onset of a second-degree burn on human tissue. ATPV is a rating assigned to Flame Retardant Clothing indicating the level of protection provided. Higher fabric weights typically have higher ATPV's and provide increased protection as does the layering of Flame Retardant Clothing. ATPV is measured in calories per centimeter squared (cal/cm2).

What is a Calorie?

A Calorie is an energy measurement used to characterize the amount of arc flash energy which is required to cause a second degree (blister burn) on human skin. Without protection, according to the Stoll Curve, it takes about 1.2 cal/cm2 to cause a second degree burn.

What is HRC?

Hazard Risk Category is a rating range directly related to ATPV. There are 5 HRCs ranging from 0 to 4, with a hazard risk of 0 presenting the least risk and a hazard risk of 4 being the greatest risk.

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CHOOSING THE RIGHT ARC RATED PERSONAL PROTECTIVE EQUIPMENT

How do I know what rating Arc Flash PPE to wear?

To calculate likely incident energy from a switchboard is time consuming, onerous, and technical. Variables include voltage, current, fault current, switchboard materials, switchboard opening dimensions and much more. Australian Standards acknowledges this, by virtue of AS4836, which gives a layman, conservative approach to choosing arc flash equipment in table 9.1. It is still always recommended to do full and proper arc flash calculations to choose the exact correct rating of clothing.

Personal Protective Equipment (PPE)	Requirements to AS/NZS 4836:2011	Clarification
Eye protection	No metal, complying with AS/NZS1337 and selected in accordance with AS/NZS 1336.	Heat resistant, no metal
Face Shield	Certified to 10cam/cm2	Tested to 10cal
Arc Flash suit and hood	Certified to 40cam/cm2	Tested to 40cal
Insulating gloves	AS2225 or Equivalent, rated to appropriate voltage, air tested before use.	IEC, ASTM and EN gloves acceptable
Flame-resistant (Flame Retardant) gloves	Gloves made from leather or other non-melting heat-resistance material	Complying with AS/NZS2161.4
Protective Clothing	Flame-resistant, full body clothing with no metal.	Cotton not suitable. Must be Flame Retardant rated and tested fabric.

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What key points are most important when choosing Flame Retardant or Arc Rated garments?

In choosing the right Flame Retardant garments for your workforce, there are several qualities that you should consider: thermal protection, static resistance, arc rating (if any), comfort, durability, stability, employee satisfaction, overall appearance, ease of laundry care, and relative cost. But most importantly, it is essential that you choose the Flame Retardant garments that provide the appropriate level of protection based on your hazard risk analysis.

Is it safe to roll up the sleeves of a Flame Retardant or Arc Rated garment?

Flame Retardant clothing can only provide protection where it separates the wearer from the ignition source. If the sleeves are rolled up or cut off, the exposed body parts are completely unprotected and will suffer the same injuries as if the garments had never been worn. Some company policies may allow for employees to unbutton their shirts or roll up their sleeves when not working around energized parts or other potential ignition hazards.

Why do I need Flame Retardant clothing? I've never had an accident?

Accidents can happen anytime, anywhere, and to anybody, regardless of past performance. The fact is that equipment breaks, people make mistakes and eventually a situation will arise with the potential of causing serious injury. The use of Flame Retardant clothing and other personal protective equipment is the last line of defence when these incidents occur.

How does Flame Retardant Clothing help protect against burn injury?

Flame Retardant and Arc Rated will provide thermal protection, which if exposed to electric arcs or flash fires, will self extinguish after the source of ignition is removed, limiting the degree of burn and body burn percentage. The flame-resistant fabrics are impregnated with chemicals that extinguish flames and help char the fabric. It is not designed to be flame proof; however, it is flame-resistant.

Will normal 100% cotton, wool and other natural fibers help protect against possible burn injury from arc flash?

Non-treated cotton and wool are flammable fibres. If exposed to electric arcs and flash fires, these materials will continue to burn causing possible severe injury and death. In fact, cotton burns very hot, and whilst it will not melt like some polyester fibres, it does not extinguish and burns at a high temperature, making it potentially extremely harmful to the wearer.

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