



# Arc Flash Guide



...work safer, be better.

## About FireBear® by Tower

Welcome to FireBear, the specialist flame retardant and arc protection range from Tower Supplies, one of the UK's largest independently owned health & safety companies.

Established in 1983, we have unprecedented experience over 30 years in the manufacture of PPE and workwear built round our core values: Innovation, Integrity & Respect. FireBear itself embodies these values and was, in fact, born out of them.

By working with fibre manufacturers, weavers and production plants we have produced a range that fully supports our mission "To make the workplace a better place" and FireBear is the finest exponent of quality, innovation and safety that is available in this industry today.

Working with clients from large Distribution Network Operators (DNO's) to family owned subcontractors in the utilities market we are continually improving the range of products we have available.

We have a dedicated team of customer service staff, technical managers and external representatives who want to assist you in making the right choice and achieving the safest solution.

I would urge you to take the time to look at the FireBear range that is fast becoming the new industry standard.

Please join the FireBear team in their mission "To make the workplace a better place"

Daniel Aris  
CHAIRMAN



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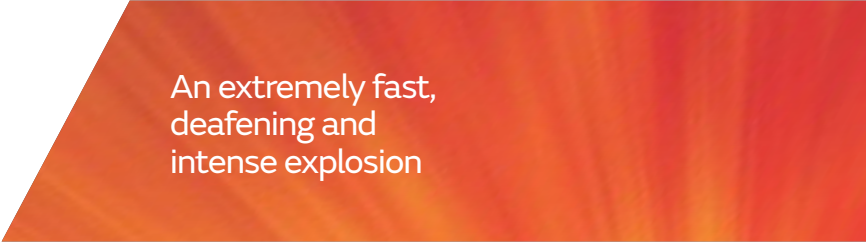
## What is an arc flash?

An arc flash and resulting arc blast is an explosion or discharge of intense light and heat caused by an electrical fault reaching temperatures of up to 20,000°C.


Arc flashes are the result of an electrical short circuit with electrical current traveling through something that is not normally conductive, such as air, until it reaches another conductor.

Arc flashes can cause loss of hearing, loss of sight, severe burns, and many other serious injuries, including death.


Arc flashes can burn through clothing and melt materials close to the skin in seconds.




An extremely fast, deafening and intense explosion



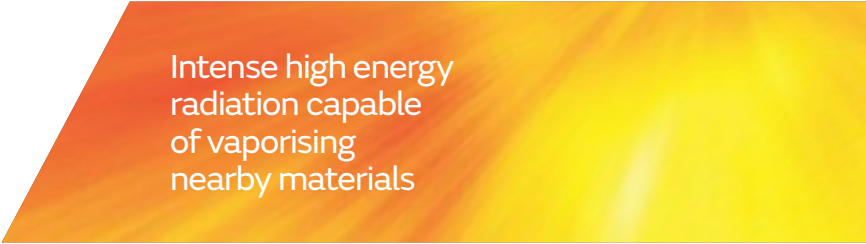
Hotter than the surface of the sun - up to 20,000 °C




57% of workers had witnessed or been involved in an arc flash first-hand



Molten metal and plasma are blasted outwards with extraordinary force.



Intense high energy radiation capable of vaporising nearby materials



Appropriate PPE is a critical last line of defence

## How common is arc flash?

According to HSE Data, 60-70% of arc flash incidents are under-reported. This could be the result of miscategorising them among the other 1,000 yearly incidents, around 25 of which are fatalities.

Of the 400 reports of arc flash-specific incidents a year, there is an average of 230 7-day injuries, 36 burn injuries, and two workplace fatalities.

HSE Data also reveals that there are around 150-160 cable strikes every single day in the UK. It's also believed that only half the drawings for cable routes are accurate.

Fines for inadequate safety measures relating to the cause or consequences of arc flash incidents can be in excess of £2 million.

## What causes arc flash?

Rodent damage to equipment and housings is one of the major causes of arc flash that is often overlooked.

Facilities not cleaned and maintained frequently can increase dust and corrosion on conductor surfaces, which can be an arc flash hazard waiting to happen.

The accidental touching of live conductors with tools or equipment, especially with worn or damaged equipment, can also cause an arc flash to occur.

### KEY FACT

While high voltage equipment does increase the likelihood and intensity of arc flash explosions, they can occur in any live electrical environment – even low voltage.

## What are the effects of arc flash?

Although the true number of arc flash incidents are still unknown due to under reporting and possible miscategorising, the consequences of an arc flash occurrence cannot be understated.

The injuries sustained by an arc flash can be physically devastating and often have a lasting mental impact.

Employers have a legal obligation under Regulation 4(1) of the Electricity at Work Regulations 1989 and Regulation 3(1) of the Management of Health and Safety at Work Regulations 1999, which mandate the need to carry out a suitable and sufficient risk assessment and to put measures in place to protect those who could be put at risk.



In April 2018, the HSE recorded two cable strike incidents including one which caused major burns resulting in a fine of £600,000 plus costs and another which caused serious burns to the worker's hands, arms and face which resulted in a fine of £80,000 plus costs.



## Who is most at risk of arc flash?

### RAIL MAINTENANCE

This is a high-risk environment and arc flashes are a major concern for those working with electrical services and breaking ground.

### UTILITIES

Arc flash is a risk for all activities on or around cables, networks and equipment. There is also a major risk when breaking ground, with many services now sharing the same trenches.

### INDUSTRIAL ELECTRICAL

Large organisations needing high levels of power will often require maintenance teams to work in live environments. This makes arc-rated clothing and base layers essential.

### TELECOMS

Telecoms is an area of real risk when maintenance and installation teams are working on new and existing connections both on the ground and at height.

### SUSTAINABLE TECHNOLOGIES

There is an ever-increasing demand from providers of renewable energy and installers of electric vehicle charging points to protect workers from the risk of arc flashes.

## How is arc PPE tested?

There are two methods used to test garments against arc flashes. As both tests measure different things, a result on one will not guarantee a result in another.

### OPEN ARC TEST METHOD

The Open Arc method determines the maximum thermal energy a garment can withstand before the wearer is subject to second degree burns.

The measurement is converted into calories per square centimetre (cal/cm<sup>2</sup>). This figure ensures that the correct level of clothing can be identified as per risk assessments.

The Open Arc testing method is also an accurate way of measuring the level of protection against the risk, making it easy to use when layering PPE products.

### BOX TEST METHOD

The Box Test indicates how much radiant heat will cause second degree burns to the wearer. This method tests against an arc duration of 500ms, tested to either Class 1 (4kA) or Class 2 (7kA).



## Arc flash Jargon

All arc flash safety wear should be tested to the new IEC 61482-2 standards using Open Arc and Box Test methods. This safety standard was updated in 2019 and resulted in the acronym ELIM joining APTV and EBT to indicate different risk threshold levels.

## But what do they all mean?

### **ATPV**

An Arc Thermal Protective Value indicates the maximum incident energy level safety clothing can be exposed to before there's a 50% probability the wearer will sustain second degree burns.

### **EBT**

The Energy Breakopen Threshold indicates the maximum incident energy a material can withstand before there's a 50% probability that at least 1.6 cm<sup>2</sup> of it will break open.

### **ELIM**

The Energy Limit Value was introduced in the IEC 61482-2 standards in 2019, which shows the maximum incident energy level the garment can be exposed to with 0% probability of the wearer sustaining second degree burns.

### **CAL/CM<sup>2</sup>**

Cal/Cm<sup>2</sup> stands for calories per square centimetre. One calorie represents the amount of heat energy needed to increase one gram of water by one degree Celsius in standard conditions. Without protection, second degree burns can happen when a square centimetre is exposed to 1.2 calories per second.

### **CAL RATING**

It's industry standard for arc flash PPE garments to have a calorie rating. This shows the maximum calories a product can withstand before it's proved insufficient.

## What arc flash PPE do you need?

All the following factors can affect the protection levels you will require:

- Distance from the equipment you're working on
- What type of equipment you're working on
- Whether working in high-risk confined spaces
- How far away from the source of energy you'll be working

You need to be aware of your own risk assessment. Check whether it states the need for ARC clothing. If it does, it may also state the level of protection required.

It's very important to understand that garments that are flame retardant (FR) are not arc-rated by default. Make sure you look for the correct marking and EN standards.

Learn how to layer garments to achieve higher levels of protection than can't be achieved with a single level. It's not always the case that simply adding layers ensures a better result, it doesn't.

## How is fabric used in arc PPE?

The fabric is the key to how a garment performs. Fabric will determine the garment's durability, and most importantly how it acts as a layer of protection between the user and an arc flash.

In the pursuit of making fabrics lightweight and durable, consideration is given to factors such as shrinkage and colour fastness, moisture management, laundry and colour constraints.

Fabrics are either treated with a flame retardant treatment after they are woven, or fabrics can be inherently flame retardant, which means the flame protection cannot be washed out over time.

## FR treated vs inherent FR

**Working around risks such as electric arc, molten metals and radiant heat require protective clothing that is either fire-retardant (FR) treated or inherent FR. But do you know what their important differences are and why one is cheaper than the other?**

### FR treated

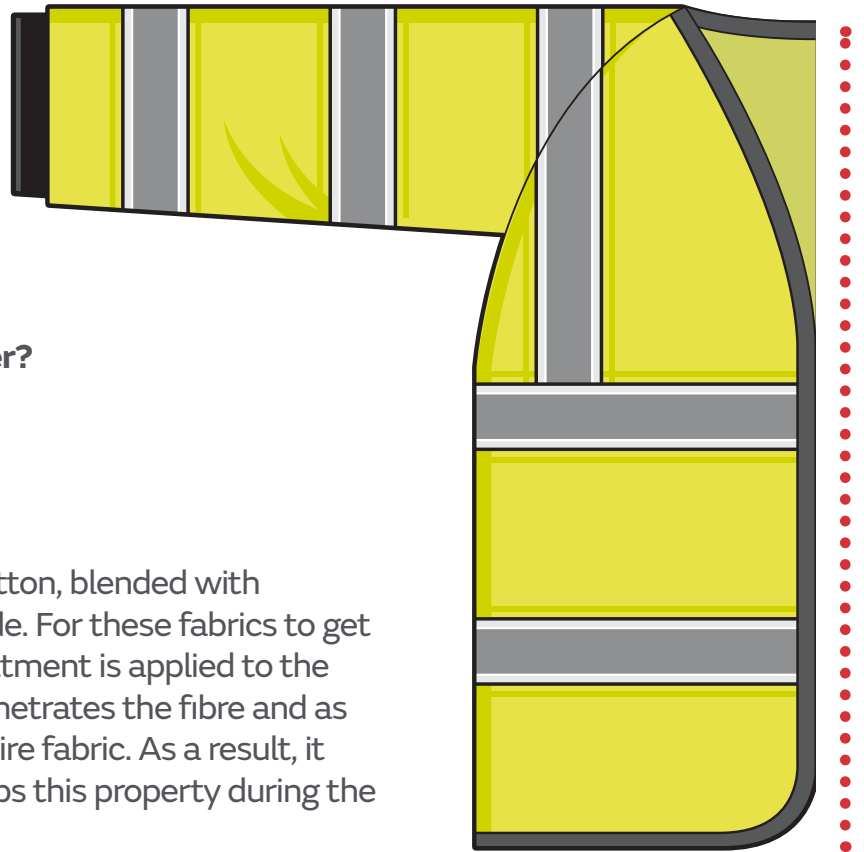
FR treated fabrics are based on cotton, blended with polyester, para-aramid or polyamide. For these fabrics to get their FR properties a chemical treatment is applied to the fabric in such a way that it fully penetrates the fibre and as such is bonded throughout the entire fabric. As a result, it becomes flame retardant and keeps this property during the lifetime of the garment.

### Pros

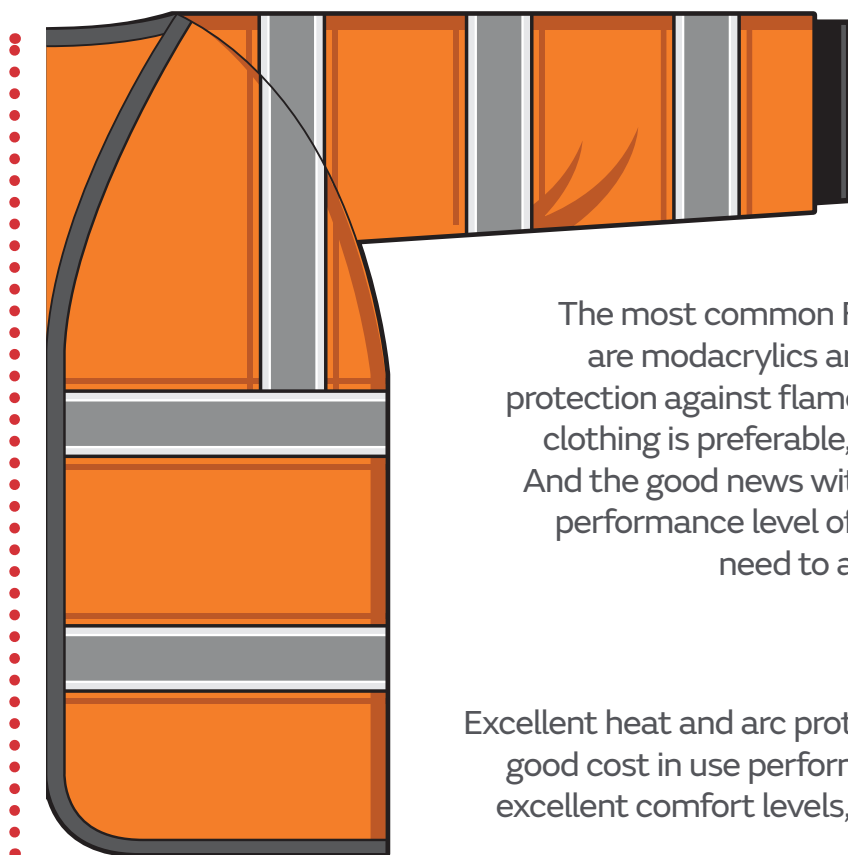
Very good protection against molten metal, heat and arc. Whilst also being relatively cheap and good value for money in dirty environments where expected lifespan is typically shorter.

### Cons

Original colour fades after several washes, and to achieve similar FR properties as inherent FR the fabrics are heavier and less comfortable.



## Inherent FR



Inherent means “existing as a natural or permanent quality of something”. So, when it comes to inherent FR fabrics, it means that at least one of the fibres used in that fabric has its own FR properties.

The most common FR fibres used in protective clothing are modacrylics and aramids, which provide excellent protection against flames and heat. Commonly lightweight clothing is preferable, due to its lightweight and comfort. And the good news with inherent FR is that the higher the performance level of the fibre, the lower the weight you need to achieve a certain level of protection.

### Pros

Excellent heat and arc protection, great colour fastness hence good cost in use performance, lighter weight solutions with excellent comfort levels, and it's often used in environments where the corporate look is vital.

### Cons

Limited protection against molten metal splash and is more expensive than FR treated.

## WHICH TO CHOOSE

Unfortunately, as it varies by industry and user there is no simple answer to this question. Whilst we have listed some pros and cons above, it does all come down to your own needs and preferences. As these are often important decisions, we are more than happy to provide you with the right advice.

## Helping your team

### HOW YOU CAN DETERMINE THE RIGHT LEVEL OF PROTECTION

Different tasks, different equipment and different environments combine to determine the overall incident energy level a worker could be exposed to. As an employer, it's your responsibility to conduct thorough risk assessments which identify the risk of an electrical or arc flash incident and its potential incident energy levels.

Understanding this data means that as the person responsible for buying the PPE, you can find the standard that will provide adequate protection in that circumstance.

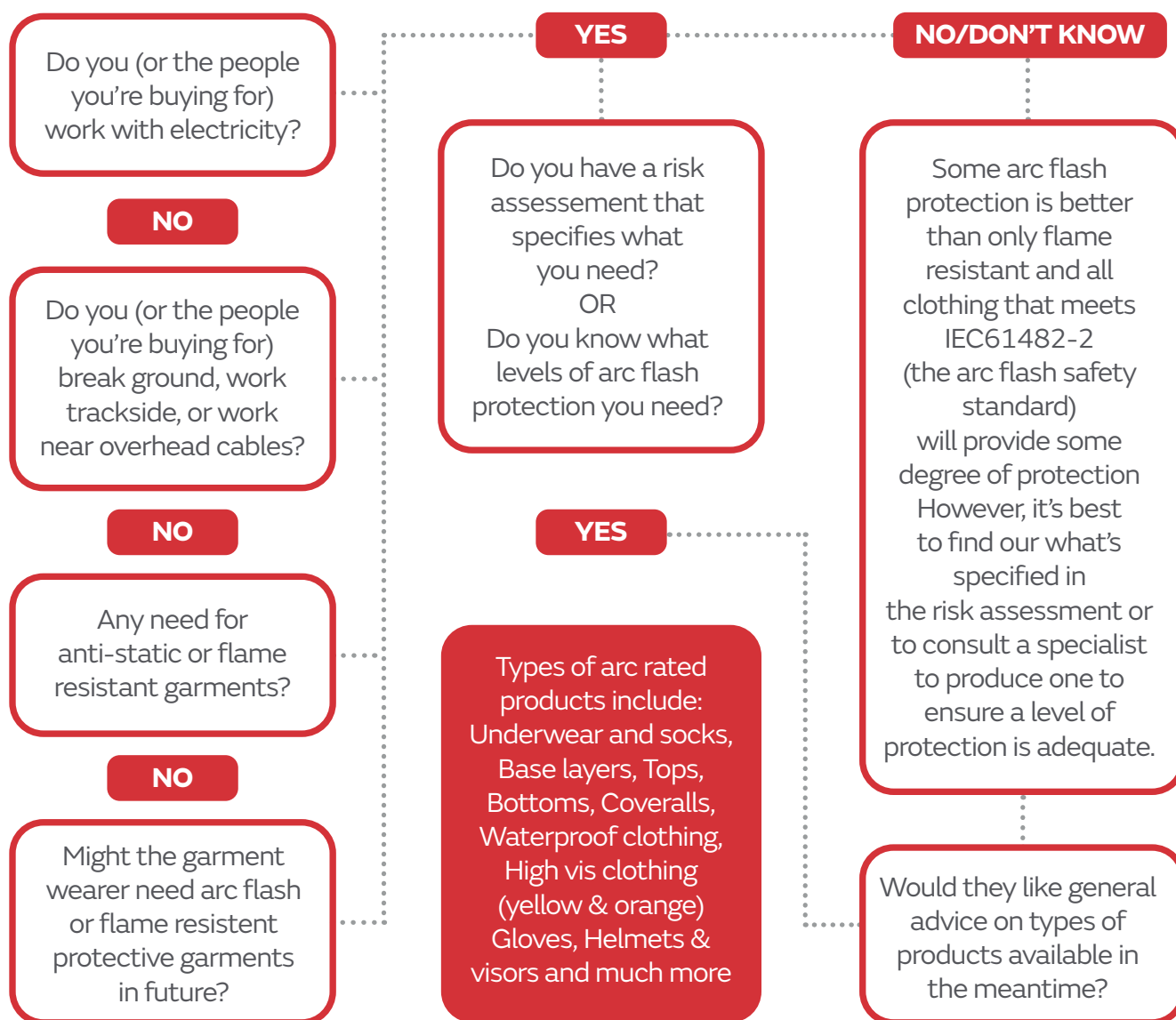
### QUESTIONS YOU CAN ASK

Unfortunately, there is still widespread ignorance about the potential risks of arc flash incidents and many people perceive it to be a risk only to those working directly with electricity rather than understanding the potential risk from accidental cable strikes.

Some product ranges have anti-static properties too, so it's also worth understanding these requirements (particularly if you're in the petrochemical sector) and any other current or potential needs to identify the best item.

## Helping your team

Here's a quick guide to some questions you can ask to help them make informed decisions about their protective clothing order.





**TOWER**



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