

ProGARM[®]
PROTECTING LIVES

ENERGY INCIDENT LIMITS (ELIM)

UNDERSTANDING THE
IMPORTANCE OF ENERGY
INCIDENT LIMITS (ELIM)
IN ARC FLASH PPE

TRUST THE ARC FLASH
SPECIALISTS

WWW.PROGARM.COM



KNOWLEDGE IS POWER.

THIS GUIDE TAKES YOU THROUGH THE NEED-TO-KNOWS OF HOW ARC FLASH PROTECTIVE CLOTHING IS TESTED, RATED AND GUARANTEED SO YOU CAN BUY WITH CONFIDENCE.

When clothing needs to be able to save your life, you're going to want some guarantees it's up to the job.

That's where European safety standards come in. They dictate everything from the robustness of car seats to the temperatures a fire-retardant jacket needs to withstand. They are the mark of quality when it comes to protective equipment and clothing.

Safety standards are updated fairly often, and what was once considered cutting-edge can quickly be surpassed. That's especially the case when it comes to protective clothing as dangers and risks evolve, alongside the technical fabrics and garments designed to protect people against them.

Testing methods are particularly important, as they produce the information relied on when deciding whether a garment or piece of equipment passes the safety standard.

This report delves into the concept of Energy Incident Limit (ELIM) in the context of Arc Flash testing. We highlight ELIM's importance and key differences from other testing methods Arc Thermal Performance Value (ATPV) and Energy Breakopen Threshold (EBT). We've also included a list of the relevant arc flash signs and symbols that you'll see on protective clothing, plus a practical section on considerations for choosing appropriate Arc Flash personal protective equipment (PPE).



WHAT IS AN ARC FLASH?

Being able to protect your people from the dangers of Arc Flash incidents is crucial, and having ultimate confidence in your PPE comes from understanding quality, as well as knowing you've provided the right kit.

A very specific type of electrical incident, Arc Flashes are characterised by intense heat, light, and pressure. They can result in severe injuries, fatalities, and significant damage to equipment. It's a common misconception that Arc Flash incidents only happen in high-voltage environments.

Also known as electric arcs and often caused by cable strikes, an Arc Flash generates temperatures up to four times hotter than the sun in milliseconds. The energy wave created can knock a person off their feet. Burns – both internal and external – are almost a certainty if you get caught in an Arc Flash. Even wearing the right PPE can't completely prevent burns to a person's hands, face and inside their airway.

There's no official HSE classification for Arc Flash incidents, but that doesn't make them any less dangerous. They are likely to be categorised as electrical incidents and there are more than 1,000 electrical incidents in UK workplaces each year, with around 30 leading to fatal injuries.

ARC FLASH & SAFETY STANDARDS

Safety standards dictate the minimum benchmark for protective clothing, and also give information about performance. Arc Flash testing is a vital tool for assessing the performance of protective clothing and equipment.

Arc Flash incidents are always serious. They can be life-changing or life-ending. If your people work in industrial environments, whether in the utilities, industrial electrical, construction, renewables, petrochemical or rail sectors, they need adequate Arc Flash protection.

Sophisticated testing methods are used to give Arc Flash garments a rating and ensure they pass stringent safety standards. They enable manufacturers to assess the performance of their protective clothing and offer insight into the way it will perform in certain situations. This enables employers to understand how to mitigate the risks their people face and what clothing will work for each situation.



4 times hotter than the sun



2/3 of arc incidents are as a result of human error



Droplets of molten metal move at 700MPH



Copper expands at 67,000 times its volume during an Arc Flash.

A small pea-size piece of copper can expand to the size of a bus!



EXPLAINING ARC FLASH TESTING METHODS

IEC61482-1-1:2019 Standard:
Introduced in May 2019, this standard emphasizes more stringent testing conditions for Arc Flash products.

In May 2019 a new Arc Flash safety standard – IEC61482-1-1:2019 – dictated that Arc Flash products had to be tested under more stringent conditions. ELIM – energy incident limit – became the new, more conservative benchmark.

All testing of Arc Flash products results in a rating which shows the energy the garment could withstand. Specifically, testing determines the calories per square centimetre (cal/cm²) energy that the garment could withstand – known as the cal rating.

(Take a look at our section on product information for more on what you should expect to see on your PPE).

ATPV – Arc Thermal Performance Value

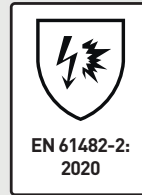
Measures the incident energy level at which there's a 50% probability of energy transfer through the fabric, causing second-degree burns. This is a lower standard than the ELIM rating but has been used for longer. It's easy to confuse the ATPV and ELIM values, which could result in you choosing PPE which doesn't have a good enough rating for the Arc Flash energy your people could be exposed to.

ELIM - Energy Incident Limit

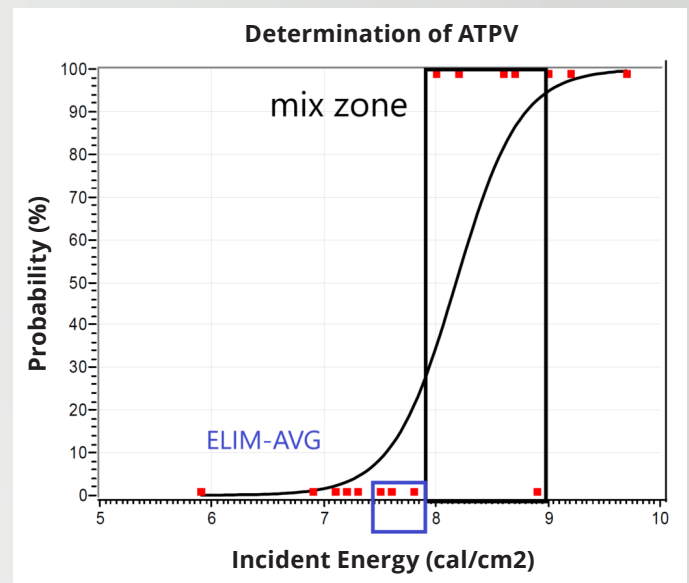
Measures the cal/cm² and, using the average of the three highest incident energy data points, determines the point at which there is an almost 0% chance of second degree burns at that incident energy level. It's a quantitative measure of the maximum allowable incident energy levels during Arc Flash events, which should guide how you choose your Arc Flash PPE. It combines information on the ATPV and EBT measures, plus other factors, to arrive at a safe energy limit for a garment which goes beyond burn injury or breakage of the garment's material.

EBT – Energy Breakopen Threshold

Defines the point at which a garment ruptures, exposing the wearer to the risk of burns. Breakopen is defined as an area at least 1.6cm³. This measure is also used in testing flame retardant clothing.



The Stoll Curve



When Arc Flash testing is carried out, the cal rating is determined using at least 20 data points and a logistical regression to determine the incident energy level at which there's a 50% probability of 2nd degree burns (enough heat to cross the Stoll Curve).

The Stoll Curve, as shown above, is a graphical representation used to predict the onset of second-degree burns. It shows the relationship between the time duration of heat exposure and the temperature rise that causes skin damage. From the graph above we can work out both the ATPV (50% burn probability) and the ELIM (Incident Energy Limit Value).

By defining energy limit values, ELIM helps organisations mitigate the risks associated with Arc Flash incidents, enhance safety, and ensure compliance with industry standards and regulations.

Prior to 2019, a combination of ATPV and EBT was used to calculate a garment's arc rating. The lower of the two values was always used.



WHY DOES SOME CLOTHING HAVE BOTH AN ELIM AND ATPV RATING?

CE certificates remain valid for 5 years before the item must be retested and recertified.

Clothing certified before 2020 will be marked with ATPV or EBT values. That's because certificates are valid for five years. But EN 61482-2 Protective clothing against the thermal hazards of an electric arc was updated in 2020 to require all garments to subsequently be labelled with the ELIM rating.

The two values represent different things, but it's all useful information in making your purchasing decision.

ATPV focuses on the thermal protection offered by the garment, arriving at a number which represents the point at which you could expect 50% second-degree burns. ELIM takes a wider view, by considering both preventing injury from burns, as well as material integrity. It's also a higher standard, which is why ELIM values on garments tend to be lower than ATPV and EBT ones, even if by only a small amount.

EN 61482-2 Protective clothing against the thermal hazards of an electric arc was updated in 2020 and it was a requirement that all garments must be labelled with the ELIM rating.

Garments certified prior to 2020 will be marked with ATPV and/or EBT50.

Energy Levels Measured in Cal/cm²:

Arc Flash PPE is rated based on the energy levels (cal/cm²) it can withstand, with ELIM providing a conservative and comprehensive measure.

WHY ELIM IS A BETTER MEASURE?

While ATPV and EBT are commonly used metrics in Arc Flash testing, ELIM offers distinct advantages in assessing protective equipment performance:

1. ELIM FOCUSES ON ENERGY LIMITS:

Unlike ATPV, which measures the incident energy with a 50% chance of causing a second-degree burn, ELIM establishes energy limit values that define safe exposure thresholds by taking the average of the three highest energy incidents that didn't cause a second-degree burn. It's effectively a more stringent standard. Similarly, EBT identifies the point at which fabric rupture occurs, whereas ELIM considers broader safety implications beyond material integrity.

2. COMPREHENSIVE RISK ASSESSMENT:

ELIM provides a comprehensive risk assessment by considering factors such as equipment ratings, fault currents, and system configurations. By incorporating these parameters, ELIM offers a more holistic approach to evaluating Arc Flash hazards and selecting appropriate protective measures.

3. REALISTIC SAFETY CRITERIA:

ELIM reflects realistic safety criteria by accounting for variations in Arc Flash conditions, equipment performance, and people's exposure. By establishing energy limit values, ELIM ensures that protective equipment can do its job, effectively mitigating the risks associated with Arc Flash incidents in a wide range of operational scenarios.

ELIM represents a significant advancement in Arc Flash testing, offering a systematic approach to assessing protective equipment performance and mitigating the risks associated with arc flash incidents.

By understanding ELIM Arc Flash testing and using results when defining your PPE selection criteria, organisations can enhance safety, minimise equipment damage, and ensure regulatory compliance in industrial environments.

THINGS TO CONSIDER WHEN CHOOSING YOUR ARC FLASH PPE

Keeping people safe from Arc Flash incidents is an operational imperative and relevant in a wide range of sectors. Choosing the right PPE for the risks your people are exposed to is critical. When doing that, you need to consider:

1. ELIM COMPLIANCE:

Ensure that Arc Flash PPE meets ELIM requirements by selecting garments and equipment with appropriate ELIM ratings – not just the ATPV or EBT ones. You'll need an Arc Flash study which outlines the energy values (cal rating) you need to protect against to decide on the right ratings for your kit. Once you know the cal rating you need, you'll have to match that to the ELIM rating. You'll find that ATPV ratings will have been higher because the ELIM standard is more stringent, so some of your kit will need to be changed.

2. MATERIAL QUALITY:

Choose Arc Flash PPE made from high-quality materials that provide durability, comfort, and protection against ArcvFlash hazards. Make sure all fastenings are also Arc Flash resistant. This can make your medium-term budget go further as you won't need to replace kit as often.

3. FIT AND COMFORT:

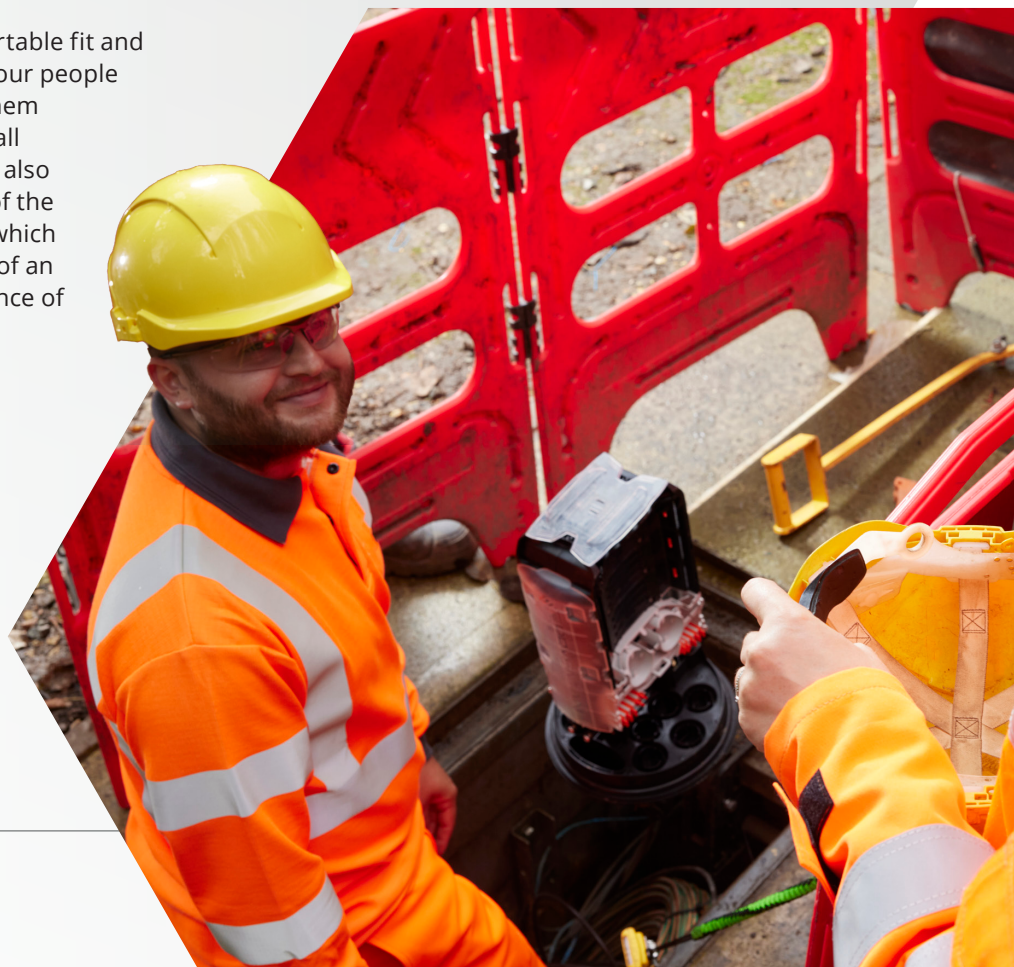
Prioritise Arc Flash PPE offering a comfortable fit and ergonomic design to make it easier for your people to move and increase the likelihood of them wearing the clothing properly (doing up all buttons, not rolling up sleeves). Clothing also needs to fit properly, covering all areas of the body and not riding up to expose parts which then wouldn't be protected in the event of an Arc Flash. Read more about the importance of comfort in this [blog](#).

4. LAYERING AND COMPATIBILITY:

Consider layering Arc Flash PPE to provide additional protection and compatibility with other safety gear, such as respiratory and fall protection equipment. The benefits of Arc Flash PPE will be compromised if people don't wear the right underwear, socks and thermals, so think about everything your workforce wears, not just an Arc Flash top layer.

5. TRAINING AND MAINTENANCE:

To make the most of your investment, and ensure people know why they should be wearing their PPE properly, provide comprehensive training on how to use Arc Flash PPE, how to look after and wash it to ensure optimal performance and longevity.

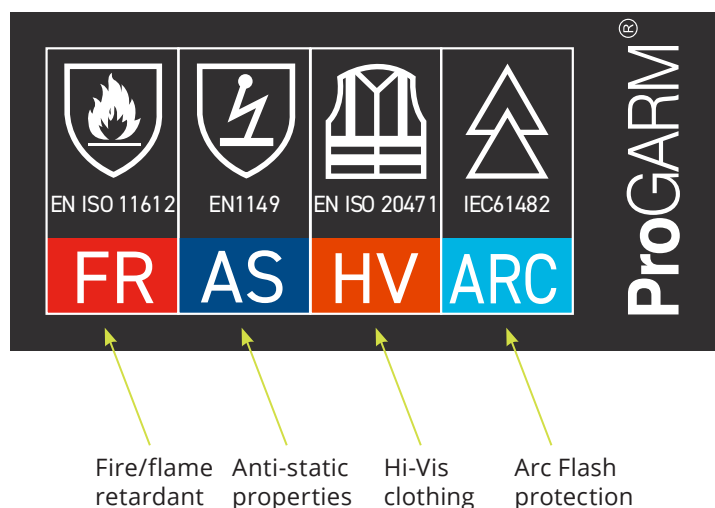


ARC FLASH SAFETY INFORMATION YOU SHOULD EXPECT TO SEE ON YOUR PPE

ProGARM's simple SafetyICON™ system gives you at-a-glance information.

- ✓ Fire/flare retardant
- ✓ High-vis
- ✓ Anti-static
- ✓ Arc Flash protection

SafetyICON™ example



Glossary of Electrical Safety Terms

This glossary provides a quick reference for understanding key terms related to electrical safety and personal protective equipment (PPE) standards.

Arc Flash

A dangerous condition associated with the release of energy caused by an electric arc. An Arc Flash can cause serious injuries, burns, and even fatalities.

Arc Rating

The value assigned to materials that indicates the level of protection they provide against arc flash. It is expressed in calories per square centimetre (cal/cm²) and represents the amount of energy the fabric can withstand before it breaks open or sustains damage.

ATPV (Arc Thermal Performance Value) Rating

The incident energy on a fabric or material that results in a 50% probability that there will be enough heat transfer through the material to cause a second-degree burn. It is one way to express an arc rating.

Cal/cm² (Calories per Square Centimetre)

A unit of measurement used to quantify the energy released during an Arc Flash. It is used to express the amount of thermal energy incident on a surface.

Cal Rating

Another term used to refer to the arc rating of a material, indicating the amount of heat energy (in calories per square centimetre) it can withstand before it fails.

EBT (Energy Breakopen Threshold) Rating

The amount of incident energy that causes a material to break open and expose the skin, which can lead to burns. Like the ATPV, it is expressed in calories per square centimetre (cal/cm²).

ELIM (Incident Energy Limit) Rating

The highest incident energy level at which a material performs adequately under specific test conditions, without causing ignition, melting, or breakopen. It is expressed in calories per square centimetre (cal/cm²).

Incident Energy Level

The amount of thermal energy impressed on a surface, typically measured in cal/cm², at a given distance from an electrical arc. It is used to assess the potential hazard to personnel.

Stoll Curve

A graphical representation used to predict the onset of second-degree burns. It shows the relationship between the time duration of heat exposure and the temperature rise that causes skin damage.

**SEE OUR CATALOGUE
FOR THE COMPLETE RANGE
OF ARC FLASH & FLAME
RESISTANT GARMENTS**

**DOWNLOAD
TODAY**

ProGARM®
PROTECTING LIVES

ProGARM® United Kingdom
Dianthus Business Park, Common Lane,
Newport, Brough,
East Yorkshire,
HU15 2FT

Tel: +44 (0)1482 679600

Email: info@progarm.com

Web: www.progarm.com

Whilst every effort has been made to ensure the accuracy of all product descriptions, sizes and specifications, continual development of our product range means that certain details may change without notice. Though we make every attempt to ensure the colours of our products are reproduced as accurately as possible, they are provided for illustrative purposes and may differ from the actual product you receive. We reserve the right to improve products from our collection without notices.

ProGARM®, VXS+, ThermSAFE and SafetyICON, and any graphic devices, are all registered trademarks of ProGARM® Ltd