Ansell

AVOIDING ARC FLASH

SAFETY BRIEFING

SELECTING THE RIGHT PERSONAL PROTECTIVE EQUIPMENT WHEN WORKING WITH ELECTRICITY

> **“Electrical risk incorporates the danger of death, shock or other injury caused by electricity.”**

Working with electricity is an inherently hazardous undertaking. Electrical risk incorporates the danger of death, shock or other injury caused by electricity – through either direct or indirect exposure. The potential seriousness of these injuries requires the use of safety precautions and control measures designed to eliminate risk in the working environment. Key to this process is identification and supply of appropriate PPE.

There are many hazards when it comes to working with electricity. Electric shocks and burns can result from contact with exposed leads, faulty equipment or with metal surfaces including flooring and roofing. Electrical faults can also cause fires, and electricity can act as a source of ignition in flammable or explosive environments with devastating effect.

While all workers in any environment can be at risk of electrical injury, those in occupations including engineer, electrician or overhead line worker face greater risk than most, as everyday tasks bring them closer to potential sources of danger. Electrical installation & repair, equipment testing & inspection, and maintenance duties commonly leave workers exposed to risk of shock via contact or arcing.

COMMON HAZARDS

Non-electrical workers are also at risk of injury through contact with common items. The following areas of concern should be evaluated in a thorough safety risk assessment of all workplaces.

POWER LINES

Energised power lines represent a major injury risk due to the presence of high voltages. Care must be taken to ensure there is no contact with power lines if work at heights require the use of scissor lifts or similar.

TOOLS & EQUIPMENT

Damaged tools and equipment represent a major risk, but repairs should only be undertaken by a licensed electrical worker. Issues can occur through breakages, cable damage, and exposed wires.

WIRING FAULTS AND OVERLOADS

Incorrect wiring can cause issues, as can overloading electrical outlets and sockets. Fire risk assessments should identify potential problems in these areas.

EXPOSED PARTS

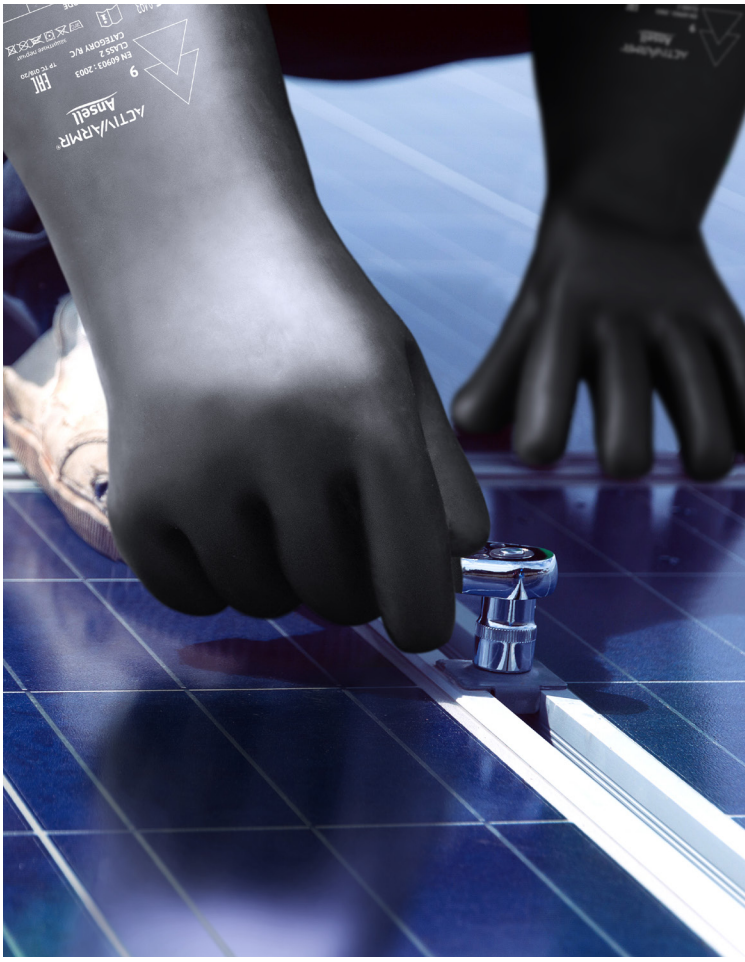
Electrical parts should never be exposed, as they present risk of shock and burns. This includes things such as damaged insulation on electrical cables or open power distribution units.

UNGROUNDED EQUIPMENT

Proper grounding eliminates unwanted voltage and reduces the risk of electrocution. Equipment should be adequately grounded to remove risk.

IMPROPER ENVIRONMENT

Electrical equipment should never be operated in wet environments, as the presence of water increases the risk of electrical injury.



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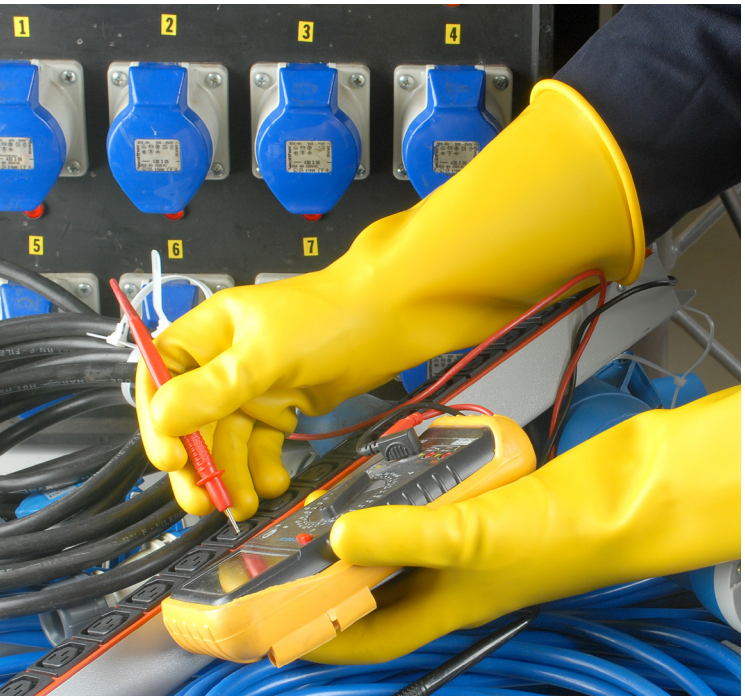
SAFETY MEASURES

The most appropriate safety measures will be defined by the specific working environment and the tasks workers must carry out. As a minimum, workers should understand the fundamental nature of electricity and be able to identify and eliminate electrical hazards in the workplace. They should also be familiar with the use of appropriate PPE.

Provision of PPE

PPE for electrical work must be suitable for the task, thoroughly tested and in good working order. It must be able to withstand the energy at the point of work when working energised[1]. It is also recommended that staff are trained in how to select and fit the correct type of equipment, and additionally trained on the use and care of equipment to ensure that it works effectively.



Depending on the nature of the work being carried out, some – or all – of the following PPE types may be appropriate:

- **Face protection** – arc-rated full-face shields should be used where there is potential for high current and arcing.
- **Eye protection** – metal glasses frames should not be worn.
- **Gloves** – hand protection should be insulated to the highest voltage expectation for the work being undertaken.
- **Clothing** – non-synthetic, non-fusible and flame-resistant fabrics should be used.
- **Footwear** – non-conductive footwear should be worn.
- **Accessories** – safety belts and harnesses should be checked and inspected including buckles, rings, hooks and clips.
- **Other tools and equipment** – all tools should be insulated, as should additional equipment including mats or ladders.

The external environment and other present risks will influence the optimum choice for hand protection. For example, when working in cold temperatures, gloves must be able to withstand the conditions and still provide a comfortable fit without becoming stiff or losing elasticity. Hand protection is only effective when worn and unsuitability in existing environmental conditions can lead to removal and subsequent harm from the original risk. Protecting outdoor workers means providing a solution that offers protection in a wide band of temperatures, including frost resistance at -40˚C.

Other types of hazards may be present in addition to electrical hazards, so care should be taken to ensure selected hand protection that will provide the appropriate defence against these other known risks, depending on the environment. For example, electrical workers use tools which can present puncture risk, so the chosen solution should offer adequate defence, providing the highest safety levels, while ensuring hand protection is not compromised and meets its original intent.

> **“PPE for electrical work must be suitable for the task, thoroughly tested and in good working order.”**

1. *SafeWork Australia – Managing Electrical Risks in the Workplace – page 50*

SELECTION OF ELECTRICAL GLOVES

Electrical safety gloves are categorised by the level of voltage protection they provide and whether they are resistant to ozone. Workplace specifics will determine the most appropriate choice. Voltage breakdown and ozone resistance identification is as follows:

VOLTAGE PROTECTION	
Class 00	Maximum use voltage of 500 volts AC/proof tested to 2,500 volts AC and 10,000 volts DC
Class 0	Maximum use voltage of 1,000 volts AC/proof tested to 5,000 volts AC and 20,000 volts DC
Class 1	Maximum use voltage of 7,500 volts AC/proof tested to 10,000 volts AC and 40,000 volts DC
Class 2	Maximum use voltage of 17,000 volts AC/proof tested to 20,000 volts AC and 50,000 volts DC
Class 3	Maximum use voltage of 26,500 volts AC/proof tested to 30,000 volts AC and 60,000 volts DC
Class 4	Maximum use voltage of 36,000 volts AC/proof tested to 40,000 volts AC and 70,000 volts DC
OZONE RESISTANCE	
Type I	Not resistant to ozone
Type II	Resistant to ozone

Other risk categories to consider:

- Resistance to acid (Category A)
- Resistance to ozone (Category Z)
- Resistance to low temperatures (Category C)
- Resistance to oil (Category H)

The potential for catastrophic injury when working with electricity should never be underestimated, making selection of the appropriate PPE choice a major consideration for safety and operations managers. A thorough safety assessment should be conducted, with hazards removed or mitigated where possible. Suitable PPE should be made available, and all staff should be trained in its proper selection, use and care.

> **“The potential for catastrophic injury when working with electricity should never be underestimated.”**

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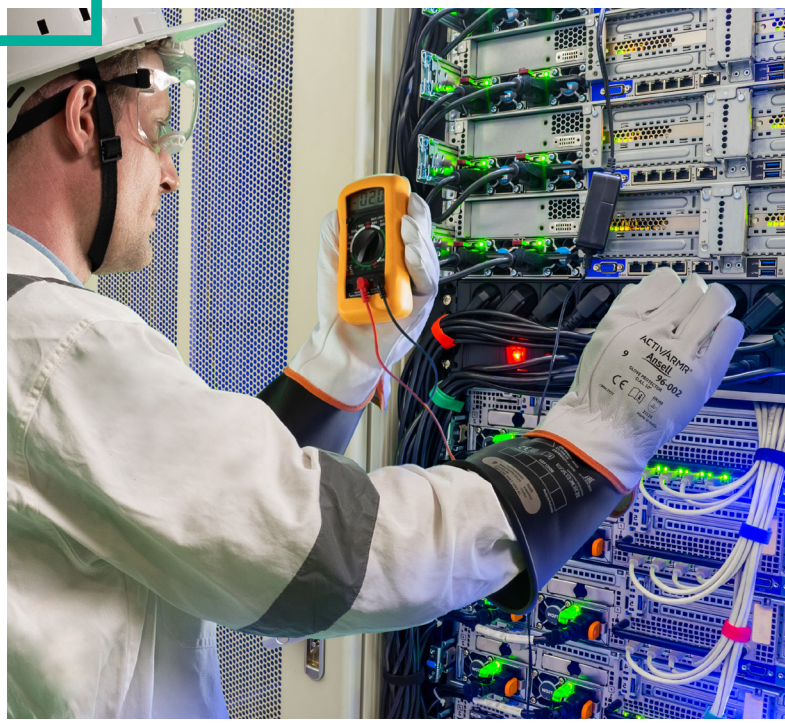
If in doubt, contact your vendor for further information and assistance in identifying the most appropriate options for your needs.

AVOIDING ARC FLASH

> **“Preventing serious industrial injury through risk assessment and appropriate PPE selection”**



Of the many workplace safety hazards and risks found in industrial environments, electrical arc flash ranks among the most serious. Injuries from arc flash events are usually acute and often fatal, potentially affecting multiple victims. These incidents also cause damage to plant and equipment, impeding an organisation’s ability to conduct business.

Given the potential for harm, a thorough risk assessment and hazard management program – including provision of suitable personal protective equipment (PPE) – should be a top priority for safety teams in environments where arc flash risks are present.

What is arc flash?

An arc flash is a type of electrical fault or short circuit, where current leaves its intended path and travels through the air from one conductor to another or to the ground. The energy released leads to a rise in both temperature and pressure and creates an arc blast.

Arc blast events generate radiant heat up to 20,000˚C – a temperature four times higher than the surface of the sun – and arc plasma, a form of ionised gas that reaches around 5,000˚C and often presents as a ‘fireball’. Additional by-products of an arc blast include a pressure wave capable of knocking a worker off their feet, loud noise, flying shrapnel and other debris including molten metal droplets and vapour.

The potential for injury is significant, with anyone located nearby at risk of serious harm. Likely injuries include external and internal burns – including damage to the lungs and other organs – hearing loss, eye damage and severe fragmentation wounds.

An arc blast will ignite flammable materials including non-arc rated clothing and personal protective equipment (PPE) that is insufficient for the application, which will continue to burn after the event, potentially causing even more harm that the initial incident.

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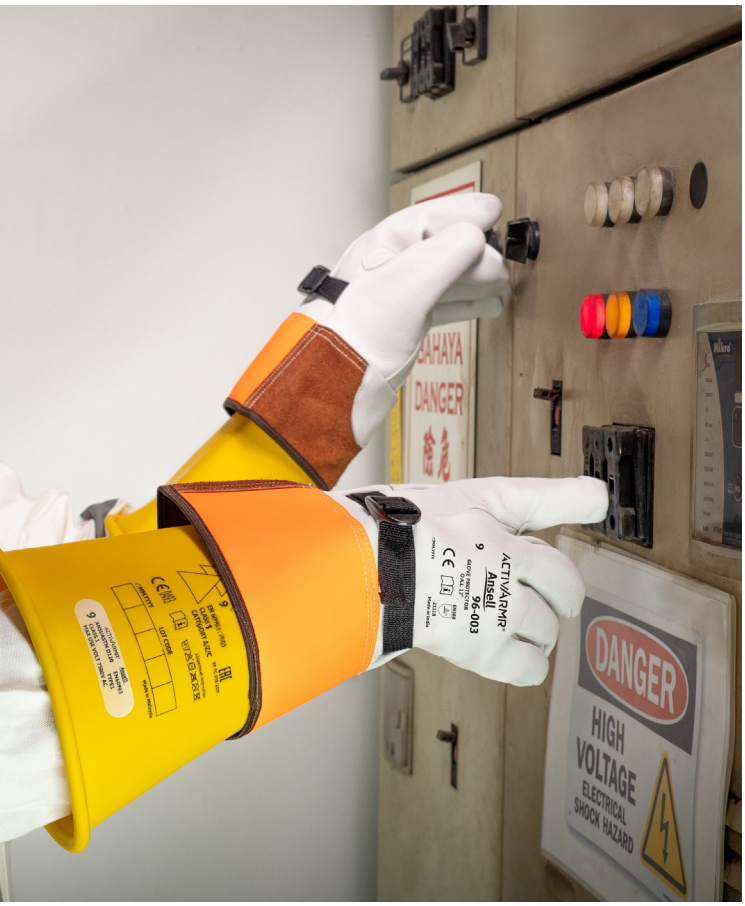
Common causes of arc flash

There are many common causes of arc flash, which range from human factors – including workplace culture, lack of training or skills deficit and distraction or carelessness – through to physical causes including the presence of foreign materials or dust, loose connections, exposed parts, and incorrectly designed or rated preventative equipment, to name but a few.

Given the magnitude of the risk and broad range of potential causes, it's best to adopt an offensive stance toward arc flash injury. A thorough risk assessment is essential, but it is only part of the picture. Workers must have access to adequate training and the organisation must also provide suitable safety equipment and procedures (including supervision where necessary) as part of the risk reduction process



Risk assessment and hazard management

The Electrical Arc Flash Hazard Management Guideline[2] suggests that 'when workers are required to work on or near electrical equipment, all reasonably practicable measures should be taken to protect workers from the harmful effects of electric arc flash hazards through hazard elimination and risk reduction'.

The recommended hazard management process to achieve that goal follows a generally prescribed format, with the addition of specific arc flash-related considerations as follows:

a. Understand the hazard
b. Identify assets or asset groups with arc flash hazard potential
c. Quantify the hazard (calculate the arc flash incident energy on each asset or asset group)
d. Assess the risk (using your organisation's risk management framework)
e. Develop and implement risk treatments using the hierarchy of controls
f. Validate control effectiveness
g. Monitor and review

Among the risk treatments for arc flash hazard, measures include:

- Where possible – and as a principle – work on dead equipment only
- De-energise and stringently maintain all electrical equipment
- Use suitable current protection including circuit breakers and fuses
- Utilise remote or robotic operators for high-risk activities
- Implement barrier controls including lockable containers and vaults, fences and other barricades
- Educate and adequately train staff and ensure appropriate supervision.

2. Electrical Arc Flash Hazard Management Guideline – The Australian Energy Council 2019 – p12

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Hierarchy of controls – Protect the worker

WHS regulation requires that safety and operations managers work through the hierarchy of controls to manage risk. Where it is not possible to eliminate the risk entirely, replace it with a safer option, isolate the hazard from people, reduce risk through engineering controls or change work practices to avoid it, then PPE that offers the appropriate level of defence must be supplied.

When working on or near electrical equipment, the following types of PPE may be required, dependent on the present risk:

- Arc-rated clothing and/or protective suits
- Hand protection
- Face and head protection including arc flash hoods
- Eye protection
- Ear canal inserts

The Electrical Arc Flash Hazard Management Guideline[3] provides guidance on appropriate PPE types, identified from least to highest risk based on work activity and corresponding tasks, providing a useful starting point for selection.

In the case of hand protection, opt for industrial rubber insulating gloves (RIGs) designed specifically for electrical hazards. RIGs fall under one of six classes (from 00 to 4), which indicate voltage resistance capability. When choosing the right glove, it is important to determine the maximum voltage to which the worker will be exposed and select a class of glove rated at or above that voltage.

In addition, leather protectors should be worn over the RIGs to extend the life of the glove while also protecting the wearer from cuts, abrasions, punctures, and arc flash. The leather cover gloves must be shorter than the RIG and are available in differing lengths that correspond to specific RIG classes, based on the distance between the gauntlet and the cuff.

> **“In the case of hand protection, opt for industrial rubber insulating gloves (RIGs) designed specifically for electrical hazards.”**

3. *Electrical Arc Flash Hazard Management Guideline – The Australian Energy Council 2019 – p16-17*

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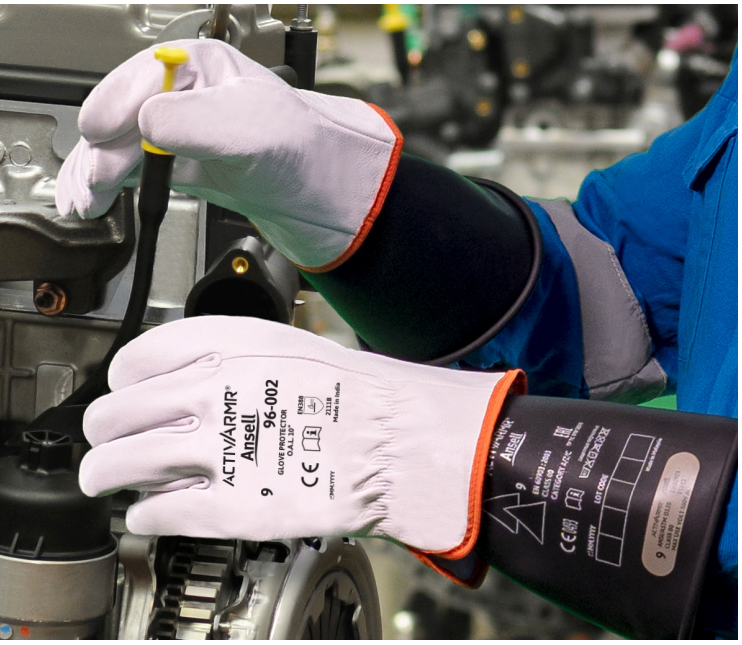
Let standards be the guide

As always, PPE must comply to the applicable PPE regulations and be safe for its intended use. This can be done using harmonised or mandated standards or technical specifications. To be suitable for use against arc flash injury, PPE must protect against the relevant risk presented by following existing standards. Some of these standards are designed for protective clothing and some for protective gloves, although in some instances a standard existing for clothing can also be applied to gloves, depending on the test method described in these standards:

Be flame resistant-rated (FR) or arc flash-rated (AR), as determined under the following standards and testing methods:

- **ASTM F1506** Standard performance specification for flame resistant and electric arc rated protective clothing worn by workers exposed to flames and electric arcs
- **ASTM F2675-13** Standard test method for determining arc ratings of hand protective products developed and used for electrical arc flash protection
- **EN 61482-1-1/IEC 61482-1-1:2019** Protective clothing against the thermal hazards of an electric arc - Part 1-1: Test methods - Method 1: Determination of the arc rating (ELIM, ATPV and/or EBT) of clothing materials and of protective clothing using an open arc
- **EN 61482-1-2/IEC 61482-1-2:2014** Live working - Protective clothing against the thermal hazards of an electric arc - Part 1-2: Test methods - Method 2: Determination of arc protection class of material and clothing by using a constrained and directed arc (box test) and;
- **IEC 61482-2** Protective clothing against thermal arc hazards of an electric arc



It is worth noting that all AR protection is flame resistant but the reverse is not true.

FR protection resists ignition, limiting burn injury and insulating the wearer from thermal hazard. AR protection is inherently flame resistant but also includes a measure of insultation to arc flash, which is expressed as Arc Thermal Performance Value (ATPV) or Energy Break-open Threshold (EBT). ATPV is the amount of energy that PPE can support before the wearer suffers second-degree burns, while EBT is determined when breakopen occurs before the onset of a second-degree burn. While the values are expressed differently, they are essentially functional equivalents in terms of protection.

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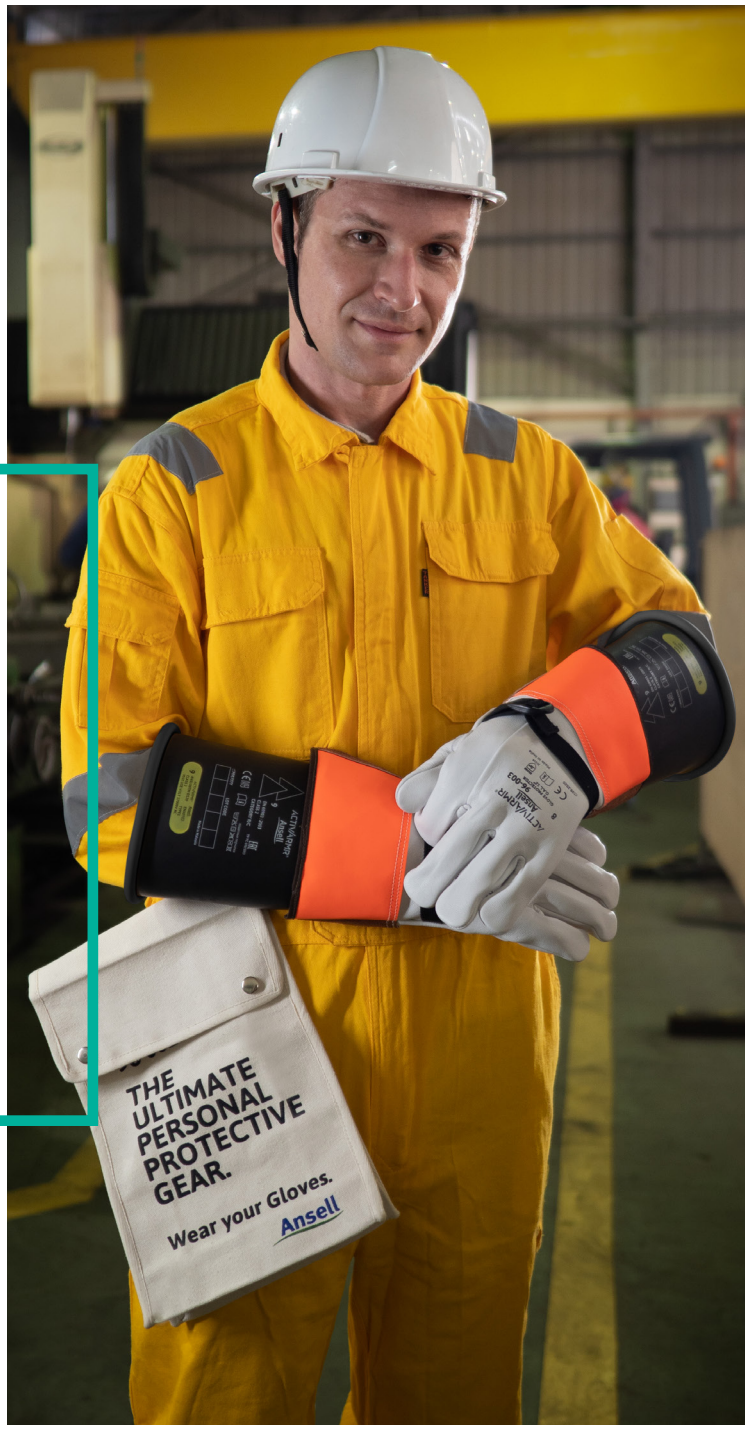
Monitor and review

The catastrophic nature of arc flash events calls for a rounded approach to risk minimisation. Hazard management should include the provision of suitable training to ensure that workers have the appropriate knowledge and skills to work safely.
It must also include development of adequate testing procedures and the provision of appropriate tools and other equipment – including PPE – to safely work on electrical equipment. As a final consideration, work processes and procedures, along with control measures, should be monitored and regularly reviewed to ensure they continue to offer the highest levels of safety.



> **"Hazard management should include the provision of suitable training to ensure worker safety."**

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