

EA D 23-05

Electrical Clothing PPE Requirements

This Engineering Advice is produced for information and guidance. Adherence to the information in this Advice is recommended but not mandatory.

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Audience:

- Persons carrying out electrical work
- Persons entering substations

Main Points:

- Requirements of Electrical PPE

Reference Document: D2013/80874 PPE for Electrical Work

Scope

The intention of this document is to provide a reminder about the PPE requirements for individuals when:

- Performing functions as specified in PR D 78701 Personal Certifications – Electrical or
- When within a system substation.

Background

For electrical tasks, the essential personal protective equipment (PPE) includes arc-rated base clothing according to *D2013/80874 PPE for Electrical Works*. Additionally, they should have safety footwear with toe protection and ankle support that meets AS/NZS 2210.3 standards, and maintained to AS/NZS 2210.1

Sydney Trains Personal may order an Arc Rated PPE “kit” via the Clothing [eForm](#)

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Action required

- Any individual entering a Sydney Trains System Substation is required to be dressed in Arc Rated PPE as outlined in D2013/80874 PPE for Electrical Works.
- The PPE must be in good condition, no rips, holes or worn material that may expose skin to an arc flash.
- The maintenance and replacement of PPE must adhere to the manufacturer's instructions and be done as needed.
- Extra PPE requirements must align with the risk assessment for the task and/or the utilized equipment.

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PPE for Electrical Work

Document no	D2013/80874
Work description	<p>Scope</p> <p>This SWI applies to all employees and contractors of Sydney Trains, Transport for NSW and Authorised Engineering Organisations:</p> <ol style="list-style-type: none"> 1. Entering any electricity substations. 2. Hold electrical certifications in accordance with PR D 78701 Personal Certifications – Electrical authorising them to: <ul style="list-style-type: none"> – Undertake operational work on the high voltage, 1500V DC or LV network – Apply working earths or safety earths – Work on live low-voltage electrical installations – Work on low voltage, 1500V DC or high voltage cables, or – Testing high-voltage equipment/cables and aerial conductors. <p>This SWI does not apply to persons performing non-electrical work outside a substation.</p>
References	<p>Electrical Safety Definitions page available on the RailSafe site</p> <p>RL D 79801 One Method of Safe Working</p> <p>SMS-06-GD-3323 Personal Protective Equipment</p> <p>Compliance:</p> <p>AS/NZS IEC 60903:2020 Insulating gloves for electrical purposes</p> <p>AS/NZS 1336:2014 Eye and face protection - Guidelines</p> <p>AS/NZS 1337.1:2020 Personal eye protection – Eye and face protectors for occupational applications</p> <p>AS/NZS 1801:1997 Occupational protective helmets</p> <p>AS/NZS 2210.1:2010 Safety, protective and occupational footwear – Part 1 Guide to selection, care and use</p> <p>AS/NZS 2210.3:2009 Occupational protective footwear – Part 3: Specification for safety footwear (ISO 20345:2004, MOD)</p> <p>AS/NZS 4602.1:2011 High-visibility safety garments – Part 1: Garments for high-risk applications</p> <p>ASTM F1891-19 Standard Specification for Arc and Flame-Resistant Rainwear</p> <p>ENA NENS 09 – 2014 National Guideline for the Selection, Use and Maintenance of Personal Protective Equipment for Electrical Arc Hazards</p> <p>IEC 61482-1-1:2019 Live working – Protective clothing against the thermal hazards of an electric arc – Part 1-1: Test methods – Method 1: Determination of the arc rating (ATPV or EBT50) of flame-resistant materials for clothing</p> <p>ISO 14116:2015 Protective clothing – Protection against flame – Limited flame spread materials, material assemblies and clothing</p> <p>NFPA 70E:2015 National Fire Protection Standards</p>
Minimum PPE for Electrical Work	The minimum PPE to be worn for electrical work consists of arc-rated base garments (next page) and safety footwear with toe protection and ankle support compliant to AS/NZS 2210.3 and maintained to AS/NZS 2210.1.
NOTE	Only wear clothing that is in good condition without holes or tears that may allow an arc to enter through a breach.

PPE for Electrical Work

<p>Assess the risk</p>	<p>Prior to work proceeding under this SWI the Line Manager shall review and consider the requirements have been risk assessed in line with the task and/or equipment to be operated. The risk assessment may lead to additional PPE requirements.</p> <p>Note: Arc Rating information may be gained by reviewing the operator’s manual or local instructions.</p>
<p>Work in the rail corridor</p>	<p>The base garments should be suitable for work in the rail corridor in accordance with SMS-06-GD-3323 Personal Protective Equipment and RL D 79801 section 3.1.</p>
<p>Base Garments</p>	<p>Base garments consist of either a long-sleeved shirt with placket and gusset; and long trousers, or one-piece coveralls (overalls). They must:</p> <ol style="list-style-type: none"> Be labelled stating the fabric or garment is arc-rated not less than 6 cal/cm² Be labelled stating the fabric or garment has been tested (in accordance with either IEC61482-1-1, ASTM F1959) or complies with ISO 14116 Be worn so that the body is covered from neck to wrist to ankle. Shirt, coat or jacket, and/or overalls must be fastened at both the wrist and neck area Have non-metallic fasteners or have fasteners protected by a layer of the same material as that of the garment on both the top and undersides Have colours and reflective hi-visibility tapes in accordance with SMS-06-GD-3323 Personal Protective Equipment, and Not be modified subsequent to their original manufacture. In instances where altering is required e.g. shortening of pants see details in maintenance and repair
 <p>Arc Flash Shirt</p>	
 <p>Arc Flash Trousers</p>	
<p>NOTE</p>	<p>Short sleeves or short trousers/pants are not permitted.</p>
<p>Outer garments</p>	<p>Outer garments (thermal or otherwise) must, as a minimum, be either made of wool, or be Flame Resistant to ISO 14116.</p>
<p>Undergarments</p>	<p>Undergarments should contain no more than 10% flammable synthetic materials.</p>
<p>Safety helmet</p>	<p>Safety Helmets must be worn unless a risk assessment substantiates otherwise</p>
<p>Safety boots</p>	<p>Non-conductive soles with ankle support. NOTE: Elastic sides are not permitted.</p>
<p>Cold weather and/or rain</p>	<p>Thermal underwear may be worn under the base garments. Thermal underwear should have not less than 90% natural fibres.</p> <p>A 100% woollen cap or beanie can be worn.</p> <p>Thermal outer garments (pullovers, jumpers) and/or rainwear may be worn over the base garments. Thermal outer garments shall have an outer layer that is flame retardant in accordance with ISO 14116 and have no flammable melting layers or components (e.g. no synthetic fabrics or plastic components). 100% woollen knitwear is recommended. These outer garments must not be relied on for protection against arcs, base garments must still be worn</p> <p>Rainwear must be arc and flame resistant in accordance with ASTM F 1891 or ISO 14116, and be labelled stating compliance with that standard, and have no flammable melting layers, fasteners or components.</p> <p>Orange arc-rated wet weather coats and trousers may be worn. The orange jacket must be suitable for electrical work, i.e. flame resistant in accordance with ASTM F 1891 or ISO 14116, labelled stating compliance with that standard, and have no flammable melting layers, fasteners or components.</p>
 <p>Arc Flash wet weather coat</p>	
 <p>Arc Flash wet weather trousers</p>	

PPE for Electrical Work

Additional PPE



Balaclava



Face shield with arc-rated hood and chin flap

Where indicated by the risk assessment and/or operating instructions, Additional PPE shall be worn over or in combination with the base garments. These items include:

- Flame-resistant balaclava, constructed from two layers of Nomex rated to not less than 10 cal/cm² and complying with NFPA 70E Hazard/Risk Category 2;
- Face shield (with chin flap covering the chin, or a balaclava);
- Insulated gloves compliant to AS 60903 to be worn on both hands when undertaking live LV work, or when the hazard assessment shows a need. Riggers gloves shall be worn at all times as outer gloves to ensure the insulation is not compromised
- Arc rated gloves while performing HV, 1500VDC and LV operational work.
- Hearing protection (earplugs or earmuffs).



Insulated glove with cotton inner and leather/rigger glove outer



Arc rated glove

Hazardous equipment

All personnel undertaking tasks in the following locations shall wear arc-rated electrical PPE providing protection not less than 6 cal/cm² – including face shield, neck guard (or, balaclava) and gloves:

- When within 1m of rear of indoor HV switchgear that vents to the rear, including (but not limited to):
 - live 33kV AREVA/Schneider WSA switchgear
 - live 33kV Nuova Magrini Galileo switchgear
 - live 33kV Alstom Normafleur DNF7
 - live 33kV Merlin Gerin FLUARC FG4
 - live 11kV Merlin Gerin type DIS 10T2
 - live 11kV South Wales D4X4
- Operating or working within 1m of:
 - live Nebb, Andelec and Holec Switchgear
- Verifying or inspecting exposed equipment that may be energized while covers are removed eg
 - proving dead Rectifier 1500V diode units
 - fault finding on live low voltage distribution boards.

PPE for Electrical Work

Maintenance & Replacement	<p>Heavily Soiled Garments should be changed prior to tasks that require arc rated clothing.</p> <p>PPE should be kept clean by washing or cleaning according to the manufacturer's instructions.</p> <p>GENERAL GUIDELINES FOR HOME CARE</p> <p>Arc Flash garments may be washed and dried by any conventional home method followed by hand ironing if required. If washing does not remove obvious contamination which may potentially affect the thermal protective performance of the garments, then commercial laundering or garment replacement may be required.</p> <p>Bleaches – <u>Chlorine bleach must not be used.</u> Although chlorine bleach will not affect some types of flame resistance of the material, it may cause strength and colour loss in garments over time. Chlorine bleach-based products could deteriorate performance of chemically treated arc rated products.</p> <p>Hydrogen Peroxide – <u>Hydrogen Peroxide bleach must not be used.</u> Hydrogen peroxide and its derivatives are another form of bleach commonly found in some laundry additives. They are often called oxygen bleach usually identified by having the word "Oxy" in their name and will degrade arc rated garments.</p> <p>Fabric Softeners and Anti-Stats – <u>Liquid fabric softeners and dryer softener sheets must NOT be used.</u> Fabric Softeners will coat the fibre and "mask" the arc rated performance of the garment. Additionally, many fabric softeners contain chemicals that are flammable.</p> <p>Tumble Drying – Arc Rated garments are not affected by tumble dryers</p> <p>Ironing – If arc rated garments need touch-up pressing, a steam or dry iron may be used at the medium setting. Avoid ironing any reflective stripe on the garment.</p> <p>GENERAL GUIDELINES FOR DRY CLEANING</p> <p>There are times when dry-cleaning arc rated garments is desirable for economic reasons or because greases and oils cannot be adequately removed during home or commercial laundering. Flame retardant garments can be satisfactorily dry cleaned in any conventional commercial dry-cleaning system. With heavily soiled garments, using a two-bath cycle may improve soil removal and minimise re-deposition. Arc Rated garments should be cleaned separately from articles of other materials to avoid contamination with lint of flammable fibres.</p> <p>GARMENT ALTERATION/REPAIR/REPLACEMENT</p> <p>Where arc rated trousers need to be "taken up" to remove excess leg length, the use of cotton tread in this instance is permissible. It should be noted that the fabrics in the fully synthetic garments may be very difficult to cut with scissors due to the kevlar content of the fabric.</p> <p>Arc rated garments are assembled or sewn using 100% Nomex thread. Should your garment become torn, ripped or in need of mending, do not attempt to mend at home or with a local alteration's person. The garment must be replaced.</p> <p>The nominal life of the base garments is 50 machine washes as indicated by the label or swing tag, after which they should be replaced by new garments.</p> <p>Old garments should be disposed of.</p>
Storage	<p>Avoid storing PPE in proximity to chemicals known to fade or damage fabrics, such as bleach or chlorine. For longer life of reflective materials, store at room temperature, avoiding unnecessary sunlight exposure</p>
Inspection	<p>Inspect before use for excessive dirt, rips, fractures, tears, missing fasteners, or fading.</p>
Additional controls	<p>As per risk assessment</p>