

AS/NZS 4836:2023



Australian/New Zealand Standard™

Safe working on or near low-voltage and extra-low voltage electrical installations and equipment



AS/NZS 4836:2023

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- Australian Energy Council
- Australian Industry Group
- Communications, Electrical and Plumbing Union — Electrical Division
- Consumers Federation of Australia
- Electrical Regulatory Authorities Council, Australia
- Electrical Safety New Zealand
- Electrical Workers Registration Board
- ElectroComms & Energy Utilities Industry Skills Council
- Energy Networks Australia
- Engineering New Zealand
- Engineers Australia
- Institute of Electrical Inspectors
- Master Electricians Australia
- Master Electricians NZ
- National Electrical and Communications Association
- National Electrical Switchboard Manufacturers Association
- The Manufacturers' Network
- WorkSafe New Zealand

Additional Interests

- ABB Australia
- Current Training Services
- Engineering Safety
- SafeWork NSW
- Siemens Energy
- Triple Electrical Inspections

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Australian/New Zealand Standard™

Safe working on or near low-voltage and extra-low voltage electrical installations and equipment

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-001, Wiring Rules, to supersede AS/NZS 4836:2011.

The objective of this document is to provide principles, guidelines, practices and recommended safe working procedures when working on or near low-voltage electrical installations and equipment.

The major changes in this edition involve additional information on the following:

- (a) Principles of risk management, assessment of risk and risk treatment.
- (b) Working with asbestos and polychlorinated biphenyls.
- (c) Working below ground level.
- (d) Cutting cables and wiring enclosures.
- (e) Selection and use of test equipment.
- (f) Selection and use of personal protective equipment.
- (g) Preservation of an incident scene.

The inclusion of roles and responsibilities in AS/NZS 4836:2023, was approved by the Standards Australia Production Management Group on 16 September 2021.

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The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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Foreword

Application of typefaces

Three different typefaces are used in this document. Each of these has a specific purpose as follows:

- (a) Normal print indicates requirements that form the main part of a clause. It also indicates deemed to comply methods that satisfy the requirements. Normal print is used in the appendices to present informative material for guidance only.
- (b) *Italic print indicates exceptions or variations to requirements. Exceptions generally give specific examples where the requirements do not apply or where they are varied for certain applications. They may contain requirements. Examples are also presented in italic text.*
- (c) Reduced normal print indicates Notes which give explanations and advice. They are preceded by “NOTE” in the manner used in previous editions.

It is important not to read text in any single typeface without consulting the preceding or following paragraphs, which may contain additional or modifying requirements.

National requirements

Certain provisions of the document have a different application in Australia and New Zealand. The following symbols appearing in the outer margin indicate that the identified section or clause is:

- (i) Applicable in Australia only.

AS

- (ii) Applicable in New Zealand only.

NZ

Informative appendices

An informative appendix is for information or guidance only. Informative appendices provide additional information intended to assist in the understanding or use of the document.

Deemed to comply

The term “deemed to comply” means that a requirement can be met by following a specified document or method.

So, where an installation is carried out in accordance with the specified document or method, within the text of this document, the installation is “deemed to comply” with the requirements of this document.

Conformance to a deemed to comply document may exceed the minimum requirements of this document.

Notes

Notes to clauses are informative and give explanations or advice. They do not form a mandatory part of this document.

Cross-references

Where reference to another clause has been made, such reference, unless otherwise stated, includes all appropriate subclauses and paragraphs of the clause or portion thereof referred to.

Provision for revision

This document is not intended to discourage invention or to exclude materials, equipment and methods that may be developed. Revisions will be made from time to time in view of such developments and amendments to this edition will be made where essential.

Australian/New Zealand Standard

Safe working on or near low-voltage and extra-low voltage electrical installations and equipment

Section 1 Scope and general

1.1 Scope

This document outlines principles, guidelines and procedures for safe work by electrical and non-electrical workers on or near low-voltage and extra-low voltage electrical installations and equipment. It provides a minimum set of guidelines, procedures, safety requirements and recommendations to manage the hazards associated with electricity, specifically arc blast, arc flash, electric shock, and electrocution. Adopting the requirements will provide a safe environment for work on or near low-voltage as well as for extra-low voltage electrical installations and equipment.

This document covers general risk management and mitigation principles for determining the controls to be implemented to provide a safe working environment.

This document applies to all electrical and non-electrical workers carrying out work on or work near low-voltage and extra-low voltage electrical installations and equipment for both a.c. and d.c..

NOTE The general principles of this document may be applied in the risk management of other voltages outside this range where specific procedures and documents are not available.

In New Zealand, these practices may also apply to work carried out on or near works.

NZ

Warning disclaimers are used in this document where there is potential for injury or death to the user. This text is bold print and full capitals.

1.2 Application

This document may be applied through legislative requirements, made in each State and Territory of Australia and in New Zealand, concerned with the safety of electrical installations. The document may also be applied in conjunction with any additional requirements, exemptions or restrictions in such legislation.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1892.2, *Portable ladders, Part 2: Timber*

AS 2210.2, *Personal protective equipment, Method 2: Test methods for footwear*

AS 4202, *Insulating covers for electrical purposes*

AS/NZS 1336, *Eye and face protection—Guidelines*

AS/NZS 1337.1, *Personal eye protection, Part 1: Eye and face protectors for occupational applications*

AS/NZS 1715, *Selection, use and maintenance of respiratory protective equipment*

AS/NZS 1716, *Respiratory protective devices*

AS/NZS 1801, *Occupational protective helmets*

AS/NZS 1892.3, *Portable ladders, Part 3: Reinforced plastic*

AS/NZS 1892.5, *Portable ladders, Part 5: Selection, safe use and care*

AS/NZS 2161.4, *Occupational protective gloves, Part 4: Protection against thermal risks (heat and fire)*

AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand wiring rules)*

AS/NZS 61008.1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs), Part 1: General rules (IEC 61008-1, Ed. 3.2 (2013) MOD)*

AS/NZS 61009.1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs), Part 1: General rules (IEC 61009-1, Ed. 3.2 (2013) MOD)*

AS/NZS 61558 (all parts), *Safety of power transformers, power supply units and similar*

AS/NZS IEC 60903, *Live working — Electrical insulating gloves*

AS/NZS IEC 61111, *Live working — Electrical insulating mats*

ENA NENS 09, *National guidelines for the selection, use and maintenance of personal protective equipment for electrical arc hazards*

1.4 Terms and definitions

For the purposes of this document, the definitions in AS/NZS 3000 and those below apply.

1.4.1

approved

having a relevant organization's endorsement for a specified function

1.4.2

arc blast

rapid heating and expansion of air and molten metal resulting from an arc fault

Note 1 to entry: Arc blast is a function of current and equipment configuration. It is not a function of incident energy.

Note 2 to entry: The arc blast may result in metal and droplet spray, ejected debris, noise, and pressure wave(s) from build-up and release from inside enclosed electrical equipment.

1.4.3

arc fault

unintended and uncontrolled discharge through air

1.4.4

arc fault condition

condition where arcs are produced through fault or failure of electrical equipment

1.4.5

arc flash

generation and transfer of heat, plasma gas, light and sound from an arc fault

1.4.6

arc flash boundaries

distances from the energized equipment that should be maintained to manage arc flash risk

1.4.7

asbestos

naturally occurring mineral made up of tiny, microscopic fibres

[SOURCE: Asbestos Safety and Eradication Agency, available at <https://www.asbestossafety.gov.au/asbestos-health-risks-and-exposure/asbestos-health-risks>, modified]

1.4.8**competent person**

person, who has acquired, through training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the required task correctly

1.4.9**de-energized**

separated from all sources of supply, but not necessarily isolated, earthed or out of commission

1.4.10**discharge**

<verb> extract all or part of the energy stored in a device

<noun> release of electrical energy

Note 1 to entry: Typically, discharge is performed in a controlled manner by the application of a device.

[SOURCE: IEC 151-15-19, modified – noun form added and note to entry amended. Copyright © IEC Geneva, Switzerland. www.electropedia.org]

1.4.11**disconnected**

physically separated from any source of electrical energy

Note 1 to entry: Disconnection may be by a switching action or physical removal of circuit connections.

1.4.12**earth (known)**

earth point previously tested to confirm that it is connected to the installation earthing system

[SOURCE: AS/NZS 3017:2022, 1.4.11, modified – term amended from “known earth”]

1.4.13**earthed**

connected to the general mass of earth

Note 1 to entry: Requirements for earthing are set out in AS/NZS 3000.

[SOURCE: AS/NZS 3000:2018, 1.4.47, modified – definition shortened and Note 1 to entry added]

1.4.14**electrical equipment**

wiring systems, switchgear, control gear, accessories, appliances, luminaires, and fittings used for such purposes as generation, conversion, storage, transmission, distribution, or utilization of electrical energy

[SOURCE: AS/NZS 3000:2018, 1.4.50]

1.4.15**electrical incident**

electrical event that may cause an injury to a person or damage to property

1.4.16**electrical installation**

electrical equipment installed for the purposes of conveyance, control, measurement or use of electricity, where electricity is or is to be supplied for consumption

Note 1 to entry: This includes electrical equipment supplied from a distributor's system or a private generating system.

Note 2 to entry: An electrical installation usually commences at the point of supply and finishes at a point (in wiring) but does not include portable or stationary electrical equipment connected by plug and socket-outlet (other than where a socket-outlet is used to connect sections of the fixed installation).

[SOURCE: AS/NZS 3000:2018, 1.4.52, modified]

1.4.17

electrical work

physical work of installing, maintaining, repairing, altering, removing, or adding to an electrical installation or supervision of that work

1.4.18

electrically safe work condition

state in which an electrical conductor or circuit part has been isolated from energized parts, locked or tagged in accordance with the relevant requirements, tested to confirm the absence of voltage, and if applicable, temporarily earthed for personal protection

1.4.19

energized

connected to a source of electrical supply or subject to hazardous induced or capacitive voltages

1.4.20

fault-finding

process of taking measurements or carrying out tests on electrical installations and equipment to locate faults or prove operability

Note 1 to entry: This may also include the process of applying testing instruments or devices to various parts of the electrical installation and equipment to determine how the electrical installation and equipment are operating.

1.4.21

hazard

potential source of harm

[SOURCE: ISO/IEC Guide 51:2014, 3.2]

1.4.22

hazardous area

area in which an explosive atmosphere is present or can be expected to be present, in quantities such that special precautions for the construction, installation and use of equipment are required

[SOURCE: AS/NZS 60079.14:2022, 3.2.1, modified – “gas” deleted from definition]

1.4.23

incident energy

amount of thermal energy impressed on a surface, a given distance from the source, generated during an electrical arc event

Note 1 to entry: Incident energy is typically expressed in cal/cm².

1.4.24

isolated

separated from all possible sources of electrical energy and rendered incapable of being energized unintentionally

1.4.25

isolation (isolating function)

function intended to cut off the supply from the whole installation, or a discrete section of it, by separating it from every source of electrical energy for reasons of safety

[SOURCE: AS/NZS 3000:2018, 1.4.75]

1.4.26**isolator**

safety device which provides, in the open position, breaks appropriate to the voltage and insulating medium

1.4.27**material containing asbestos**

see *asbestos* ([1.4.7](#))

1.4.28**may**

indicates the existence of an option

1.4.29**on or near**

in close proximity to exposed energized conductors or live conductive parts

Note 1 to entry: The term “on or near exposed energized conductors or live conductive parts” does not apply if the uninsulated and energized part is safely and securely shielded by design or segregated and protected with barricades or insulated shrouding or insulating material to prevent inadvertent or direct contact.

Note 2 to entry: The term “on or near” includes an activity which may affect the properties of conductors or conductive parts and cause them to be exposed energized conductors or live conductive parts.

1.4.29.1**work near**

performance of a function within 3 m of exposed energized conductors or live conductive parts and/or electrical equipment

Note 1 to entry: Work within 3 m is classified as “work near”, as per [Figure 2.1](#).

Note 2 to entry: Functions may include cleaning, pest control or other tasks that are not defined as *electrical work* ([1.4.17](#)).

1.4.29.2**work on**

performance of a function within 500 mm of exposed energized conductors or live conductive parts and/or electrical equipment

Note 1 to entry: Work within 500 mm is classified as “work on”, as per [Figure 2.1](#).

Note 2 to entry: Includes undertaking or supervising the following: constructing, manufacturing, assembling, installing, connecting, maintaining, repairing, altering, testing, verifying, assessing, or inspecting, removing, or adding to an electrical installation or equipment.

1.4.30**operating work**

operation of switching devices, links, fuses or other connections intended for ready removal or replacement, proving that electrical conductors are de-energized, earthing or short-circuiting, locking or tagging of electrical apparatus and erection of barriers or signs

1.4.31**personal protective equipment****PPE**

clothing, equipment and/or substances, which when worn or correctly used, protect parts or all of the body from foreseeable risk of injury or disease at work or in the workplace

1.4.32**relevant authority**

agency authorized by legislation or regulation to issue determinations, orders, or other instructions in respect of any subject covered by this document

1.4.33**ripple-free d.c.**

for sinusoidal ripple voltage, a ripple content not exceeding 10 % r.m.s

Note 1 to entry: The maximum peak value does not exceed 140 V for a nominal 120 V ripple-free d.c. system and 70 V for a nominal 60 V ripple-free d.c. system.

1.4.34**risk**

combination of the probability of occurrence of harm and the severity of that harm

[SOURCE: ISO/IEC Guide 51:2014, 3.9]

1.4.35**risk assessment**

overall process of risk identification, risk analysis and risk evaluation

[SOURCE: ISO Guide 73:2009, 3.4.1]

1.4.36**safety observer**

person who has been specifically assigned the responsibility of observing and warning against the unsafe approach to electrical equipment, exposed energized conductors or live conductive parts and other potential risks

Note 1 to entry: See [Clause 4.3.1](#) for functions of a safety observer.

1.4.37**shall**

indicates that a statement is mandatory

1.4.38**should**

indicates a recommendation

1.4.39**Safe Work Method Statement****SWMS**

document that sets out the work activities to be carried out at a workplace, the hazards arising from these activities and the measures to be put in place to control the risks

1.4.40**testing**

use of test instruments or test equipment by a competent person

1.4.41**voltage**

differences of potential normally existing between conductors or between conductors and earth

1.4.41.1**extra-low voltage****ELV**

not exceeding 50 V a.c. or 120 V ripple-free d.c.

1.4.41.2**low voltage****LV**

exceeding extra-low voltage, but not exceeding 1 000 V a.c. or 1 500 V d.c.

1.4.41.3
high voltage
HV
exceeding low voltage

1.4.42
zero energy state
isolator position in which the energy source has been deemed to have been dissipated and controlled

Section 2 Principles of risk management

2.1 General

Before work is commenced on or near any electrical installation or equipment, a competent person shall determine whether it is safe to do so. This is achieved by applying a risk management system. All work shall be planned and organized to minimize the risk associated with the work.

The most effective way to control risk is to eliminate it. If a risk assessment indicates that risks cannot be sufficiently controlled to enable the work to be performed safely, then the work shall not proceed.

This section sets out the principles of risk management for the identification and assessment of risk. It also provides information regarding means of reducing risk and the work permit system.

NOTE 1 AS ISO 31000 provides guidance on the establishment and implementation of the risk management process.

NOTE 2 AS/NZS 4804 provides guidance on the development and implementation of occupational health and safety management systems.

NOTE 3 [Appendix E](#) provides information on a risk assessment technique involving a bowtie analysis.

2.2 Principles

The principles of risk management comprise —

- (a) identifying the hazards (see [Clause 2.3](#));
- (b) assessing and prioritizing the risks (see [Clause 2.4](#));
- (c) applying control measures to the identified risks (see [Clause 2.5](#)); and
- (d) monitoring and review (see [Clause 2.6](#)).

2.3 Identify the hazards

2.3.1 General

The first step of the risk management process is to identify the factors that have the potential to cause harm.

Before undertaking work, all hazards and environmental considerations shall be identified.

Hazard identification is the process used to identify all possible conditions, situations, practices, and behaviours in the workplace where people may be exposed to injury, illness or disease, or when damage may be done to the environment, property, plant or equipment.

Examples of hazards and environmental considerations include the following:

- (a) Electric shock.
- (b) Arc flash.
- (c) Position of exposed energized conductors or live conductive parts.

WARNING: ALL ELECTRICAL CONDUCTORS AND PARTS, INCLUDING NEUTRAL AND EARTHING CONDUCTORS, SHALL BE TREATED AS ENERGIZED UNTIL PROVEN DE-ENERGIZED. ALWAYS TEST BEFORE TOUCHING.

- (d) Cramped conditions.

- (e) Moving equipment, such as cranes or transfer cars.
- (f) Hot or wet conditions.
- (g) Hazardous areas (see [Clause 4.3.3](#)).

NOTE All non-electrical sources of energy (e.g. counterweights on machines and stored hydraulic and pneumatic energy) should be isolated, controlled or secured to prevent the release of energy. The AS/NZS 4024 series provides guidance on the safeguarding of machinery.

2.3.2 Electrical hazards

Electrical hazards within electrical installations shall be identified before any work is carried out. Electrical hazards can arise from work and the interaction that occurs in the installation. This can include the following:

- (a) Work required to be performed.
- (b) Physical work area.
- (c) Work design and management.
- (d) Equipment, materials and substances used.
- (e) Design, construction, installation, maintenance and testing of the electrical installation or electrical equipment.
- (f) Any design change or modification.
- (g) Work being performed on or near electrical installation or electrical equipment.
- (h) Defective/inoperable electrical protection.

To assist with hazard identification, consultation should occur with the following:

- (i) Personnel and other workers.
- (ii) Suppliers of the equipment.
- (iii) Health and safety representatives and specialists.

2.3.3 Electric shock

Potential sources of electric shock shall be identified before any work is carried out. There are many possible sources of electric shock, including the following:

- (a) Voltages between actives, and between actives and neutral.
- (b) Voltages between actives and earth (including metalwork, damp situations, other conductive surfaces, and persons nearby).
- (c) Voltages across open switch contacts.
- (d) Voltages across undischarged capacitors, e.g. electromagnetic interference filters.
- (e) Voltages on disconnected conductors (particularly neutrals).
- (f) Voltages caused by static electricity.
- (g) In multiple earthed neutral (MEN) electrical installations or systems, the rise in the earth potential in an electrical installation due to a high resistance return path to the supply neutral.

- (h) Induced voltages.
- (i) Voltages across secondary terminals of transformers, including current transformers.
- (j) Voltages between different earthing systems.
- (k) Incorrect wiring connections.
- (l) Faulty electrical equipment or wiring, which may result in the frame of the electrical equipment being energized.
- (m) Voltages from other sources of supply, e.g. illegal connections, uninterruptible power supplies, motor generators, inverters, solar panels, batteries, and wind generators.
- (n) Lightning.
- (o) Breaking of the continuity of the incoming water supply.
- (p) Voltages triggered inadvertently through the operation of float switches, thermostats, time switches and photo-electric cells, etc.
- (q) Penetration with tools or fixings of structures containing concealed conductors.
- (r) Voltages caused by electrical welders.

NOTE See [Appendix C](#) for electric shock survival guidance.

2.3.4 Arc blast and flash injuries

Arc blast, flash risks and the possibility of resulting injuries shall be taken into account in the design, operation and maintenance of electrical installations.

A person working on or near energized conductors or electrical equipment is at risk of injury, including serious burns and death from arcing faults. With short (bolted) circuit fault currents of up to 25 times the rated current of the supply transformer, arc fault impedance can reduce arcing fault current to less than half the prospective short circuit current. These reduced arc fault currents might not initiate the operation of protective devices, which can increase the duration of the arcing fault.

The main mechanism for injury from arc blast and flash is from thermal effects due to radiated heat and the fault-generated plasma cloud often described as a fireball. The energy impacting the body of the worker is the incident energy. Incident energy as low as 1.2 cal/cm^2 can produce second degree burns and ignite personal protective equipment (PPE) made of cotton. Three-phase electrical equipment with protective devices rated from 63 A and above may have prospective incident energy levels above 1.2 cal/cm^2 .

Incident energy exposure to the worker may be quantified using IEEE 1584 or an equivalent standard. The incident energy is a function of voltage, prospective fault current, component and switchgear geometry, distance, and protective device characteristics.

A person conducting a business or undertaking with high current equipment with a rated capacity of 800 A and above should complete an arc fault study as part of their hazard identification and control process. This does not preclude other installations needing to assess the risk of arc flash.

See [Section 11](#) for further information on PPE. See [Appendix B](#) for further information and controls for arc blast and flash.

WARNING: ARCS THAT ARE PRODUCED UNDER ARC FAULT CONDITIONS HAVE THE ENERGY TO CAUSE AN EXPLOSION, MELT METALLIC SWITCHBOARD CUBICLES AND EQUIPMENT, CAUSE SEVERE BURNS AND FLASH BURNS TO THE FACE, EYES AND BODY AND CAUSE INJURY THROUGH IMPACT FROM FLYING DEBRIS OR DISLODGED COMPONENTS.

CIRCUIT PROTECTION DEVICES MAY NOT OPERATE AS A SAFEGUARD IN SUCH CIRCUMSTANCES.

2.3.5 Hazardous areas

Hazardous areas present a risk of injury as there is the possibility of explosion or fire as a result of work on the wiring and equipment used in these areas. Live work within hazardous areas shall not be carried out.

Sources of ignition that can generate an electrical spark or generate heat sufficient to ignite a flammable gas or vapour or combustible dust include the following:

- (a) Clothing made from wool, wool blends, and synthetic materials (unless treated with an antistatic process) may generate a static electrical spark sufficient to ignite a flammable gas or vapour or combustible dust.
- (b) Personal effects, e.g. watches, cigarette lighters, matches, battery-operated items such as mobile telephones, electronic car keys, torches and other electronic devices that are not certified for use in hazardous areas.
- (c) Electric tools, test equipment and instruments, e.g. mains and battery-powered appliances such as lamps, drills, multimeters and data devices that are not certified for use in hazardous areas.

- (d) Actions which may generate sparks or heat such as —

- (i) any form of hot work including welding or brazing;

NOTE 1 AS 1674.2 and Safe Work Australia's *Welding Processes Code of Practice*, July 2020 specify requirements for welding.

- (ii) drilling or grinding of any type;
 - (iii) impact of steel onto concrete, e.g. hitting a hammer or chisel on concrete;
 - (iv) impact of some metals to other metals, e.g. rusty steel and aluminium; and
 - (v) rubbing or movement of plastics.

Sources of ignition should not be taken into hazardous areas. Actions that could generate sparks or heat should not be carried out in hazardous areas, unless the area where the work is to be carried out is safe, i.e. an explosive atmosphere is confirmed to not exist. See [Clause 4.3.3](#).

NOTE 2 AS/NZS 60079.14 and AS/NZS 60079.17 specify requirements for competency of personnel, and for the selection, installation and maintenance of electrical equipment in hazardous areas.

NOTE 3 Due to variances in the ignition properties of different materials, the management of ignition sources for different sites may differ. For example, hydrogen is very sensitive to ignition by electrostatic discharges and so might need special consideration, whereas ammonia is not sensitive to electrostatic discharges and so controls for static electricity might not be needed in a hazardous area due to ammonia.

2.3.6 Other risk factors

Other potential sources of risk shall be identified before any work is carried out. Potential sources of risk include the following:

- (a) Live conductors.
- (b) Adjacent live conductors such as —
 - (i) concealed conductors, e.g. they can be present within building cavities and slabs, concealed by earth (dirt) or other material;
 - (ii) overhead conductors (see [Section 5](#)); and

- (iii) underground conductors (see [Section 6](#)).
- (c) Cramped working conditions.
- (d) Confined spaces.
- (e) Multiple sources of supply including stored or generating sources, e.g. solar, wind, co-gen, battery banks, uninterruptible power supply (UPS), inverters and capacitors.
- (f) Damp situations.
- (g) Environmental factors, e.g. heat, cold, vibration and noise.
- (h) Height, e.g. working at heights and danger of falling objects.
- (i) Operational pressures to carry out work or to restore electricity supply.
- (j) Instability of the work area.
- (k) Conductors, cables or equipment under tension or likely to fall.
- (l) Proximity of other work functions and other mobile plant and equipment including moving machinery such as gantry cranes or transfer cars.
- (m) Working below ground.
- (n) Corrosive and toxic materials.
- (o) Radiation, e.g. microwave antennas, radio towers, mobile phone antennas, and radar.
- (p) Material containing asbestos.
- (q) Hazardous substances, e.g. polychlorinated biphenyls (PCBs) (see [Clause 4.3.11](#)).
- (r) Accumulation of conductive dust.
- (s) Failure to comply with practices and procedures.
- (t) Working in isolation from others.
- (u) Equipment design, e.g. not operating switches under load unless they are designed for the purpose.
- (v) Position of exposed energized conductors or live conductive parts.

2.3.7 Work zone

If any person is required to work within 3 m of energized exposed conductors or parts, a competent person shall identify appropriate risk treatments (see [Figure 2.1](#)).

Safety shall not be compromised because of operational pressures to carry out the work.

[Figure 2.2](#) depicts the 500 mm work zone for work on low-voltage (LV) and extra-low voltage (ELV) equipment within an enclosed switchboard panel. The 500 mm work zone is shown in the circle. Energized conductors and live conductive parts do not pose a significant risk when the door of the cabinet in which they are contained is closed. Therefore, when the cabinet door is closed, the internal components are not considered to be part of the work zone and may remain energized even if they are within the exclusion zone depicted in [Figure 2.1](#).

NOTE 1 In some cases, the identification and possibility of encroaching within 3 m of energized exposed conductors or parts will be obvious, e.g. overhead lines and cables and crane collector rails. In other cases, it will not be immediately obvious, e.g. power tools drilling into structures (see [Clause 8.3](#)). Work equipment may extend into the 3 m distance, e.g. with ladders (see [Clause 8.4](#)).

NOTE 2 [Appendix A](#) provides a typical form for use in the assessment of risk.

WARNING: INFORMATION REGARDING ALL HAZARDS AND THE CONTROL MEASURES REQUIRED FOR MITIGATION SHALL BE READILY AVAILABLE.

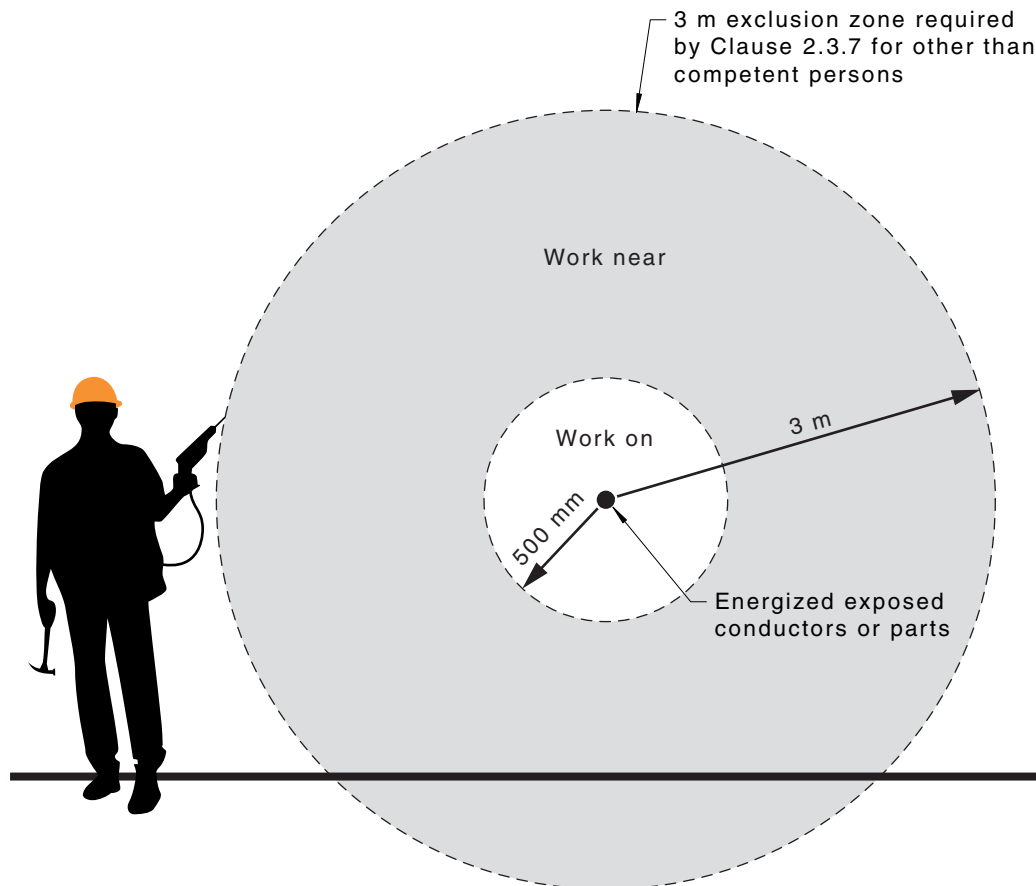


Figure 2.1 — Illustration of 3 m exclusion zone and “on or near”

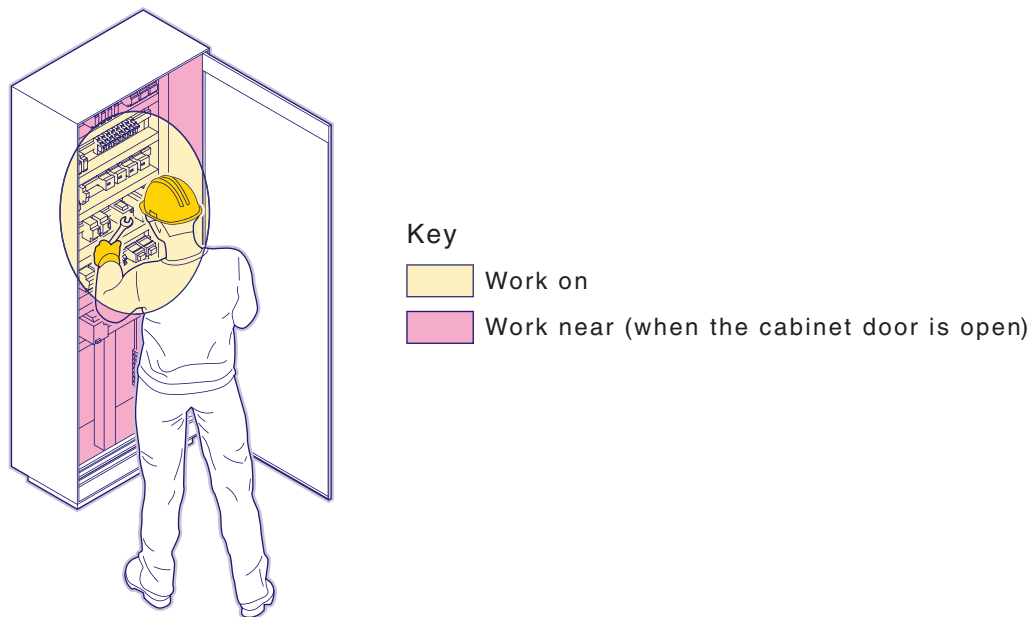


Figure 2.2 — 500 mm electrical work zone for work on low-voltage and extra-low voltage equipment within an enclosed switchboard panel

2.4 Assess and prioritize risk

The second step of the risk management process is risk assessment.

Prior to undertaking work, a risk assessment shall be carried out at the work site to assess the level of risk associated with all hazards that have been identified.

Where hazards are identified, the risks shall be prioritized, and control measures implemented in accordance with [Clause 2.5](#).

NOTE 1 An example of a risk matrix is included in [Appendix E](#).

NOTE 2 AS/NZS IEC 31010 provides guidance on risk assessments.

2.5 General risk control measures

The third step of the risk management process is applying risk control measures.

Before undertaking work, control measures shall be applied to hazards which have been identified.

The hierarchy of control is a system for controlling risks and hazards in the workplace. It involves a step-by-step approach to eliminating or reducing risks and hazards, using a hierarchical process of the highest level of protection and reliability, through to the lowest and least reliable protection. [Figure 2.3](#) depicts the hierarchy of control, from most effective to least effective.

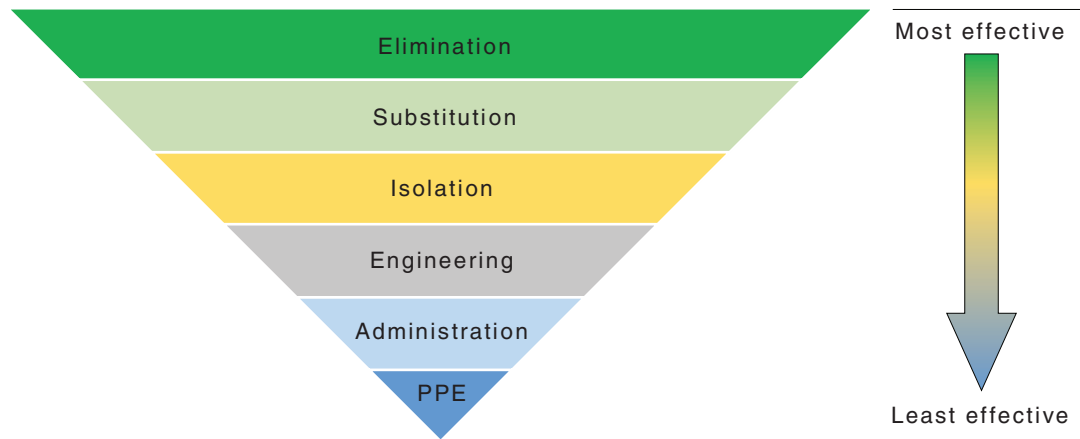


Figure 2.3 — Hierarchy of control

If elimination of the risks and hazards cannot be achieved, then the hierarchy shall be applied to select controls that most effectively reduce the risk.

NOTE The relevant authority may have additional requirements for the elimination of hazards and risks.

The following is a hierarchy of controls such that the level of risk mitigation decreases with the order:

- (a) Eliminate the hazard, which is always the first priority, e.g. by switching off and isolating. This may require rescheduling the work to a time when it can be de-energized.
- (b) Substitution, e.g. use of battery-powered tools instead of mains powered. This is not always an option but should be considered whenever possible.
- (c) Use separation or isolation methods such as barriers or distance from the hazard.
- (d) Minimize risk through engineering, e.g. design, automation, provision of local isolation, containment or limitation, such as residual current devices (RCDs).
- (e) Minimize risk by administration, e.g. policy, procedures (including SWMS), safe work practices, signage and training.
- (f) Minimize risk with PPE. Relying on PPE as the first line of defence is the least desirable approach and should only be used in conjunction when other alternatives are unavailable, or as an additional precautionary measure.

It is normal to use a combination of control measures to reduce the risks associated with a serious hazard to a tolerable level. It should be noted that the nature and duration of a given task may be a cause to amend the specific controls from job to job and location to location on a project, e.g. in relation to fatigue or exposure.

Risk control procedures shall be developed in accordance with [Figure 2.4](#) and reviewed before work commences in accordance with [Figure 2.5](#).

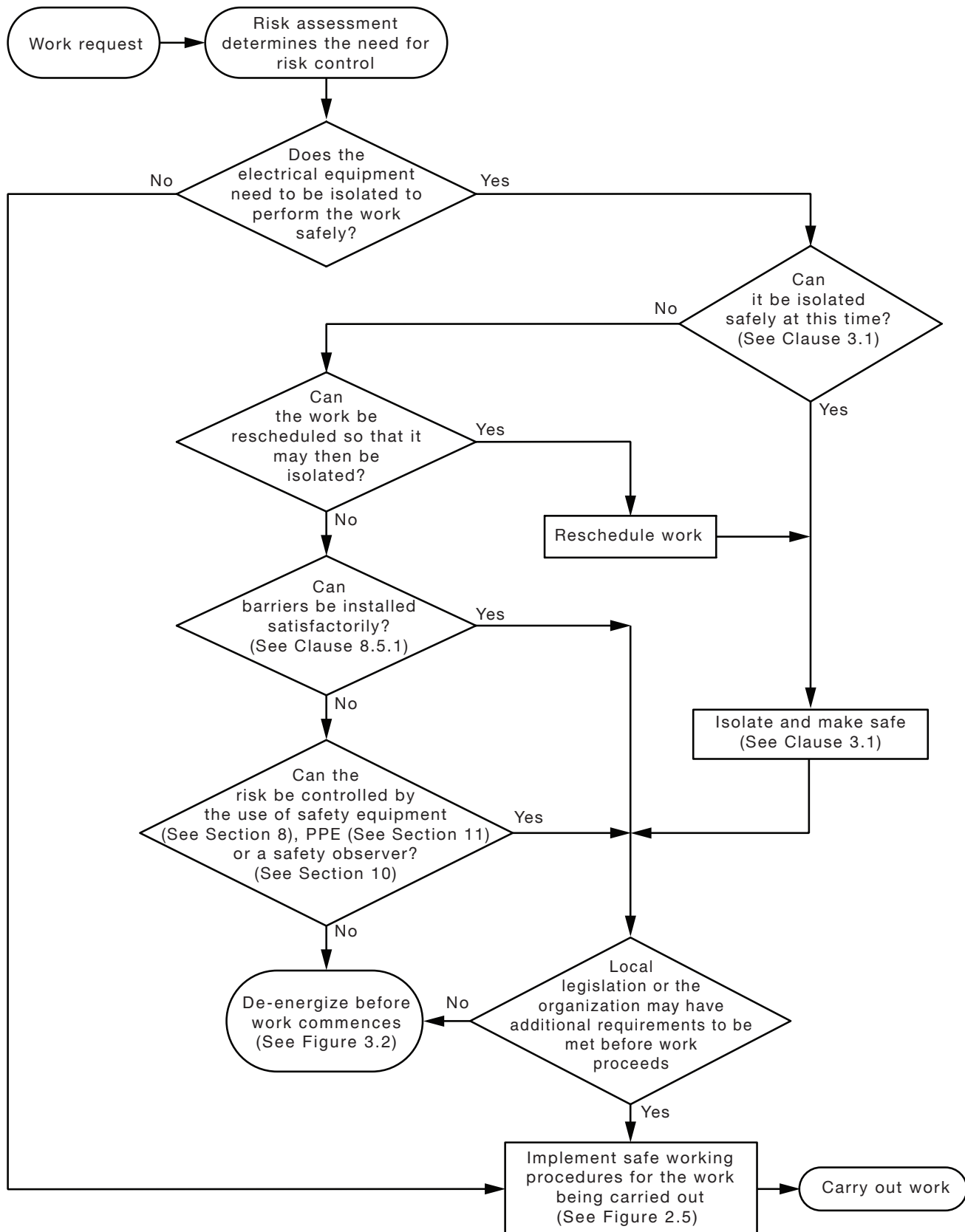


Figure 2.4 — Risk control procedures

2.6 Monitor and review

The risk management process shall include ongoing monitoring and periodic review. Monitoring and review should take place at all stages of the process. Responsibilities should be clearly defined and actions recorded.

Monitoring and review may include planning, gathering and analysing information, recording results and providing feedback.

2.7 Means of reducing risk

A person should maximize electrical safety where possible when working with electrical installations or equipment. Electrical safety is inversely proportional to the level of risk and depends on —

- (a) appropriate job planning by a competent person;
- (b) correct isolation and testing procedures and techniques;
- (c) use of safety equipment and tools, test instruments and PPE that are fit for purpose;
- (d) work being carried out by competent persons;
- (e) display of warning notices to reduce the risk of injury or death; and
- (f) use of barriers to prevent inadvertent contact with energized parts.

WARNING: ALL ELECTRICAL CONDUCTORS AND PARTS, INCLUDING NEUTRAL AND EARTHING CONDUCTORS, SHALL BE TREATED AS ENERGIZED UNTIL PROVEN DE-ENERGIZED. ALWAYS TEST BEFORE TOUCHING.

Work should be planned in advance, particularly where other services are likely to be present or affected, e.g. gas, telephone, data communications, water pipes, other electrical circuits, other energy sources, and where other trades are likely to be working.

Work should be planned to avoid jeopardizing the operation of lighting and electrical equipment essential for safety or for the preservation of life, e.g. emergency lighting and dialysis machines.

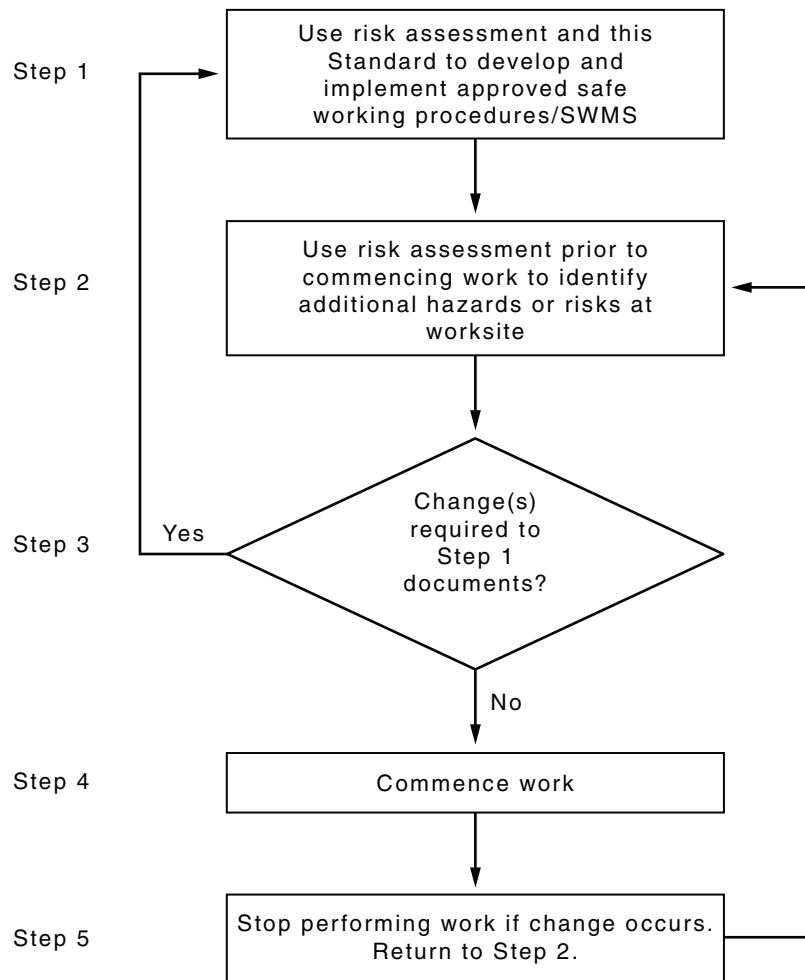


Figure 2.5 — Safe working procedures

2.8 Work permit system

Some electrical installations may have a work permit system to control access to any work being performed on or near electrical installations or equipment where potential for injury or equipment damage exists. The work permit system should set out relevant conditions for —

- (a) accessing electrical equipment;
- (b) using electrical or mechanical isolation of equipment;
- (c) using safety observers;
- (d) using safety equipment;
- (e) restoring operational status; and
- (f) other relevant matters.

NOTE Work permit systems may require practices additional to those set out in this document.

Section 3 Isolation, fault-finding and testing

3.1 Isolation

3.1.1 Isolation principles

Work shall not be carried out on or near de-energized exposed conductors and parts until a competent person has —

- (a) positively identified the electrical equipment and conductors, all energy sources and the isolation points in accordance with [Clause 3.1.2](#);
- (b) isolated electrical equipment and conductors from all energy sources in accordance with [Clause 3.1.3](#);
- (c) secured the isolation in accordance with [Clause 3.1.4](#);
- (d) discharged any stored energy, where necessary, e.g. within capacitors in accordance with [Clause 4.3.2](#);
- (e) proven the de-energization of all relevant electrical equipment and conductors in accordance with [Clause 3.1.5](#);
- (f) identified the limits of the safe area of work in accordance with [Clause 3.1.7](#); and
- (g) displayed warning notices to reduce the risk of injury or death (see example below).

WARNING: ALL ELECTRICAL CONDUCTORS AND PARTS, INCLUDING NEUTRAL AND EARTHING CONDUCTORS, SHALL BE TREATED AS ENERGIZED UNTIL PROVEN DE-ENERGIZED. ALWAYS TEST BEFORE TOUCHING.

If the electrical installation is complex, the isolation procedures should be checked by another competent person.

NOTE Examples of complex electrical installations include supplementary and alternative supplies such as back up supplies, generator supplies, multiple isolation points, remote control isolators, and safety services.

3.1.2 Identification of electrical equipment and isolation points

The following components shall be positively identified:

- (a) Electrical equipment to be worked on.
- (b) Points of isolation.
- (c) All energy sources, including non-electrical sources.

NOTE Methods used to positively identify include line diagrams, labelling and ID numbering.

3.1.3 Isolation of electrical equipment

The electrical equipment to be worked on shall be isolated from all sources of electrical supply either by opening switches, removing fuses or links, opening circuit breakers, or removing circuit connections.

Procedures shall be adopted to identify alternative power supplies connected to the electrical installation.

NOTE 1 Alternative sources of supply may include inverter/UPS systems, standby generators, solar cells, neutral backfeed from intermixed circuits, ring main systems, main power with separate auxiliary power supplies for control, transformation up (backfeed from ELV controls), multiple control supplies, luminaires supplied from emergency sources of supply, and batteries.

Control circuits or control systems (such as programmable logic controllers (PLCs), emergency stops, control selector switches) shall not be used as a means of isolation, e.g. by operation of a stop button.

WARNING: CIRCUIT WIRING OF ELECTRICAL EQUIPMENT OR CONDUCTORS MAY BECOME ENERGIZED DUE TO ANY OPERATION OF AUTOMATIC CONTROL DEVICES, E.G. THERMOSTATS, SWITCHES, PLCs, AND OTHER INTERFACE DEVICES.

NOTE 2 When removing circuit connections, active conductors should be disconnected first, followed by neutral conductors. Earth conductors should be disconnected last.

3.1.4 Isolation securing devices and identification

3.1.4.1 General

Isolating devices shall be secured in the open position or zero energy state in such a manner as to prevent inadvertent operation of the isolator. It may be necessary to apply some form of third-party adaptor to the isolator to facilitate the attachment of the isolation-securing device or devices. No person shall operate an isolator (e.g. switches, valves, protective devices) or use equipment to which an isolation-securing device is attached.

Where a facility exists to lock an isolation switch, it shall be used.

The securing device need not be an integral part of the switch. Securing devices shall require a deliberate action to engage or disengage. Securing devices may be —

- (a) an additional component, such as a clip, screw, bolt, pin, or padlock that will prevent the switch from being operated;
- (b) a personal danger tag, lock-out or permit system; or
- (c) some other system that provides an equivalent level of safety.

NOTE For further information on the lock out tag out process for isolation, see [Appendix D](#).

3.1.4.2 Padlocks

Personal padlocks should be used for locking isolating devices. They should be red in colour and uniquely keyed to prevent inadvertent removal by others.

Each personal padlock should identify the person's name, company, and contact details. This may be achieved by either engraving on the padlock or by attaching a personal identification tag to it.

A multi-lock device that is suitable for the isolator shall be employed where more than one person is required to attach a personal lock to an isolator.

[Figure 3.1\(A\)](#) shows a typical lock and multi-lock device. [Figure 3.1\(B\)](#) shows a typical personal identification tag.



Figure 3.1(A) — Typical personal red lock and multi-lock device

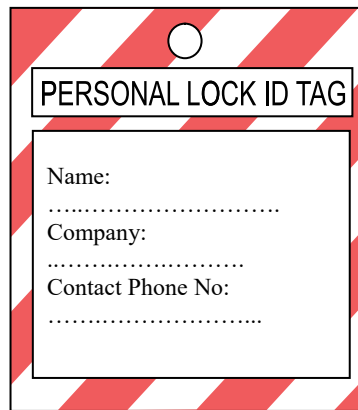


Figure 3.1(B) — Typical personal identification tag

3.1.4.3 Tags

3.1.4.3.1 General

Tags shall be attached with a lock, string or tie. The entries on the tag shall be legible and permanent. PVC tape shall not be used to secure a tag. If a formal permit system is used, the designated sign on and tagging procedures shall be used.

NOTE AS 1319 specifies requirements for the design and use of safety signs.

3.1.4.3.2 Danger tags

Danger tags shall be placed at all points of switching, isolation or disconnection, except where a padlock is used in accordance with [Clause 3.1.4.2](#).

Danger tags are intended to protect the individual.

[Figure 3.1\(C\)](#) displays examples of typical danger tags.



Figure 3.1(C) — Typical danger tags