Industry Standard

Industry Standard for Electrical Installations on Construction Sites

March 2002

OFFICE OF THE CHIEF ELECTRICAL INSPECTOR

WorkSafe VICTORIA

State Government Victoria The Place To Be

Developing the Standard in Partnership

Foundations for Safety is Victoria's primary forum for dealing with occupational health and safety issues in the construction industry.

Foundations for Safety has brought together State Government regulatory agencies, accident research expertise, construction workers' unions and employer associations representing principal contractors and specialist trades sub-contractors.

It meets in full session every three months and establishes working parties to progress various health and safety initiatives.

At the time of printing, the organisations represented on Foundations for Safety are:

- Australian Industry Group
- Australian Manufacturing Workers Union
- Air Conditioning and Mechanical Contractors Association
- Civil Contractors Federation
- CEPU Electrical Trades Union
- CEPU Plumbing Division
- CFMEU Construction and General Division
- CFMEU FEDFA Division
- Finishing Trades Association of Australia
- Housing Industry Association
- Master Builders Association of Victoria
- Master Plumbers & Mechanical Services Association of Australia
- Monash University Accident Research Centre
- National Electrical and Communications Association
- Office of the Chief Electrical Inspector
- Victorian Construction Safety Alliance
- Victorian Employers Chamber of Commerce and Industry
- Victorian Trades Hall Council
- WorkSafe Victoria

You can help improve health and safety in the construction industry by providing your feedback on this Industry Standard or on other health and safety issues to any of the Foundations for Safety member organisations.

Cover: Courtesy Multiplex Constructions, federation Square, Melbourne

Contents

Contents cont.

Introduction

Electrical hazards are a major source of death and serious injury on construction sites.

This Industry Standard has been produced in order to assist the construction industry to provide and maintain an acceptable level of electrical safety so as to safeguard construction workers and the general public from electrocution and electric shock.

When WorkCover's *Code of Practice for Temporary Electrical Installations on Building and Construction Sites* was published in 1988, it was the first of its kind in Australia.

Since then, the joint Australian and New Zealand Standard AS/NZS 3012, *Electrical Installations - Construction and Demolition Sites,* has been developed. The current edition of AS/NZS 3012 was published in 1995. This edition is now under revision, but the revised Australian and New Zealand Standard is not expected to be finalised for some time.

Pending the new edition of AS/NZS 3012, this Industry Standard was developed so as to provide clear guidance to all those with responsibilities for ensuring the safety of electrical installations on Victorian construction sites.

Drafting work on this Industry Standard was commenced in 2000 by a working group comprising representatives of:

- CEPU Electrical Trades Union
- National Electrical and Communications Association
- Office of the Chief Electrical Inspector (OCEI)
- WorkSafe Victoria.

The contributions made to the working group by Elecraft and ADJ Contracting are acknowledged with thanks.

The working party provided a draft for comment to the Foundations for Safety forum at its March 2001 quarterly meeting.

Final editorial work was then undertaken by the Victorian WorkCover Authority, with the finalised text circulated to all Foundations for Safety delegates for endorsement.

The Office of the Chief Electrical Inspector and the Victorian WorkCover Authority publish this Industry Standard on behalf of Foundations for Safety.

It supersedes the Victorian WorkCover Authority Code of Practice for *Temporary Electrical Installations on Building and Construction Sites,* which has now been revoked.

Part 1:
Scope and general information

1.1 Scope

This Industry Standard applies to fixed wiring, fixed and/or portable electrical apparatus, tools, appliances and associated flexible cords used in connection with all forms of construction work.

This includes the construction, renovation and demolition of all types of buildings and structures. It also applies to any excavation work undertaken in relation to the construction or demolition of buildings or structures.

1.2 Relationship to Australian Standards

This Industry Standard should be read in conjunction with AS/NZS 3012, *Electrical Installations - Construction and Demolition Sites.*

Compliance with AS/NZS 3000 and AS/NZS 3012 is mandatory under Victorian electrical safety legislation.

AS/NZS 3012 makes extensive reference to AS 3000, *Wiring Rules*. The latest edition of this Standard was published as a joint Australian and New Zealand Standard in 2000. Where this edition is silent on a particular matter, any guidance on that matter provided in the 1991 edition of AS 3000 may be used.

1.3 Compliance with legislation

The safety of electrical installations on Victorian construction sites is covered by two separate Acts. These are the ***Occupational Health and Safety Act 1985,*** administered by the Victorian WorkCover Authority, and the ***Electricity Safety Act 1998,*** administered by the Office of the Chief Electrical Inspector.

Designers, manufacturers, importers and suppliers (including hirers) of electrical plant and equipment have a duty under the *Occupational Health and Safety Act* to ensure that such plant and equipment is safe and without risks to health when properly used, has been appropriately tested and examined and is accompanied by adequate information regarding its safe use.

The *Occupational Health and Safety Act* requires employers, including principal contractors, to provide and maintain for employees and independent contractors a working environment that is safe and without risks to health. This includes a duty to provide and maintain plant and systems of work that are safe and without risks to health. Compliance with these requirements includes ensuring that suppliers of electrical plant and equipment have provided all necessary safety instructions and information.

In addition to their duties under the *Occupational Health and Safety Act,* registered electrical contractors and licensed electricians must comply with the *Electricity Safety Act,* the *Electricity Safety (Installations) Regulations,* and the Australian Standards incorporated by those Regulations. In particular, this includes compliance with AS/NZS 3000 and AS/NZS 3012.

Compliance with the provisions of this Industry Standard will assist employers, designers, manufacturers, importers, suppliers (including hirers), electrical contractors and electricians to comply with occupational health and safety, and electrical safety legislation.

1.4 Referenced documents

The documents referenced in this Industry Standard are listed in Appendix A.

1.5 Explanation of terms

To assist the reader in understanding the provisions of this Industry Standard, the following explanation of terms is provided:

RCD is a residual current device. Along with RCCB (residual current circuit breaker), RCD is an internationally adopted term for an earth leakage circuit breaker (ELCB) or safety switch.

Licensed electrician is the holder of a current Electrician's Licence issued by the Office of the Chief Electrical Inspector.

Relocatable structure includes site sheds, portable sheds, transportable construction huts, and relocatable construction premises.

Portable equipment covers such items as portable generators, welders, portable power tools, and appliances.

Shall is used to indicate mandatory requirements under the electrical safety legislation administered by the Office of the Chief Electrical Inspector.

Should is used to indicate recommended safe practices and procedures.

Inspector covers an inspector of WorkSafe Victoria, appointed under health and safety legislation, or a licensed electrical inspector working on behalf of the Office of the Chief Electrical Inspector.

Part 2:
Switchboards

2.1 General information

All supply switchboards for construction sites shall:

- be designed and constructed to comply with AS/NZS 3012
- include a means to prevent strain on termination of cables and flexible cords such as a tie bar or other means which shall be insulated and shall prevent mechanical damage
- be mounted securely (this mounting may be on a secure portable stand).

In addition, all such supply switchboards should:

- incorporate insulated stands for the support of cables and flexible extension cords, or for those not mounted on a pole or permanent structure, have an insulated stand fixed adjacent the supply switchboard
- be fitted with a door with a locking facility for security purposes, one which will not damage the cables when closed
- be provided with means to retain the door in the open position when it is required to be kept open for the purpose of conducting electrical work on the switchboard
- be fitted with a lockable cover for circuit breakers and RCDs, which does not prevent access to main switches, and main isolating switches. This provision also applies to relocatable structures
- have a clear and legible sign on the door stating
  KEEP CLOSED – LEADS THROUGH BOTTOM
- have, at the bottom of the enclosure, a means for the passage of flexible cords that will prevent mechanical damage to the cords.

Illustration 1

Generalised example of a typical switchboard appropriate for a commercial construction site.

Note that a tie bar, insulated stand, door, signage, and means of passage for flexible cords have been omitted from this illustration for the sake of clarity.

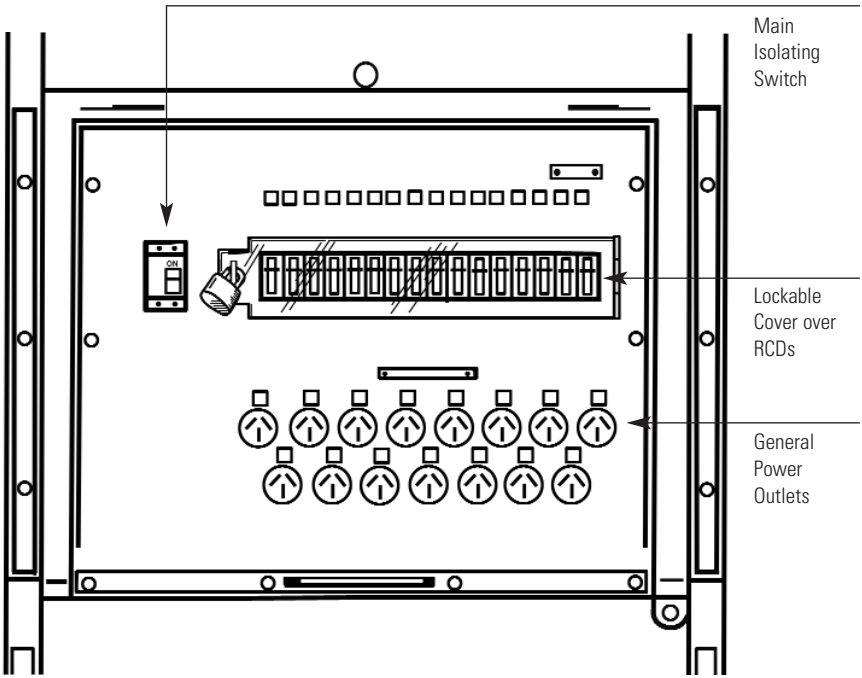
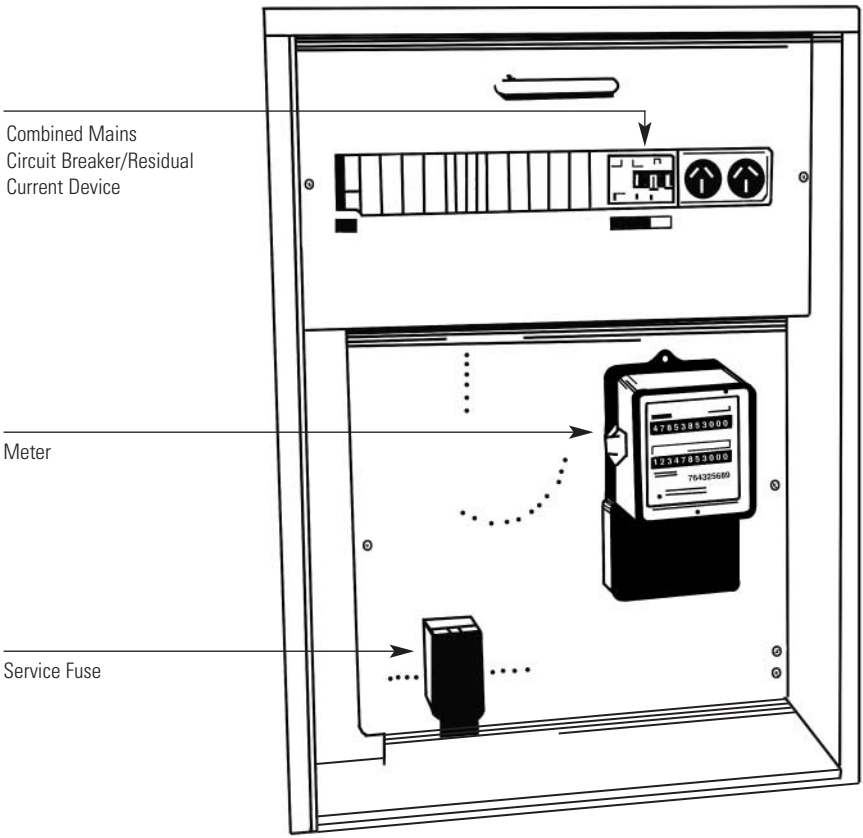


Illustration 2

Generalised example of a typical switchboard appropriate for a residential construction site.

For details of the fuse holder locking arrangement, refer to 2.5 and Illustration 3.

Note that a tie bar, door, signage, and means of passage for flexible cords have been omitted from this illustration for the sake of clarity.



2.2 Installations comprising one final sub-circuit

Where the electrical installation comprises only one final sub-circuit, or includes or incorporates a combined mains circuit breaker/residual current device (MCB/RCD) as the main switch, the fitting of a lockable cover for circuit breakers and RCDs is not necessary.

2.3 Clearance in front of switchboards

Clearance of at least 1.0 metre should be maintained in front of all switchboards.

2.4 Location of switchboards

Switchboards should be located to suit the maximum flexible cord lengths as set out in Appendix B.

In multi-level buildings switchboards shall be positioned in a manner which eliminates the need for flexible cords or cables to be run between levels.

2.5 Use of permanent meter panels

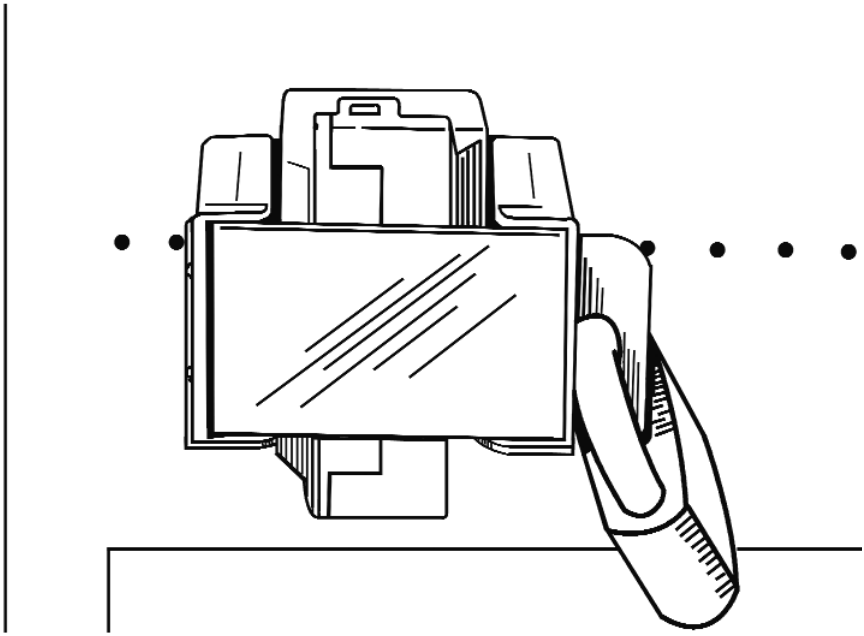
Where the electrical service is protected by a fuse assembly mounted on the meter panel, a suitable locking and/or securing device endorsed by the OCEI, must be provided.

Alternatively a suitable circuit breaker in lieu of the meter panel mounted service fuse may be provided.

The above requirement only applies to construction sites which are not permanently occupied by persons other than construction contractors and their employees. This means that sites comprising permanently occupied domestic or business premises are excluded from this requirement.

Illustration 3

Example of a typical securing device for the service fuse.



Part 3:
Electrical circuits

3.1 Provision of RCDs to final sub-circuits

Every final sub-circuit shall be protected by an RCD with a rated tripping current not greater than 30 mA. This includes lighting, socket outlets, and relocatable structures.

This requirement need not apply to final sub-circuits supplying equipment where safe mechanical operation is at risk, such as for cranes or personnel lifts.

3.2 Security of power circuits

To prevent unauthorised access and the risk of electrocution or fire, the principal contractor or nominated persons should ensure that all power circuits are secured upon completion of the work shift, and/or when the site is unattended. This need not apply to security lighting and essential equipment, or to locked relocatable structures.

3.3 Over-current circuit breakers

Every final sub-circuit shall be protected by a fixed over-current circuit breaker, except that final sub-circuits exceeding 50 A may be protected with HRC (High Rupturing Capacity) fuses.

3.4 Clear identification of construction wiring

Construction wiring for consumers' mains, sub-mains, and sub-circuits should be readily distinguishable from permanent wiring by using cable of a different colour, or by attaching iridescent yellow tape stamped with the words "construction wiring".

The tape should be spaced at intervals not exceeding 5 metres.

3.5 Separation of construction wiring from permanent wiring

Construction wiring should not be tied to, bundled, or grouped with permanent wiring.

3.6 Mechanical protection of cabling

Where there is a risk of cabling being damaged, it shall be provided with suitable mechanical protection.

Some examples of where mechanical damage may occur include cabling slung under concrete ceiling slabs, or cabling located in risers which may be accessed for other purposes.

Cables installed within 150 mm of a corner formed by a ceiling and a wall, or a beam and a ceiling, may not require additional mechanical protection.

As construction sites are dynamic workplaces, a risk assessment should be undertaken whenever a change occurs which may affect the likelihood of the cabling being damaged. The risk assessment is the joint responsibility of the electrician and the principal contractor.

Where the risk assessment identifies a risk of mechanical damage to cabling, the cabling must be protected.

Examples of suitable mechanical protection include cabling installed in appropriate conduit or suitable metal enclosures, or the use of cabling of a type which does not require additional protection, such as armoured cable.

3.7 Height clearance for flexible electrical cords

Flexible electrical cords should be run on hangers or stands to provide a safe route through the work area and passageways and to provide sufficient height clearance for personnel and vehicles.

This need not apply within a horizontal distance of 4 metres from the immediate work area where the power is to be used.

3.8 Double pole switches

Double pole switches should be used on every 240 volt socket outlet on portable equipment that is supplied by means of a plug and socket, and on relocatable structures.

3.9 Multi-plug portable outlet devices

Multi-plug portable outlet devices shall:

- comply with AS/NZS 3105
- incorporate over-current and RCD protection
- be of robust construction
- have extended sides or covers over the outlets
- be suitable for outdoor use, having a minimum rating of IPX3.

  Note that an IPX3 rating does not provide adequate protection from splashing or hosing liquids.

For further information refer to AS 1939:1990.

Flexible cords supplying multi-plug portable outlet devices shall be of the heavy duty sheath type complying with AS 3191. Where they are supplied by a circuit without 30 mA RCD protection, flexible cords shall incorporate over-current and RCD protection not exceeding 30 mA.

3.10 Fixed wiring

Cables normally used as fixed wiring should not be used as flexible extension cords.

3.11 Extension sockets and plugs exposed to water

Where flexible extension cords are linked together and used outdoors or where water may be present, the extension socket and plug should be protected by design or enclosure against the ingress of water.

3.12 Insulated hangers

Where flexible extension cords pass through scaffolding or other metal structures, they should be run on hangers covered with non-conducting material to prevent mechanical damage.

3.13 Unused electrical cables

Unused electrical cables should be removed or appropriately terminated by a licensed electrician.

3.14 Aerial conductors

Aerial conductors including conductors on catenary cables must not be used in hazardous bush fire areas.

3.15 Cable ties

Where exposure to direct sunlight occurs, cable ties should be ultraviolet resistant.

Part 4: Testing

4.1 Testing of construction wiring

All construction wiring, including switchboards and wiring within relocatable structures, shall be tested by a licensed electrician (E licence) before connection to the mains supply. As well as visual inspections, testing shall be for earth continuity, insulation resistance, polarity, and correct circuit connections, and shall be in accordance with AS/NZS 3000. Guidance relating to testing may be found in AS/NZS 3017.

A certificate of electrical safety must be provided when work is handed over for use. These certificates shall be stored on site or be made available for audit.

4.2 Re-testing of construction wiring

Following initial testing, re-testing shall be carried out at 6-monthly intervals.

Results of the inspection shall be recorded, and kept on site or made available for audit.

4.3 Testing of plant, portable electrical equipment and appliances, and flexible electrical cords

All plant including portable electrical equipment and flexible electrical cords, shall be visually inspected for wear and mechanical damage, and tested in accordance with AS/NZS 3760 for earth continuity, and insulation resistance. Inspection and testing should be undertaken by a licensed electrician or electrician supervised (ES or L) prior to its first use, and every 3 calendar months thereafter, while being used on the site.

Tested portable electrical equipment and flexible electrical cords shall be tagged, and all test results shall be recorded in a book kept for the purpose, and records kept on site or made available for audit.

Where the book is not kept on the site, arrangements should be such that the book can be produced for an Inspector or elected Health and Safety Representative within 24 hours of request.

The details recorded shall include the following:

- date of inspection
- plant number of the item inspected
- licence number of the inspecting electrician
- any repairs required as a result of the inspection.

4.4 RCDs

All portable RCDs shall be tested before each use by operation of the test button.

All RCDs should be tested for tripping current and time by a licensed electrician each calendar month while being used on the site.

Refer to Appendix C.

Tested RCDs shall be tagged, and all test results should be recorded and kept on site or be available for audit.

Part 5: Generators

5.1 RCDs on generators

Electrical socket outlets mounted on generators shall be protected by RCDs not exceeding 30 mA.

Where generators are supplying fixed switchboards, the RCDs may be mounted on the switchboard.

5.2 Fixed installation

When a generator set supplies a fixed installation, the generator set bonding conductor should be earthed by connection to the earthing system of the fixed installation.

The fixed installation shall be:

- installed to the requirements of AS/NZS 3000 and AS 3010.1
- installed and inspected by a registered electrical contractor and a certificate of electrical safety provided
- inspected by a licensed electrical inspector prior to being used for the first time, and after relocation.

5.3 Earth and bonding connections

When a generator set supplies portable tools and equipment, the manufacturer or supplier of the generator must provide information regarding relevant earth and bonding connections. This information must be displayed prominently on the generator.

In order for the RCD to function correctly, the generator frame must be bonded to an earth stake if there is no internal link between the neutral output and the metallic frame of the generator.

Part 6:
Lift shafts

6.1 Separate final sub-circuit

Construction wiring in lift shafts shall be from a separate final sub-circuit protected by a 30 mA residual current device (RCD). This supply should be provided for the sole purpose of installing lift shaft equipment.

6.2 Circuit breakers

Circuit breakers should be locked and tagged to prevent accidental isolation of the supply to the lift shaft by other persons on the site.

6.3 Lift shaft lighting

Lift shaft lighting may be supplied from either temporary or permanent fixed wiring and shall conform with the following:

- Lighting fixtures should be a minimum of 36 watt fluorescent lamps suitably guarded against mechanical damage
- Lighting fixtures should be connected to the supply wiring by means of a lighting plug and socket
- Lighting fixtures should be installed at intervals not exceeding 9 metres with the uppermost fixture within 1 metre of the top of the lift shaft
- The lighting should be controlled by two-way switches located within easy reach of the lift well access points at the top and bottom floor levels
- Where lighting fixtures are installed and intended to be part of the permanent lift installation, the lighting shall comply with section 11.3 of AS 1735.2.

6.4 Lift shaft illumination

Where multiple lift shafts are being constructed, for the purpose of installing more than one lift in an adjacent shaft, one lift shaft may be provided with effective illumination from a vertical riser of luminaires in an adjacent shaft.

6.5 Emergency lighting

Emergency lighting shall be provided to allow safe egress from the lift well upon loss of normal lighting. Emergency lighting shall be provided for a minimum duration of one hour after the loss of normal lighting, and shall be capable of providing illuminance of at least 20 lx throughout the lift well. (Refer to section 6 of AS 1680.0:1998 *Interior Lighting Part 0: Safe Movement*.)

6.6 False-cars

Where false-cars are installed for the purpose of the installation of lift well equipment, construction wiring for electrical supply to the false-car should conform with the following:

i) It should have a minimum 240 volt supply with a 20 A socket outlet sourced from a separate final sub-circuit which is protected by a 30 mA residual current device. The sole purpose of this supply should be for the provision of adequate power to the climbing hoist including task lighting and power for the use of electrical tools when working from the false-car working platform.

ii) The electrical wiring to the false-car working platform shall:

- be from a heavy duty double insulated flexible cord rated at a minimum of 20 A with a minimum conductor size of 4.0 mm2 in compliance with AS 1979, *Electric Cables-Lifts-Flexible Travelling*;
- be suspended from a device that does not damage the core wires, such as a built-in thimble.

iii) The flexible cord should:

- be secured at the top of the shaft and at the point of attachment to the false-car by a suitable means to prevent mechanical damage;
- be suspended in the lift well in a manner which will ensure adequate running clearance between the false-car and the lift well, preventing fouling or mechanical damage to the cord;
- be of sufficient length to allow for free travel of the false-car through the entire length of the lift well.

Part 7: Lighting

7.1 Protection of light fittings

To prevent mechanical damage, light fittings shall be fitted with devices such as wire cages, or be manufactured from impact resistant material such as poly-carbonate.

7.2 Emergency lighting

Where there is insufficient or inadequate natural light, adequate artificial emergency lighting is to be provided. Refer to AS/NZS 2293.1:1998 for more details.

7.3 Evacuation lighting

Where work or amenities areas do not have natural daylight, sufficient maintained battery powered evacuation lighting shall be installed to allow safe exit from those areas in the event of an emergency. Refer to AS/NZS 2293.1:1998 and section 6 of AS 1680.0:1998 I*nterior Lighting Part 0: Safe Movement.*

Battery powered evacuation lighting, including exit signs shall operate for a minimum of one hour following loss of supply. Evacuation lighting should be subjected to a discharge test every 6 months, and results recorded and kept on site, or made available for audit.

7.4 Exit lights

Exit lights shall not be positioned any more than 1 metre directly above an exit, or any more than 2 metres directly in front of the exit.

Exit directional arrows are required to be positioned in hallways which do not lead directly to an emergency exit.

7.5 Festoon lighting

Use of festoon lighting is restricted to underground shafts, wells, and tunnels, and is subject to the following:

- lamp holders shall be of the moulded, non-removable type
- supply voltage should be extra low voltage.

Part 8:
Miscellaneous

8.1 Supply to relocatable structures

Where electrical supply to a relocatable structure is by means of a flexible cord, the supply should not be taken from a socket outlet in one relocatable structure to another relocatable structure, or to another inlet on the same structure.

8.2 Evacuation system

Where an evacuation system including sirens is installed, battery backup should be provided.

Appendices

Appendix A: Documents referenced in this Industry Standard

Acts and regulations

Electricity Safety Act 1998
Electricity Safety (Installations) Regulations
Occupational Health and Safety Act 1985

Australian Standards

AS 1735.2:1997	Lifts, escalators and moving walks - Passenger and goods lifts - Electric
AS 1939:1990	Degrees of protection provided by enclosures for electrical equipment
AS 1979:1993	Electric cables - Lifts - Flexible travelling
AS 3010.1:1987	Electrical installations - Supply by generating set - Internal combustion engine driven sets
AS/NZS 1680.0:1998	Interior lighting - Safe movement
AS/NZS 2293.1:1998	Emergency evacuation lighting for buildings - System design, installation and operation
AS/NZS 3000:2000	Standards Association of Australia Wiring Rules
AS/NZS 3012:1995	Electrical Installations - Construction and Demolition Sites
AS/NZS 3017:2001	Electrical installations - Testing and inspection guidelines
AS/NZS 3105:1998	Approval and test specification - Electrical portable outlet devices
AS/NZS 3191:1996	Approval and test specification - Electric flexible cords
AS/NZS 3199:2000	Approval and test specification for cord extension sets - Cord extension sets
AS/NZS 3760:2000	In-Service Safety Inspection and Testing of Electrical Equipment

Appendix B: Restrictions on flexible cords

Restrictions on flexible cords
(including total in-line length of multiple cords)

Rating of Flexible Cord	Maximum Rated Current of Type C Protective Circuit Breaker	Minimum Cross-Sectional Area of Flexible Cable	Maximum Length of Flexible Cable
A	A	mm2	m
10	20	1.0	25
	20	1.5	35
15	20	1.5	25
	32	1.5	25
	32	2.5	40
20	32	2.5	30
	32	4.0	50

Note:
Lengths quoted for flexible cords are taken from AS/NZS 3199 and are based on a voltage drop of 5% of 230 volts at rated current and on short circuit (i.e. fault) protection requirements.

Appendix C: Testing of RCDs

Testing of RCDs

Test Current	Type (II)
100% rated tripping current	300*
500% rated tripping current	40*

* Maximum tripping time in ms

Type (II) 10 ≤ 30mA minimum requirement to protect final sub-circuits and hand held equipment on construction sites.

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Preston	9485 4555
Shepparton	5381 8260
Traralgon	5174 8900
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