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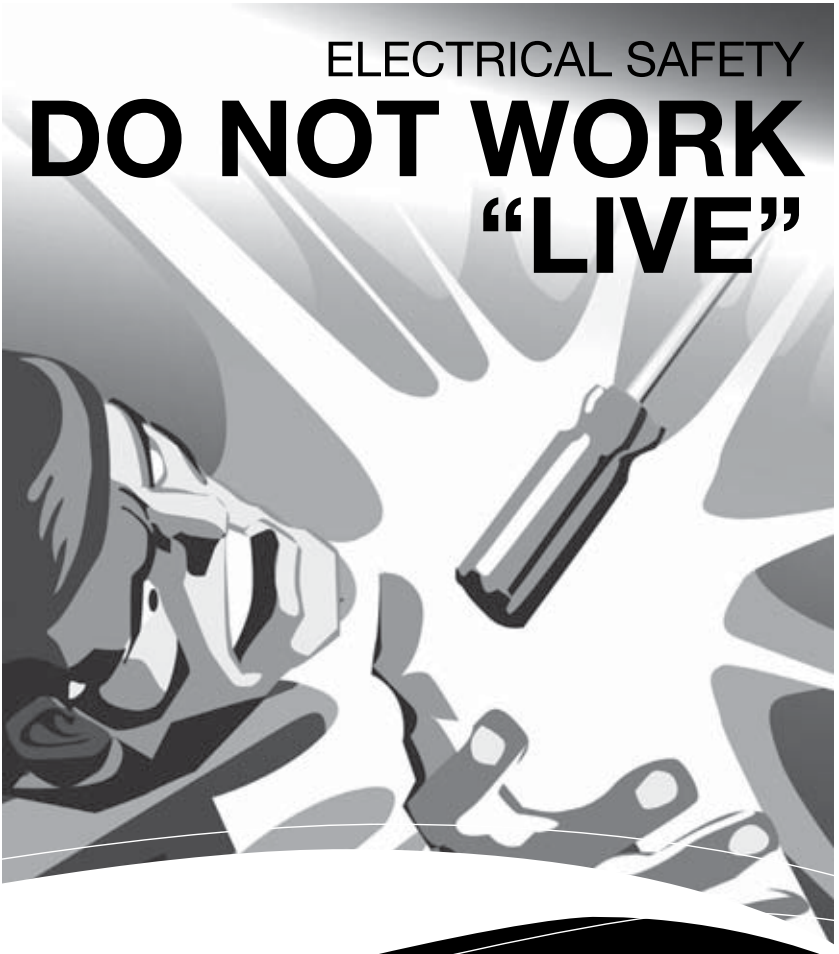
Electrical Safety For Construction

Handbook 2007

ELECTRICAL SAFETY

DO NOT WORK "LIVE"



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Working "live" on switchboards and electrical installations can be very dangerous. Think of your fellow workers and in particular, your families. Electrocutions and injuries can be just as devastating for others as it can be for you. Don't risk it

Foreword

Dear ETU Member

The ETU is proud to provide you with a copy of this occupational health and safety book. It has been produced by the Union with generous support from many employers and those associated with the electrical industry in the hope that it will help make our workplaces safer.

Occupational health and safety is the number one priority of our Union. Ensuring that our members go home to their families safely every day is of critical importance to us and we hope that the information contained in this book will provide a strong reference point on how to improve safety in the workplace.

While the contents of this book will no doubt assist people in ensuring that the most stringent health and safety standards are followed, everyone should be aware of the critical need to undergo thorough and proper training on all aspects of the work that we perform. Electrical workers have spent years learning how to work safely and efficiently. We should be encouraged to take on additional training courses such as those offered by the Electrical Trades Union including construction wiring courses and other training programs that will increase our knowledge-base and ensure that we are skilled to do the work that we are asked to do in the safest possible manner.

The ETU defends the highest of safety standards and we support the highest integrity of the electrical trades – neither should be compromised in the performance of work.

We thank all those employers associated with the electrical industry for their support in bringing this important health and safety publication into the electrical industry. We hope that it will make the entire electrical industry safer.

Yours sincerely

DEAN MIGHELL
BRANCH SECRETARY

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Contents

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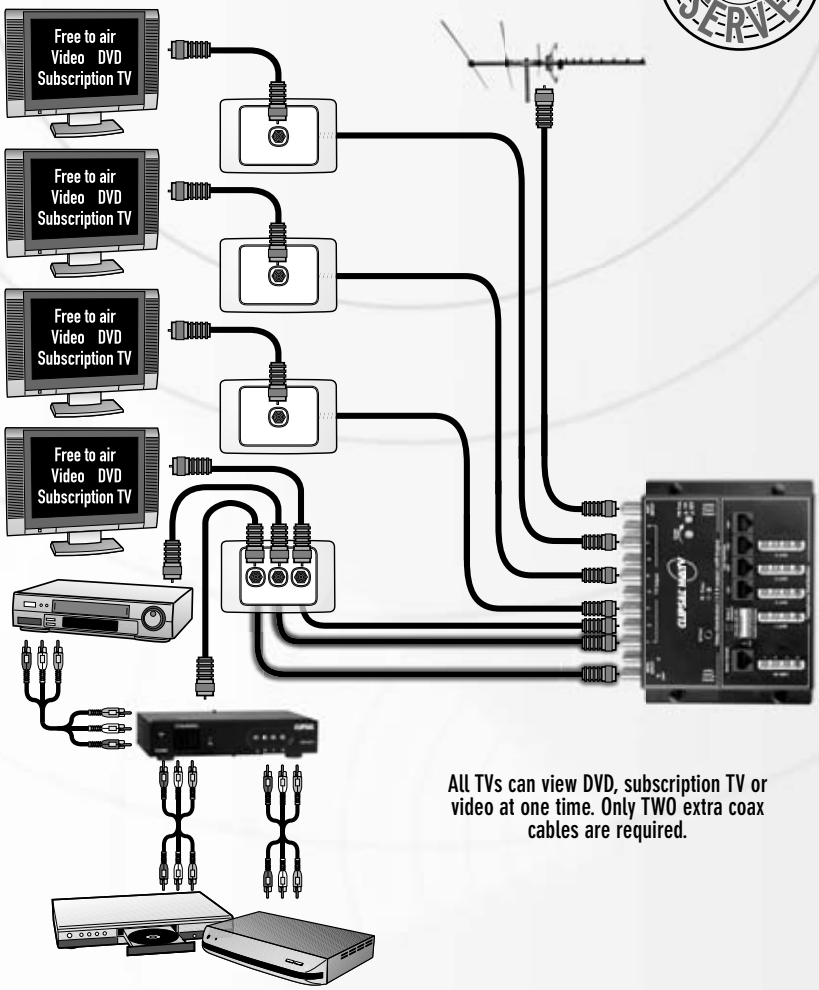

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Australian and New Zealand Standards:

Some relevant Australian Standards:

- AS/NZS 3000:2000 WIRING RULES.
- AS/NZS 3001:2001 ELECTRICAL INSTALLATIONS: RELOCATABLE PREMISES (INCLUDING CARAVANS AND TENTS) AND THEIR SITE INSTALLATIONS.
- AS/NZS 3008.1.1: 1998 ELECTRICAL INSTALLATIONS: SELECTION OF CABLES.
- AS/NZS 3010:2005 ELECTRICAL INSTALLATIONS: GENERATING SETS
- AS/NZS 3012:2003 ELECTRICAL INSTALLATIONS – CONSTRUCTION AND DEMOLITION SITES
- AS/NZS 3017:2001 ELECTRICAL INSTALLATIONS: TESTING GUIDELINES.
- AS/NZS 3190:2002 APPROVAL AND TEST SPECIFICATIONS - RESIDUAL CURRENT DEVICES (CURRENT OPERATED EARTH-LEAKAGE DEVICES)
- AS/NZS 3760:2003 IN SERVICE SAFETY INSPECTION AND TESTING OF ELECTRICAL EQUIPMENT.
- AS 1674.2:2007 SAFETY IN WELDING AND ALLIED PROCESSES - ELECTRICAL
- AS 2790:1989 ELECTRICITY GENERATING SETS: TRANSPORTABLE (UP TO 25 KW).

INTRODUCTION

Construction has been described as the second most dangerous industry nationally.

Throughout Australia the construction industry comprises some 715,300 employees, or approximately 7% of the national workforce. In Victoria it accounted for 11.8% of the 28,600 workplaces registered with VWA in 2004-5, and for 191,000, or 7.7%, of Victoria's 2.48 million employees.

In comparison to this population data, the construction industry is disproportionately over represented in figures on Victorian workplace fatalities and injuries. Although in broad terms annual fatality data for the construction industry has been trending downwards over the last 5 years, construction still accounted for the second highest number of workplace fatalities in any industry in Victoria, at 32 deaths during the period (Agriculture was the highest with 49).

This represents 21% of all reported workplace fatalities, with an average of 6.4 construction fatalities occurring each year. Nine fatalities occurred in the year 2001-2. In the same period construction also had the fourth highest rate of fatalities per 100,000 employees at 3.84, more than three times the average rate for all industries, which was 1.27 fatalities per 100,000 employees.

Over the same period there has been a modest decline in the rate of claims for the construction industry. An average of 2,844 construction claims were logged per year, peaking at 2,903 in 2004-5. The rate of claims in the Victorian construction industry per 1,000 employees in the period 2001-2 to 2004-5 was the fourth highest after the manufacturing, transport, and community services industries. At 16.13 claims per 1,000 employees the construction industry average was 20% higher than the scheme average of 13.52. The average cost per construction industry claim over the same period was similarly disproportionate, at 19% higher than the rest of the scheme ($47,100 in comparison to $39,700). The total cost of claims in the Victorian construction industry for 2004-5 was $120 million.

It should be noted that this data is most likely to be conservative, due to the nature of the way claims data are reported and collated. One issue is that statistics may not cover diseases resulting from long term exposure or with long latency periods. Another significant difficulty is that unknown numbers of cases cannot be claimed or acknowledged as workers' compensation. This is because absences which are of up to 10 days duration and below the cost threshold ($506 in 2004-5) cannot be claimed.

LEGAL FRAMEWORK

In Victoria whilst at work we have two primary pieces of legislation that we must comply with, one of them being the Occupational Health and Safety Act 2004 (OHS Act), the other the Electricity Safety Act 1998 (ES Act).

The OHS Act applies in general terms to workplaces where there is an employer – employee relationship. The ES Act applies to electrical safety overall whether at a workplace or not.

The primary duty holder under the OHS Act is the employer because they should have the management or control of the workplace. The employee also has a duty of care specified under the OHS Act. The ES Act places the primary duty on the electrical worker to ensure that the electrical installation is safe and to standard and that the worker works safely.

OCCUPATIONAL HEALTH & SAFETY ACT 2004

Section 2. Objects of Act, states:

(1) The objects of this Act are—

(a) to secure the health, safety and welfare of employees and other persons at work; and
(b) to eliminate, at the source, risks to the health, safety or welfare of employees and other persons at work; and
(c) to ensure that the health and safety of members of the public is not placed at risk by the conduct of undertakings by employers and self-employed persons; and
(d) to provide for the involvement of employees, employers, and organisations representing those persons, in the formulation and implementation of health, safety and welfare standards—

having regard to the principles of health and safety protection set out in section 4.

(2) It is the intention of the Parliament that in the administration of this Act regard should be had to the principles of health and safety protection set out in section 4.

Section 4. The principles of health and safety protection

(1) The importance of health and safety requires that employees, other persons at work and members of the public be given the highest level of protection against risks to their health and safety that is reasonably practicable in the circumstances.

(2) Persons who control or manage matters that give rise or may give rise to risks to health or safety are responsible for eliminating or reducing those risks so far as is reasonably

practicable.

(3) Employers and self-employed persons should be proactive, and take all reasonably practicable measures, to ensure health and safety at workplaces and in the conduct of undertakings.

(4) Employers and employees should exchange information and ideas about risks to health and safety and measures that can be taken to eliminate or reduce those risks.

(5) Employees are entitled, and should be encouraged, to be represented in relation to health and safety issues.

Employer duty: Section 21 – Sub Clause (1) & (3) states in part:

(1) An employer must so far as is reasonably practicable, provide and maintain for employees of the employer a working environment that is safe and without risk to health.

(3) …… employee includes an independent contractor engaged by an employer and any employees of that independent contractor.

…… in relation to any matter over which the employer would have had control but for any agreement between the employer and the independent contractor to the contrary.

The OHS Act defines reasonably practicable in (Section 20) as having regard to the:

- ***the likelihood of the hazard or risk concerned eventuating;***
- ***the degree of harm that would result if the hazard or risk eventuated;***
- ***what the person concerned knows, or ought reasonably to know, about the hazard or risk and any ways of eliminating or reducing the hazard or risk;***
- ***the availability and suitability of ways to eliminate or reduce the hazard or risk;***
- ***the cost of eliminating or reducing the hazard or risk.***

Employer and self-employed persons duties: (Sections 23 and 24) requires:

Section 23 states in part:

> ***An employer must ensure, so far as is reasonably practicable, that persons other than employees of the employer are not exposed to risks to their health or safety arising from the conduct of the undertaking of the employer.***

Section 24 states in part:

> ***A self-employed person must ensure, so far as is reasonably practicable, that persons are not exposed to risks to their health or safety arising from the conduct of the undertaking of the self-employed person.***

Employee duties: (Section 25), states:

1. ***While at work, an employee must:***

   a. ***take reasonable care for his or her own health and safety; and***
   b. ***take reasonable care for the health and safety of persons who may be affected by the employee's acts or omissions at the workplace; and***

   c. ***co-operate with his or her employer with respect to any action taken by the employer to comply with any requirements imposed by or under this Act or the regulations.***

2. ***Whilst at work, an employee must not intentionally or recklessly interfere with or misuse anything provided at the workplace in the interest of health, safety or welfare.***

3. ***In determining for the purposes of sub-section (1) (a) or (b) whether an employee failed to take reasonable care, regard must be had to what the employee knew about the relevant circumstances.***

ELECTRICITY SAFETY ACT 1998

Energy Safe Victoria (ESV) is governed by the Electricity Safety Act 1998 and the Electricity Safety (Installations) Regulations 1999.

Section 43 (1) – Safety of Electrical Installations, states:

> ***A person must not install any electrical equipment which the person knows or should reasonably be expected to know is unsafe or will be unsafe if connected to an electricity supply.***

Section 43(iv) – Safety of Electrical Installations, states;

> ***A person carrying out electrical installation work must ensure that:***
>
> ***(a) all electrical circuits or electrical equipment handled in the course of that work are disconnected from the electricity supply; or***
>
> ***(b) adequate precautions are taken to prevent electric shock or other injury in the handling of electrical circuits or electrical equipment in the course of that work.***

ELECTRICITY SAFETY (INSTALLATIONS) REGULATIONS 1999

Requirement to Comply with AS/NZS 3000

The regulations were proclaimed in May 1999 and amended in February 2001 with direct reference to AS/NZS 3000 and AS/NZS 3012. Not only do the regulations mandate AS/NZS 3000 but they also amend certain provisions of AS/NZS 3000.

One example of an amendment is:

Clause 7.11.12 AS/NZS 3000 – Wiring Rules states;

> ***7.11.12 Construction and Demolition Sites. Guidance on the installation requirements for construction and demolition sites is given in AS/NZS 3012.***

But the Electricity Safety (Installations)(Amendment) Regulations 2001 Clause 10 (1) of the Regulations requires that clause 7.11.12 of the Wiring Rules be substituted with –

> ***7.11.12 CONSTRUCTION AND DEMOLITION SITES.***
> ***Installations on construction and demolition sites must comply with AS/NZS 3012.***
>
> ***THIS THEREFORE MAKES AS/NZS 3012 MANDATORY***

Codes of Practice

Energy Safe Victoria has produced a Code of Practice for Safe Electrical Work for Low Voltage Electrical Installations. It is designed to constitute a set of minimum recommended procedural and safety requirements for a safe working environment for all electrical workers, including self-employed workers, authorised to perform work on electrical equipment and installations.

Codes of Practice were developed under the OHS Act 1985 to provide practical guidance on how employers may meet their obligations under the Act or Regulations.

Since the inception of the OHS Act 2004 Codes of Practice no longer hold their status as was described under the 1985 Act, but are able to be used as guidance material in accordance with Section 20 in relation to what a person knows or ought reasonably to know, about the hazard or risk and any ways of eliminating or reducing the hazard or risk.

Compliance Codes are specified in Section 149 of the 2004 OHS Act. Compliance Codes will replace Codes of Practice but are envisaged to be more mandatory than what Codes of Practice were.

Industry Standard

Industry Standards are developed in a tripartite forum with the focus on a specific hazard. The Industry Standard provides practical guidance on hazard control to enable the employer to meet their duty of care.

The Industry Standard for Electrical Installations Construction Sites – Victorian WorkCover Authority – 2002 has been produced in order to assist the construction industry to provide and maintain an acceptable level of electrical safety so as to safe guard construction workers and the general public from electrocution and electrical shock. Energy Safe Victoria and the Victorian Work Cover Authority publish the industry standard on behalf of Foundations for Safety. The 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. The industry standard should be read in conjunction with AS/NZS 3012.

CONSTRUCTION WIRING

Electrical installations on construction sites are required to meet three requirements. Firstly all construction wiring must comply with the provisions of the *Wiring Rules (AS/NZS 3000)*, additionally construction wiring must comply with *AS/NZS 3012*, and thirdly in Victoria there are the requirements of the *Industry Standard for Electrical Installations on Construction Sites*.

Construction wiring requirements are intended to protect persons, livestock and property from electric shock, fire and physical injury hazards that may arise from an electrical installation that is used with reasonable care and with due regard to the intended purpose of the electrical installation.

Australian Standard AS/NZS 3012 applies to electrical installations associated with construction and demolition sites which include—

(a) building work, excavation work, compressed air work and diving work;

(b) parts of buildings which undergo structural alterations, such as extensions, major repairs or demolition, to the extent that the work necessitates the provision of a temporary electrical installation;

(c) work on or in connection with the construction or maintenance of roads, airfields or airstrips, civil engineering works or bridges, or of the permanent way of a railway or tramway;

(d) dredging or salvaging work;

(e) the laying, lining or maintenance of pipes or cables;

(f) earthmoving work carried out with equipment requiring the use of other than manual power;

(g) any work in which explosives are used;

(h) site offices, cloakrooms, meeting rooms, dormitories, canteens, toilets, appliances and other facilities provided during any work referred to in (a) to (g); and

(i) land clearing in preparation for any work referred to in (a) to (g).

INSTALLATION METHODS

All wiring systems shall be selected and installed so as to minimize damage to the sheath and insulation of cables and insulated conductors and their connections during installation, use and maintenance.

The radius of every bend in a wiring system shall be such that conductors and cables shall not suffer damage.

Where a conductor or a cable is not resting on a continuous surface it shall be supported by suitable means at appropriate intervals in such a manner that the conductor or cable does not suffer damage by its own weight.

Every cable or conductor used as fixed wiring shall be supported in such a way that it is not exposed to undue mechanical strain and so that there is no appreciable mechanical strain on the connections of the conductors, account being taken of mechanical strain imposed by the supported weight of the cable or conductor itself.

A flexible wiring system shall be installed so that excessive tensile and torsional stresses to the conductors and connections are avoided.

Wiring systems shall be installed in accordance with the generally accepted principles of safe and sound practice using methods that will protect the electrical installation against mechanical or electrical failure under ordinary use, wear and tear, and any abnormal conditions which may reasonably be anticipated.

Where a wiring system is not resting on a continuous surface it shall be supported by suitable means, where necessary the wiring system shall be fixed in position by suitable clips, saddles or clamps or by means which will not damage the wiring system and which will not be affected by the wiring system material or any external influences.

CABLE SELECTION

There are many factors to consider when selecting the appropriate sized cable for the installation and not just maximum demand.

AS/NZS 3008.1.1 sets out a method of cable selection for those types of electrical cables and methods of installation that are in common use at working voltages up to and including 0.6/1 kV at 50 Hz a.c.

DE-RATING FACTORS

Section 3.5 of AS/NZS 3008.1 specifies that the current carrying capacity of a cable will be affected by the presence of certain external influences as detailed in Clauses 3.5.2 to 3.5.8. Under such conditions the current carrying capacity provided in Tables 3 to 21 shall be corrected by the application of an appropriate rating factor or factors obtained from tables 22 to 28.

Effect of ambient temperature

The current-carrying capacities given in the tables of AS/NZS3008.1.1:1998 are based on a consistent ambient air temperature of 40°C and an ambient soil temperature of 25°C. Where other ambient temperatures apply, the appropriate rating factors shall be as given in Table 27 of AS/NZS3008.1.1:1998.

Effect of direct sunlight

Current-carrying capacities are given in Tables 15, 20 and 21 of AS/NZS3008.1.1:1998 for flexible cables and aerial cables exposed to direct sunlight. For other types of cable installed in locations exposed to direct solar radiation it will be necessary to make some provision for the effects of the increased heating. This may be achieved by one of the following means:

(a) Provision of a shield, screen or enclosure which allows for the natural ventilation of the cable.

(b) Reduction of the current-carrying capacity of the cable by an appropriate amount in accordance with the higher air temperature.

As a rule-of-thumb alternative to any recommendation from a cable manufacturer, a correction factor obtained from Table 27(1) for a temperature 20°C higher than the ambient air temperature may be applied.

VOLTAGE DROP

Where long runs of construction wiring are installed, the likelihood of voltage drop must be considered.

Unless an electrical installation is specifically designed to operate under reduced voltage conditions, the voltage drop between the point of supply and any point of the electrical installation shall not exceed 5% of the nominal voltage at the point of supply, instances have occurred under short circuit conditions, where the protective device has not operated because of excessive voltage drop caused by the impedance of long circuits.

Where a switchboard is to be installed primarily to supply a designated piece of equipment, for example a swing stage, false car, welder or a compressor etc, the installation must be specifically designed for that load. There is now an agreed position between the industry and the regulator, that in these circumstances that for voltage drop calculations purposes a maximum Vd of 2% of the nominal supply voltage is allowable for the installation from the consumer terminals to the switchboard and then a maximum Vd of 3% from the switchboard to the consuming device.

A proper assessment of all the following factors should result in an optimum economic design of the electrical installation;

(a) Calculation of the maximum demand of the installation; AS/NZS 3000.2000 Table C2
(b) Type of electrical load.
(c) Type of supply – number of phases.
(d) Method of installation.
(e) Cable sizing of the various circuits – mains, sub-mains, final sub-circuits.
(f) Conductor parameters – Milli-Volt per Amp-metre.
(g) Provision for future additional loading.

The minimum cable size will be the smallest cable that satisfies the following factors.

- Current Carrying Capacity – Dependant upon the method of installation and the presence of external influences, such as thermal insulation, underground etc.
- Voltage Drop – Dependant upon the impedance of the cable, the magnitude of the load current and load power factor.

The cable selection procedures set out in Section 2 of AS/NZS 3008.1.1.1998 details the guidelines to be followed to determine the minimum size of cable required to satisfy a particular installation condition.

Determination of minimum cable size based on voltage drop

(a) Determine the current requirements of the circuit (I).
(b) Determine the circuit route length (L).
(c) Determine the maximum voltage drop permitted on the circuit run (V_d).
(d) Determine the voltage drop (V_c) in millvolts per ampere metre (mV/A.m)
(e) Refer to the tables of voltage drop (mV/ A.m) for the different cable types, using Tables 40 through to 50 in AS/NZS 3008.1.1:1998

NOTE: To convert single-phase voltage drop (mV/A.m) values, multiply the single-phase values by 0.866. To convert three-phase values to single-phase values, multiply the three-phase values by 1.155.

Then using Tables 22 through to 26(2) of AS/NZS 3008.1.1:1998 determine the method of cable installation to be used, and if the method of installation requires the application of a derating factor, then divide the value of the determined current requirement of the circuit by the derating factor.

Then determine any environmental conditions that may effect the cable installation using Tables 27 through to 29 and where applicable divide the value of the current determined in step (b) by the derating factor.

EXAMPLE (1) SUSPENDED SCAFFOLD (SWINGSTAGE)

Where a maximum circuit route length is the determining factor:

$$\text{For a 3 phase installation} \quad V_c = \frac{1000 \times V_d}{I \times L}$$

$$\text{For a 1 phase installation} \quad V_c = \frac{1000 \times V_d}{I \times L \times 1.155}$$

A Swingstage comprising of 2 x 6.5A single phase electric winch motors is to be installed.

From the designated switchboard socket-outlet to the winch motor terminals is a maximum distance of 87mtrs, with a nominal supply voltage of 240V ac at the consumer terminals, the maximum allowable voltage drop of 3% from the switchboard socket-outlet to the winch motor terminals is 7.2V ac.

$$V_c = \frac{1000 \times V_d}{I \times L \times 1.155} \qquad V_c = \frac{1000 \times 7.2V\ ac}{(2 \times 6.5A) \times 87mtrs \times 1.155} \qquad Vc = \frac{7200}{1{,}306.305}$$

Vc = 5.511 mV/Am

Using AS/NZS 3008 Table 47 V90 10mm^2 = 4.38 mV/Am

The minimum size cable able to be used to supply this swingstage over 87mtrs is 10mm^2.

EXAMPLE (2)

Where the cable type and size is the determining factor

$$\text{For a 3 phase installation} \quad L = \frac{1000 \times V_d}{I \times V_c}$$

$$\text{For a 1 phase installation} \quad L = I \times \frac{1000 \times V_d}{(V_c \times 1.155)}$$

A 4mm^2 2 core and earth V75 flexible cable is to be used to supply an arc welder that has a current rating of 12.5Amps and is to be supplied from a designated switchboard, with a nominal supply voltage of 240V ac at the consumer terminals, the maximum allowable voltage drop of 3% from the switchboard socket-outlet to the welding machine's terminals is 7.2V ac.

Using AS/NZS 3008 Table 47 V75 4mm^2 = 10.4mV/Am

$$L = \frac{1000 \times V_d}{I \times (V_c \times 1.155)} \quad L = \frac{1000 \times 7.2V\ ac}{12.5 \times (10.4mV/Am \times 1.155)} \quad L = \frac{7200}{150.15}$$

L = 47.95

The maximum allowable length is 48mtrs.

EXAMPLE (3)

Where a maximum circuit route length is the determining factor:

For a 3 phase installation $V_c = \frac{1000 \times V_d}{I \times L}$

For a 1 phase installation $V_c = \frac{1000 \times V_d}{I \times L \times 1.155}$

A Falsecar comprising of 1 x 7A single phase electric winch motors is to be installed.

From the designated switchboard socket-outlet to the winch motor terminals is a maximum distance of 125mtrs, with a nominal supply voltage of 240V ac at the consumer terminals, the maximum allowable voltage drop of 3% from the switchboard socket-outlet to the winch motor terminals is 7.2V ac.

$$V_c = \frac{1000 \times V_d}{I \times L \times 1.155} \quad V_c = \frac{1000 \times 7.2V\ ac}{7 \times 125mtrs \times 1.155} \quad Vc = \frac{7200}{1,010.625}$$

Vc = 7.124 mV/Am

Using AS/NZS 3008 Table 47 V90 10mm^2 = 4.38 mV/Am

The minimum size cable able to be used to supply this falsecar is 10mm^2.

EXAMPLE (4)

Where a maximum circuit route length is the determining factor:

$$\text{For a 3 phase installation} \quad V_c = \frac{1000 \times V_d}{I \times L}$$

$$\text{For a 1 phase installation} \quad V_c = \frac{1000 \times V_d}{I \times L \times 1.155}$$

A False car comprising of 1 x 4.6A three phase electric winch motors is to be installed.

From the designated switchboard socket-outlet to the winch motor terminals is a maximum distance of 125mtrs, with a nominal supply voltage of 415V ac at the consumer terminals, the maximum allowable voltage drop of 3% from the switchboard socket-outlet to the winch motor terminals is 12.45V ac.

$$V_c = \frac{1000 \times V_d}{I \times L \times 1.155} \qquad V_c = \frac{1000 \times 12.45V\ ac}{4.6 \times 125mtrs} \qquad Vc = \frac{12450}{575}$$

Vc = 21.652 mV/Am Using AS/NZS 3008 Table 47 V90
2.5 mm^2 = 15.2 mV/Am

A 2.5mm^2 cable is the smallest size able to supply this falsecar over the route length of 125mtrs.

EXAMPLE (5)

Where a maximum circuit route length is the determining factor

$$\text{For a 3 phase installation} \quad V_c = \frac{1000 \times V_d}{I \times L}$$

$$\text{For a 1 phase installation} \quad V_c = \frac{1000 \times V_d}{I \times L \times 1.155}$$

A Site Office without permanently installed heating or cooling and comprising of 3 x 10A Double GPO's, 2 x 10A Single GPO's and 2 x Double Fluorescent Lights

Using Table C2 Maximum Demand – Non-Domestic Electrical Installations column 3 Factories, shops, stores, business premises, schools and churches.

Equipment	Load Group	Calculation	Result
Lighting	A	2 x Double 36w Fluro	
		4x36w+(4x5w Ballast)	
		164w / 240V = 0.68	0.68A
GPO's (8x outlets)	B(1)	1000w+(7x750w)	
		5250w / 240V = 21.88A	21.88A
		Total Maximum Demand	22.56A

NOTE: For the purpose of determining maximum demand, a multiple combination Socket-outlet shall be regarded as the same number of points as the number of integral socket-outlets in the combination.

The site office is to be supplied from a distribution board that is a total route length away of 35mtrs; the cable is to be bundled with 4 other circuits and installed on a catenary wire in direct sunlight.

Using AS/NZS 3008.1 Table 22 Derating Factors for Bunched Circuits of Single-Core or Multicore Cables in air or in wiring Enclosures, Column 2-3 Row 1 Bunched in air and number of circuits 5 = Derating factor of 0.70

Apply the rating factor of 0.70 to the total maximum demand of 22.56A

$$\frac{22.56A}{0.70} = 32.23A$$

From the distribution board to the point of attachment on the site office is a distance of 35mtrs, with a nominal supply voltage of 240V ac at the consumer terminals the maximum allowable voltage drop of 3% from the distribution board to the site office is 7.2V ac.

$$V_c = \frac{1000 \times V_d}{I \times L \times 1.155} \qquad V_c = \frac{1000 \times 7.2V\ ac}{32.23 \times 35mtrs \times 1.155} \qquad Vc = \frac{7200}{1302.90}$$

Vc = 5.53 mV/Am

Using AS/NZS 3008 Table 42 V90 10mm^2 = 4.05 mV/Am

EXAMPLE (6)

Where the cable type and size is the determining factor

For a 3 phase installation $L = \frac{1000 \times V_d}{I \times V_c}$

For a 1 phase installation $L = \frac{1000 \times V_d}{I \times (V_c \times 1.155)}$

A 6mm^2 V90 – 2core and earth is to be used to supply a transportable toilet block without permanently installed heating or cooling and comprising of 1x 10A double GPO, 1x 15A GPO, 2x Double Fluorescent Lights and 1x 40w Exhaust Fan from a distribution board, with a nominal supply voltage of 240 V ac at the consumer terminals, the maximum allowable voltage drop of 3% from the switch board to the toilet block is 7.2V ac. The cable will be bundled with 3 other circuits and installed on a catenery in direct sun light.

Using Table C2 Maximum Demand – Non-Domestic Electrical Installations column 3 Factories, shops, stores, business premises, schools and churches

Equipment	**Load Group**	**Calculation**	**Result**
Lighting	A	2 x Double 36w Fluro 4x36w+(4x5w Ballast) $\frac{164w}{240V} = 0.68$	0.68A
GPO's 10A	B(I)	1000w+(1x750w) $\frac{1750w}{240V} = 7.29A$	7.29A
GPO's 15A	B (III)	1x15A= 15A	15A
Exhaust Fan	D	$\frac{40w}{240V} = 0.17A$	0.17A
		Total Maximum Demand	23.14A

NOTE: For the purpose of determining maximum demand, a multiple combination Socket-outlet shall be regarded as the same number of points as the number of integral socket-outlets in the combination.

Using AS/NZS 3008 Table 22 Derating Factors for Bunched Circuits of Single-Core or Multicore Cables in air or in wiring Enclosures, Column 2-3 Row 1 Bunched in air and number of circuits 4= Derating factor of 0.72

Apply the rating factor of 0.72 to the total maximum demand of 23.14A

$$\frac{23.14A}{0.72} = 32.14A$$

Using AS/NZS 3008 Table 42 V90 6mm^2 = 6.8mV/Am

$$L = \frac{1000 \times V_d}{I \times (V_c \times 1.155)} \quad L = \frac{1000 \times 7.2V\ ac}{32.14x\ (6.8mV/Am \times 1.155)} \quad L = \frac{7200}{252.43}$$

L = 28.52mtrs The maximum allowable length is 28.52mtrs.

EXAMPLE (7)

Where the cable type and size is the determining factor

For a 3 phase installation $L = \frac{1000 \times V_d}{I \times V_c}$

For a 1 phase installation $L = \frac{1000 \times V_d}{I \times (V_c \times 1.155)}$

A 10mm^2 V90 2 core and earth cable is to be used to supply a transportable site shed with permanently installed heating or cooling and consisting of 11x 10A Double GPO's, 2x 10A Single GPO's, 5x Double Fluorescent lights and 2x 15A reverse cycle air-conditioners from a distribution board, with a nominal supply voltage of 240 V ac at the consumer terminals, the maximum allowable voltage drop of 3% from the switch board to the site shed is 7.2V ac. The cable will be installed in heavy duty conduit in the ground with 3 other circuits that will be spaced 30mm apart.

Using Table C2 Maximum Demand – Non-Domestic Electrical Installations column 3 Factories, shops, stores, business premises, schools and churches.

Equipment	**Load Group**	**Calculation**	**Result**
Lighting	A	5 x Double 36w Fluro	
		10x36w+(10x5w Ballast)	
		$\frac{1800w}{240V} = 7.5A$	7.5A
GPO's 10A	B(II)	1000w+(23x100w)	
		$\frac{3300w}{240V} = 13.75A$	13.75A
Air-Conditioners	C	15A+(15x0.75) = 26.25	26.25A
		Total Maximum Demand	47.5A

NOTE: For the purpose of determining maximum demand, a multiple combination Socket-outlet shall be regarded as the same number of points as the number of integral socket-outlets in the combination.

Using AS/NZS 3008 Table 26(2) Derating Factors for Groups of Circuits of Single Core or Multicore Cables Installed in Underground Wiring Enclosures – Multicore Cables Enclosed Separatly or More That One Single-Core Cable Per Wiring Enclosure, Column 3, number of circuits 4= Derating factor of 0.85

Apply the rating factor of 0.85 to the total maximum demand of 47.5A

$$\frac{47.5A}{0.85} = 55.88A$$

Using AS/NZS 3008 Table 42 V90 10mm^2 = 4.05mV/Am

$$L = \frac{1000 \times V_d}{I \times (V_c \times 1.155)} \quad L = \frac{1000 \times 7.2V\ ac}{5.88x\ (4.05mV/Am \times 1.155)} \quad L = \frac{7200}{261.39}$$

L = 27.54mtrs

The maximum allowable length is 27.54mtrs.

INSTALLATION OF CONSTRUCTION WIRING

Clauses 2.5.1, 2.5.2, 2.5.3 & 2.5.4 of **AS/NZS 3012** specify the types of cables to be used and fixing requirements. These clauses require in part;

2.5.1 Cables and fittings

Cables and fittings used in construction wiring shall comply with the requirements of AS/NZS 3000.
NOTE: Trailing cables used for surface wiring should comply with the requirements of AS/NZS 2802.

2.5.2 Installation of cables

Cables shall be installed in accordance with AS/NZS 3000 except as varied in Clauses 2.5.3 to 2.5.6. Construction wiring shall not be tied, bundled or grouped with permanent wiring.

2.5.3 Marking

Construction wiring shall be readily distinguishable from permanent wiring by using cable of a different colour or by attaching iridescent yellow tape spaced at intervals not exceeding 5 m and stamped with the words 'construction wiring'.

2.5.4 Use of unarmoured cables

Unarmoured cables shall not be installed on metallic roofs or similar structures unless suitably protected against mechanical damage.

Construction wiring is required to be fixed so as to eliminate excessive sag and to afford adequate support.

Clause 3.3.9 of AS/NZS 3000 states in part:

3.3.9 The radius of every bend in a wiring system shall be such that conductors and cables shall not suffer damage.

Where a conductor or a cable is not resting on a continuous surface it shall be supported by suitable means at appropriate intervals in such a manner that the conductor or cable does not suffer damage by its own weight.

Every cable or conductor used as fixed wiring shall be supported in such a way that it is not exposed to undue mechanical strain and so that there is no appreciable mechanical strain on the connections of the conductor,

account being taken of mechanical strain imposed by the supported weight of the cable or conductor itself.

Elimination of excessive sag applies to vertical runs as much as horizontal runs – the requirement is that the wiring be adequately supported.

CABLING RUN ON CATENARY

Cables supported by means of a catenary shall be stranded or flexible cables affording double insulation or the equivalent of double insulation.

Cables and catenary supports installed out-of-doors shall be suitable for exposure to direct sunlight.

At no time should the number of cables supported by a catenary wire exceed 6 cables.

Construction wiring is not allowed to be installed on the same catenary wire as permanent wiring. This constitutes a hazard under Occupational Health and Safety as the construction wiring is mixed with the permanent wiring and is not readily distinguishable when bunched or tied together.

On sites where permanent wiring exists together with construction wiring for construction purposes, the construction wiring must be clearly identified.

Clause 3.4 of the Industry Standard requires:

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.

A catenary shall be supported to —

(a) provide uniform support; and
(b) consist of material equally resistant to corrosion or deterioration; and
(c) be effectively fixed at each end; and
(d) be capable of withstanding mechanical stresses likely to occur, in particular those due to wind or ice; and
(e) be mounted sufficiently high above the ground to prevent danger to persons or livestock, or damage to the cable being supported.

A catenary may form part of a cable, in which case it should be installed in accordance with the manufacturer's instructions.

Cables supported by a catenary wire shall maintain the following clearances:

(a) in an outdoor location, as specified for a neutral screened cable; and
(b) in an indoor location, not less than 100 mm from any moving parts or parts of equipment operating at an elevated temperature.

Minimum Clearance for Low Voltage Cable Supported by Catenary

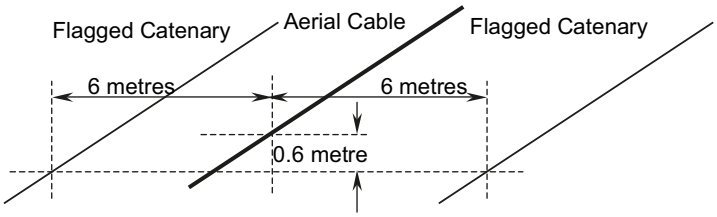
- 4.6m – over areas used by vehicles
- 3.0m – over areas not used by vehicles
- 2.7m – over roofs used for traffic or resort
- 0.5m – over other roofs and structures
- 1.0m – from buildings; horizontal clearance from walls etc.
- 2.0m – From clothes lines, radio and television aerials, counterpoise or stay wires
- 0.6m – From telecommunication lines
- 3.0m – Above swimming pools
- 4.5m – Above areas where sailing craft, or irrigation pipes are used

Furthermore in relation to cables run over areas used by vehicles, overhead wiring should be positioned to avoid crossing roadways or access ways where cranes, high loads or heavy machinery may travel.

Where it is not possible to avoid access ways, an effective means shall be provided to minimize the risk of vehicular contact with the aerial wiring system.

This condition may be satisfied by the placement of flagged catenary wires or cables of suitable material across the access way—

(a) 6m on either side of the overhead wiring; and
(b) 0.6m below the lowest point of the overhead electrical cables or lower.



MECHANICAL PROTECTION

All parts of an electrical installation shall be designed to be adequately protected against damage that might reasonably be expected from environmental and other external influences.

Damage from such influences may include mechanical injury, and damage due to exposure to weather, water, flora, fauna, seismic activity, excessive dampness, corrosive fumes, galvanic action, accumulation of dust, steam, oil, temperature, explosive atmospheres, vibration or any other influence to which the electrical installation may be exposed under the conditions of its use.

Wiring enclosures which form part of wiring systems shall be installed in accordance with safe and sound practice and provide adequate protection. A risk assessment should be undertaken, prior to the installation of cables or whenever a change occurs, as to the likelihood of the cables being exposed to mechanical damage.

The following are some examples of situations where cables may require mechanical protection:

- Cables run within 2.5m of the floor or ground level.
- Cables run on exterior surfaces and in close proximity to scaffolding.
- Cables supplying switchboards and final subcircuits to equipment located on formwork decks.
- Cables run on perimeter construction fencing
- Cables slung under a concrete ceiling slab more than 150mm away from the juncture of the ceiling slab and a wall or beam which would otherwise provide protection.
- Cables coming in close proximity to unearthed metal structures being installed as part of the construction process, (i.e. sheet metal ducts, hydraulic piping, etc.)
- Cables run across the top of relocatable structures, storage containers, shipping containers or the like.
- Cables run across or over metallic roofs or edges.
- Cables run in adverse environments

In relation to construction wiring, where the risk assessment identifies a risk of damage to cables, and the cables cannot be relocated to an alternative position, they must be protected by a suitable enclosure or barrier not less effective than—

(a) medium duty rigid PVC conduit; or

(b) heavy duty corrugated conduit; or

(c) flexible electrical hose; or

(d) armoured cable; or

(e) other means that provide equivalent protection against mechanical damage.

Where wiring enclosures are run vertically, adequate provision shall be made for the support of the enclosed cables. Cable supports shall be provided at intervals not exceeding 8 m or as recommended by the cable manufacturer.

SWITCHBOARDS

The design of switchboards for use on construction sites should not only take into account the specific requirements of isolation, RCD protection and rating of socket outlets but should also take into account the mechanical protection. The mechanical protection aspects that switchboards may require are often due to the very nature of construction activities and the likelihood of the damage that may occur to the switchboard during the construction phase of the project.

SWITCHBOARD DESIGN

All supply switchboards for construction sites shall comply with:

- Designed and constructed to comply with AS 3439.4; or
- Robust construction and materials to withstand mechanical damage from environment or other external influences that may be expected at the location
- Enclosure shall provide a minimum degree of protection IP23
- Live parts shall be effectively protected at all times against direct contact by persons operating equipment located on the switchboard, including the connection or disconnection of plugs in socket-outlets
- If the switchboard is provided with a socket-outlet, means such as an insulated or covered tie bar, shall provide anchorage for outside cables or flexible cords and cables and prevent strain at the connections or terminations
- Have, at the bottom of the enclosure, a means for the passage of flexible cords that will prevent mechanical damage to the cords.
- 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
- Mounted securely (this mounting may be on a secure portable stand).
- 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

- Where provided with a door or lid to maintain degree of protection, the door or lid shall—
    - require the use of a tool for removal;
    - be fitted with a door with a locking facility for security purposes, one which will not damage the cables when closed fitted with a facility for locking;
    - 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 fitted with a means of retention in the open position;
    - if the switchboard is provided with a socket-outlet, be provided with a clearly visible and legible sign on the external surface stating—"KEEP CLOSED—RUN ALL LEADS THROUGH BOTTOM"; and
    - be kept closed except when access is required.

- Isolating switches to be provided with a device for securing the switch in the open position so that it requires a deliberate action to engage or disengage it.

- Where there is more than one switchboard on the site, marking shall be provided, by means of numbers, letters or both, to distinguish one switchboard from another.

- All isolating switches shall be marked as required by AS/NZS 3000 and as follows:

  'MAIN SWITCH'—on main switchboards.
  'DISTRIBUTION BOARD ISOLATING SWITCH'—on distribution boards.
  'ISOLATING SWITCH AFTER HOURS SUPPLY—DO NOT SWITCH OFF'—for circuits supplying electrical equipment operating out of normal working hours.

  Letters used for marking shall be not less than 6 mm high and of a contrasting colour to the background material.

- Switchboards shall be marked to indicate the presence of live parts.

  Such marking shall be as follows:

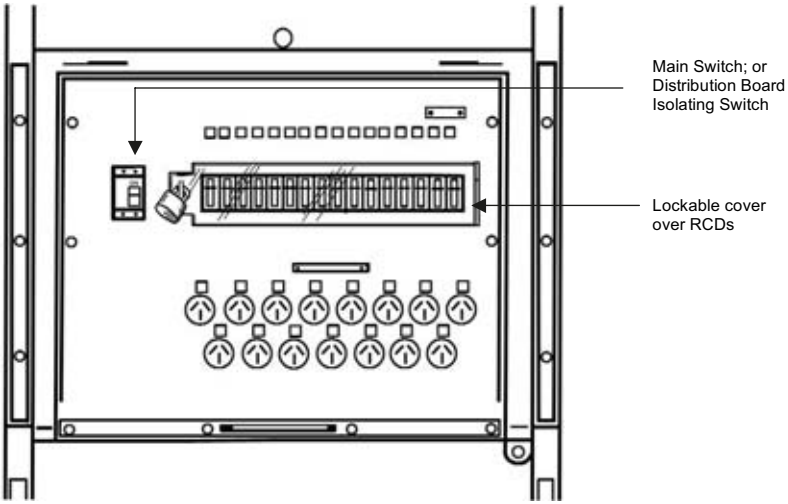
  Where access to live parts is required, the following symbolic electric shock risk sign shall be displayed in locations where additional attention is required to be given to the removal of covers and the like.

  In addition, a DANGER sign as illustrated below, with an additional message of appropriate wording, should be conspicuously displayed on the enclosure of the ASSEMBLY to alert persons to the hazard.

- All switchboards to be fitted with at least one 15 A single phase, socket outlet.

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.



RECOMMENDED FORMAT
CHECKLIST FOR CONNECTION OF SWITCHBOARDS

Checked by :*(PRINT NAME)*…….. ……. Date : ……/……/……
Electricians Licence number : ……
Signed : ……

Switchboard location : ……

Switchboard identification (Numbers/Letters) : ……...

CHECK	YES	NO
A lockable cover over RCD's and Circuit Breakers		
All socket outlets wired for correct polarity		
All switching works correctly		
All cabling is in good condition externally and internally		
All socket outlets are marked		
Tie bar is installed and insulated		
Main Isolator is installed outside of the lockable cover		
RCD for power		
At least one 15 Amp outlet is installed		
All labelling and circuit identification on switchboard as well as marking on all Socket Outlets		
Check hinge on door to ensure in good working condition and can only be removed by the use of a tool		
Door has a locking facility		
Test points for the lighting RCD's installed RCD for lights if required		
Tighten all connections		
Check for weatherproofing of board		
Pole fillers in place		
Has the switchboard been fitted with a lead stand		
Has the switchboard been fitted to the floor		

PROVISION OF DOUBLE POLE SWITCHES

Clause 3.8 of the Industry Standard requires:

> ***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.***

NOTE: Some commercially available socket outlets incorporating RCD's employ single pole switching only. If contemplating installing such a socket outlet in (for example) a relocatable structure, this type is unsuitable as it does not employ the required double pole switching. These types of RCD's are only suitable for attachment to permanent wiring.

SECURITY OF SWITCHBOARDS AFTER HOURS

The power circuits of construction installations are required to be secured after working hours.

To prevent unauthorised access and the risk of electrocution or fire, the principle 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.

PROTECTION OF FINAL SUB-CIRCUITS

All final sub-circuits of a construction installation must be protected by a circuit breaker, in addition to RCD protection.

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

AS/NZS 3012 specifically prohibits the use of rewirable fuses to protect final sub-circuits.

AS/NZS 3000 requires the identification of every circuit breaker protecting a final sub-circuit, relative to the circuit being protected. This is to enable final sub-circuits to be energised or de-energised as required by direct reference to the relevant circuit breakers, without an ad hoc 'trial and error' approach.

RESIDUAL CURRENT DEVICES (RCDs)

An RCD is defined as a device intended to isolate supply to protected circuits, socket-outlets or electrical equipment in the event of a current flow to earth which exceeds a predetermined value.

RCD's are rated by three parameters:

1. the nominal full load current rating;
2. the trip current, that is, the earth leakage current required to trip the unit; and
3. the maximum trip time at the rated trip current.

AS/NZS 3190 classifies RCD's according to the rated tripping current, as follows:

Type I	-	Up to 10mA
Type II	-	Greater than 10mA up to 30mA
Type III	-	Greater than 30mA, up to 300mA – without selective tripping time delay
Type IV	-	Greater than 30mA. Up to 300mA – with selective tripping time delay (type S)

Manufacturers are required to mark on the RCD information regarding rating and application – this information is also given in manufacturer's catalogues. The required information is given below:

- Rated voltage
- Rated load current in amperes
- Rated frequency, or alternatively – or a.c. if the rated frequency is 50Hz
- Rated residual (tripping) current I∆n.
- Number of supply conductor turns required to be passed through the core (if the RCD is of the type where supply conductors are required to be passed through the core).
- The word 'TEST' or the letter 'T' adjacent to or on the test facility (e.g., test button) and the word 'RESET' adjacent to or on the reset button, if used.
- If an RCD has a conditional short-circuit current rating:

  (a) of 3kA with a Short Circuit Protective Device (SCPD), it shall be marked I_{nc} – 3kA plus the SCPD details; or
  (b) over 3kA and also passes the short-time through-current withstand test detailed in clause 8.13 without an SCPD in circuit,

no marking is required and the SCPD details may be given in the manufacturer's data.

This marking does not apply to a portable RCD.

- Indication of open and closed positions at the place of operation. The symbols 'O' and 'I' may be used.

- The symbol S (S in a square) for Type IV RCD's.

Australian Standard AS/NZS 3190 – specifies the maximum trip time requirements for RCD's for different applications, when subject to leakage currents of various multiples of the rated trip current ($I\Delta n$). Examples are summarised in the table below:

TEST CURRENT	RCD TYPE			
	I	II and III	IV	
	TRIPPING TIME, mS			
	MAXIMUM		MINIMUM	MAXIMUM
NO TRIP				
TRIP	40	300	130	500
FAST TRIP	40	40	50	150

Every final sub circuit shall be protected by an RCD with a rated tripping current not greater than 30mA. 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.

For an RCD to correctly monitor and react to earth leakage currents, it is essential that a protected circuit neutral is earthed only 'upstream' – on the supply side – of the RCD.

NOTE 1:

ETU Recommendation does not allow for MCB/RCD's to be used as main switches as all RCD's are required to be behind a locked door. This requires a separate accessible main switch to be provided. All RCD's need to be reset only by a Licensed Electrician.

LOCATION OF SWITCHBOARDS IN RELATION TO FLEXIBLE CORD LENGTHS

The location of a switchboard should be considered in relation to the maximum length of flexible cords.

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.

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	mm^2	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 V at rated current and on short circuit (i.e. fault) protection requirements.

Recognising that flexible cords are likely to be supplied from the switchboard, consideration must be given to the maximum length of flexible cords permitted. This may necessitate the installation of an additional distribution board to supply flexible cords for work to be carried out beyond a given distance from the switchboard.

INITIAL VERIFICATION OF ELECTRICAL INSTALLATIONS

Wiring on construction sites irrespective of whether it's permanent wiring or construction wiring, must in the first instance comply with the provisions of AS/NZS 3000. Construction wiring as well as complying with AS/NZS 3000, also has the additional requirements of AS/NZS 3012 and the Industry Standard for Electrical Installations on Construction Sites to be complied with.

Documented records of all inspections and tests shall be kept on site for audit or made available for audit on the next working day- Section 3.9 AS/NZS 3012:2003.

TEST EQUIPMENT

Test equipment must be appropriate for the tests being performed. The test equipment must also be calibrated according to the manufacturer requirements (generally annually) but also appropriately rated to suit the prospective voltages, short circuit etc.

AS 61010.1 specifies that the equipment labelling must state a Measurement Category(I,II,III,IV) which relates to the prospective fault current levels in the circuit to be measured and a Voltage Level (150, 300, 600, 1000V) that the test equipment has been designed to safely withstand. The higher the category, the more robust the equipment must be to withstand the higher fault currents and voltage transients.

The following selection methodology is provided for guidance.

Selecting the Measurement Category

Select the Category according to the application (with typical fault current levels).

- Category I – very lowenergy circuits < 1kA E.g. Electronics + vehicles use (not for 240V)
- Category II – lowenergy circuits 1-5kA E.g. Home + office
- Category III – mediumenergy circuits 5-25kA E.g. Industrial use
- Category IV – high energy circuits > 25kA E.g. Industrial use

Selecting the Voltage Level

Select the voltage level above that you will be measuring.
E.g. For 230V circuits – select 300V or higher. For 400V circuits - select 600V or 1000V.

Thus a multimeter required for industrial use and needed to measure 415V will be a "CAT III 600V"meter.

TESTING REQUIREMENTS

When an electrical installation is complete there are certain requirements that must be completed prior to the installation being connected to supply.

AS/NZS 3000 (Wiring Rules) specifies those requirements.

Section 6 requires:

> *To verify that the requirements of this Standard have been met, all electrical installations, and any alterations, additions or repairs to an existing electrical installation, after completion and before being energized, shall be —*
>
> *(a) inspected as far as is practicable; and*
>
> *(b) tested.*
>
> *Precautions shall be taken to ensure the safety of persons and to avoid damage to property and the electrical installation equipment during inspection and testing.*
>
> *Where the electrical installation is an alteration, addition or repair to an existing electrical installation, it shall be verified that the alteration, addition or repair complies with this Standard and does not impair the safety of the existing electrical installation.*

VISUAL INSPECTION

A visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of the “Wiring Rules”.

The visual inspection shall be carried out before, or in association with testing, and should be made before the electrical installation is connected to supply.

Where the visual inspection of a part of the electrical installation can’t be performed at the completion of the work, e.g. not accessible due to enclosure in the building structure, consideration should be given to inspecting that part of the electrical installation during the course of the installation.

In relation to what should be visually inspected, a ready reckoner has been provided as a guide to what should be looked at.

READY RECKONER – VISUAL INSPECTION INSTALLATION

ITEMS TO BE VISUALLY INSPECTED	COMPLETED		
	Y	N	N/A
(a) General:			
(i) Basic protection (protection against direct contact with live parts), e.g. insulation and enclosure.			
(ii) Fault protection (protection against indirect contact with exposed conductive parts), e.g. by the use of double insulation or isolating transformers.			
(iii) Protection against hazardous parts, e.g. enclosure, guarding or screening of flammable materials, hot surfaces and parts that may cause physical injury.			
(iv) Protection against spread of fire, e.g. penetration of fire barriers.			
(v) General condition of the electrical equipment , e.g. signs of damage that could impair safe operation, disconnection of unused electrical equipment.			
(b) Consumers mains:			
(i) Current carrying capacity.			
(ii) Voltage drop – e.g. size of conductors.			
(iii) Underground installation conditions, e.g. enclosure, depth of burial, mechanical protection.			
(iv) Aerial installation conditions.			
(v) Connection of wiring.			
(vi) Protection against external influences.			
(c) Switchboards:			
(i) Location, e.g. access and egress.			
(ii) Protective devices, e.g. overload and residual current rating, fault current rating.			
(iii) Isolating devices, e.g. main switches.			
(iv) Connecting devices, e.g. neutral bars, earth bars and active links.			
(v) Connection and fixing of wiring and switchgear.			
(vi) Identification and labelling of electrical equipment.			
(vii) Protection against external influences.			
(d) Wiring systems:			
(i) Conductor size, e.g. current-carrying capacity and voltage drop.			
(ii) Identification of cable cores.			
(iii) Adequate support and fixing.			
(iv) Connections and enclosures.			
(v) Particular installation conditions, e.g. underground, aerial, emergency systems.			
(vi) Segregation from other services and electrical installations.			
(vii) Protection against external influences, e.g. enclosure.			

ITEMS TO BE VISUALLY INSPECTED	COMPLETED		
	Y	N	N/A
(e) Electrical equipment:			
(i) Isolation and switching devices for protection against injury from mechanical movement devices and motors.			
(ii) Isolation and switching devices for protection against thermal effects e.g. motors, room heaters, water heaters.			
(iii) Switching devices for particular electrical equipment, e.g. socket-outlets, water heaters etc.			
(iv) Particular installation conditions, e.g. locations affected by water, explosive atmospheres, extra-low voltage, high voltage.			
(v) Compliance with required Standard.			
(vi) Connection, support and fixing.			
(vii) Protection against external influences.			
(f) Earthing:			
(i) MEN connection.			
(ii) Earth electrode.			
(iii) Earthing conductors, e.g. size, identification.			
(iv) Equipotential bonding conductors, e.g. size, identification.			
(v) Connections, joints and terminations.			
(vi) Protection against external influences.			
(vii) Connection to earthing arrangements for other systems.			
(viii) Creation of earthed situation that may require earthing of additional electrical equipment.			

EE-Oz Training Standards is the Australian Government declared Industry Skill Council for the Electro Comms and Energy Utilities Industries in Australia. It is responsible for developing, with vocational, educational and industry representatives; portable nationally endorsed Qualifications and Competency Standards for careers in:

Energy: Electricity Transmission/Distribution and Generation work; Overhead Linework, Cable Jointing and Generator operations.

Gas: Gas Network Distribution and Transmission work.

Electro Comms: All electrotechnical work including unrestricted and restricted electrical, EEHA, broadcast communications, computer systems/IT, electronics, electrical, voice-data communications, instrumentation, refrigeration and air conditioning, lifts, digital imaging equipment, radio/digital TV, & sustainable/ renewable energy.

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TESTING

AS/NZS 3000 sets out the test methods required to ensure that a low voltage electrical installation is safe to be connected to supply.

Following a visual inspection of the electrical installation, testing is required to be carried out to verify that the electrical installation complies with the requirements of the "Wiring Rules", and that the installation is safe for its intended use.

Currently there are four mandatory tests but with the provision of two additional tests. On construction sites the use of RCDs on final sub circuits is mandatory. As such, the provision for RCD testing is then mandatory as they are required to be installed and so must be tested to verify that they are performing as required. The other additional test, earth fault loop impedance, verifies that the protective device will function where there is a fault to earth. This test is performed on an energised installation which tests not only the impedance of the installation but also the impedance of the network asset.

The following tests are to be carried out on the electrical installation:

Mandatory tests prior to supply being connected

- Continuity of the earthing system
- Insulation resistance
- Polarity
- Correct circuit connections

Optional Tests after supply has been connected

- Operation of residual current devices (RCDs)
- Verification of impedance required for automatic disconnection of supply (earth fault-loop impedance)

If the electrical installation fails a test, that test and any preceding tests that may have been influenced by the fault indicated shall be repeated after the fault has been rectified.

AS/NZS 3017 – Electrical Installations – Testing and Inspection Guidelines, provides practical guidance on how the testing is required to be performed to meet the provisions of the "Wiring rules".

Continuity of the earthing system

Verification to prove the continuity of the earthing system (earth resistance of the main earthing conductor, protective earthing conductors and bonding conductors) are necessary to ensure that the earthing system has been installed in a manner that will cause circuit protective devices to operate if there is a fault between live parts, other than the neutral, and the mass of earth.

An effective earthing system will ensure that exposed conductive parts of electrical equipment do not reach dangerous voltages when such faults occur.

Verification is to be conducted by testing the installation.

The resistance of the main earthing conductor or any equipotential bonding conductor shall be not more than 0.5 Ω.

The resistance of protective earthing conductors shall be low enough to permit the passage of current necessary to operate the overcurrent protective device.

> **NOTE:** Appendix B of AS/NZS 3000 describes the maximum allowable resistance of the protective earthing conductor associated with any particular circuit depends on the type and rating of the protective device and the impedance of the live conductors that comprise the circuit.

To obtain the resistance value of the protective earthing conductor use a quality ohm meter (see diagram for procedure) and compare this value with the *maximum* allowable resistance as tabulated below. For the full table, go to Table 3.2 AS/NZS 3017.

Protective Device Rating	Conductor Size		Circuit Breakers			Fuses
			Type B	Type C	Type D	
			Disconnection Times			
A	Active mm^2	Earth mm^2	0.4 sec			0.4 sec
			Maximum Final Subcircuit Earth Conductor Resistance			
6	1	1	3.08	1.65	1.00	3.69
10	1.5	1.5	1.85	1.00	0.60	2.06
16	2.5	2.5	1.16	0.62	0.37	1.00
20	2.5	2.5	0.93	0.50	0.30	0.68
25	4	2.5	1.07	0.57	0.34	0.76
32	4	2.5	0.72	0.38	0.23	0.51
40	6	2.5	0.66	0.35	0.21	0.44
50	10	4	0.54	0.29	0.17	0.34
63	16	6	0.44	0.23	0.14	0.26

TEST- Continuity of the earthing system (supply is not connected)

Test Equipment

- A multimeter set to ohms.
- Insulated copper conductor of suitable length (long lead).

Test Procedure

1. Ensure that the electricity supply is not connected.
2. Connect an insulated copper conductor of suitable length (long lead) to one terminal of the ohm meter.
3. Connect a standard length test lead to the other terminal of the ohm meter (short lead).
4. Connect the two leads together, and "zero" the multimeter or, if this is not possible, record the resistance of the test leads.
5. Disconnect the water pipe equipotential bonding conductor and the water heater earthing conductor (if applicable).

   Care must be taken that there are no parallel earth paths when conducting this test, ie. the earthing system must not be connected to either the water or gas pipes.
6. Disconnect the MEN link from the main neutral link and connect it to the long lead (ie. long lead now connected to the earth bar).

   Main Earthing Conductor/ Equipotential Bonding Conductor

   Connect the short lead to the earth electrode and measure the earth resistance of the main earthing conductor. Connect the short lead to the equipotential bonding conductor and measure the earth resistance of the bonding conductor. In both cases the resistance shall not exceed 0.5 ohms for either the main earthing conductor or the equipotential bonding conductor.

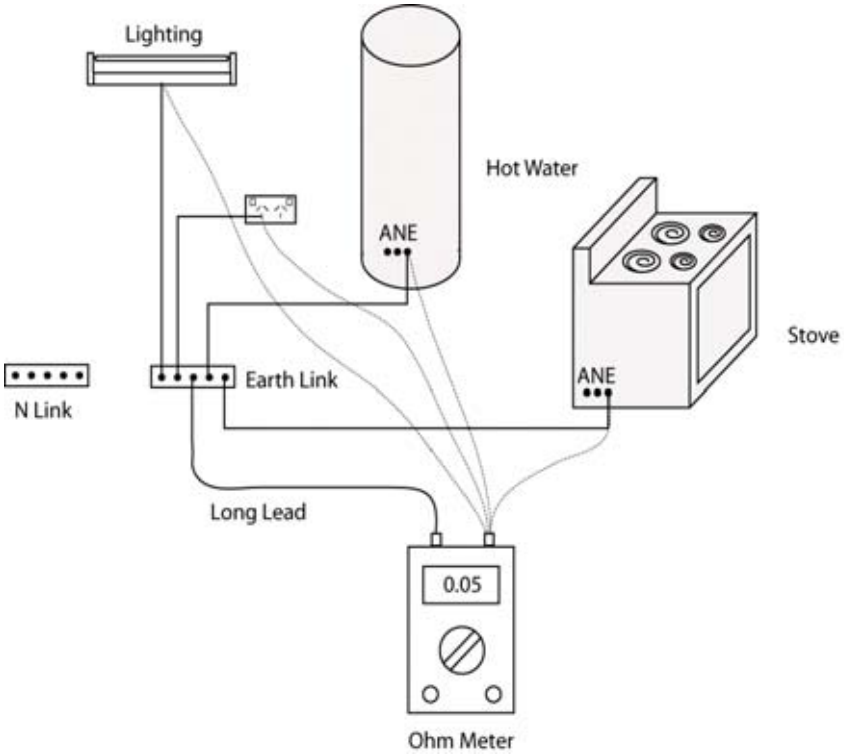
   Earth Continuity Test

   Using the long lead and zeroed multimeter, measure, for each circuit, the earth conductor resistance from the *circuit extremity* to the switchboard.

   Confirm the measured values are **less than** those values specified on the preceding page for *each* sub circuit.

   This test is applicable to all circuits, including socket outlet circuits, lighting circuits and fixed equipment (eg. water heater supply) circuits.
7. Re-connect the MEN link to the main neutral link.
8. Re-connect the water pipe equipotential bonding conductor.

Inspection – Protective Earthing Resistance



Insulation resistance

An insulation resistance test is required to ensure that the insulation resistance between all live conductors (active and neutral) and earth or, as the case may be, all live parts and earth is adequate to ensure the integrity of the insulation. This is to prevent—

(a) electric shock from inadvertent contact; and

(b) fire hazards from short-circuits; and

(c) equipment damage.

The integrity of the insulation is stressed by applying a direct current at 500 V. Where surge protective devices (SPDs) or other equipment are likely to influence the verification test or be damaged, such equipment shall be disconnected before carrying out the insulation resistance test.

Where it is not reasonably practicable to disconnect such equipment (e.g. in case of fixed socket-outlets incorporating an SPD), the test voltage for the particular circuit may be reduced to 250 V d.c. The insulation resistance must be not less than 1 MΩ.

Note: It is envisaged that on construction sites that there would be no valid reason why it is not reasonably practicable to disconnect surge protection and/or RCD protection from the installation so that the test voltage would be 500V with an insulation resistance not less than 1MΩ.

The insulation resistance tester used shall be able to maintain its terminal voltage when measuring a resistance of 1 MΩ on the 500 V range or 10 MΩ on the 1000 V range.

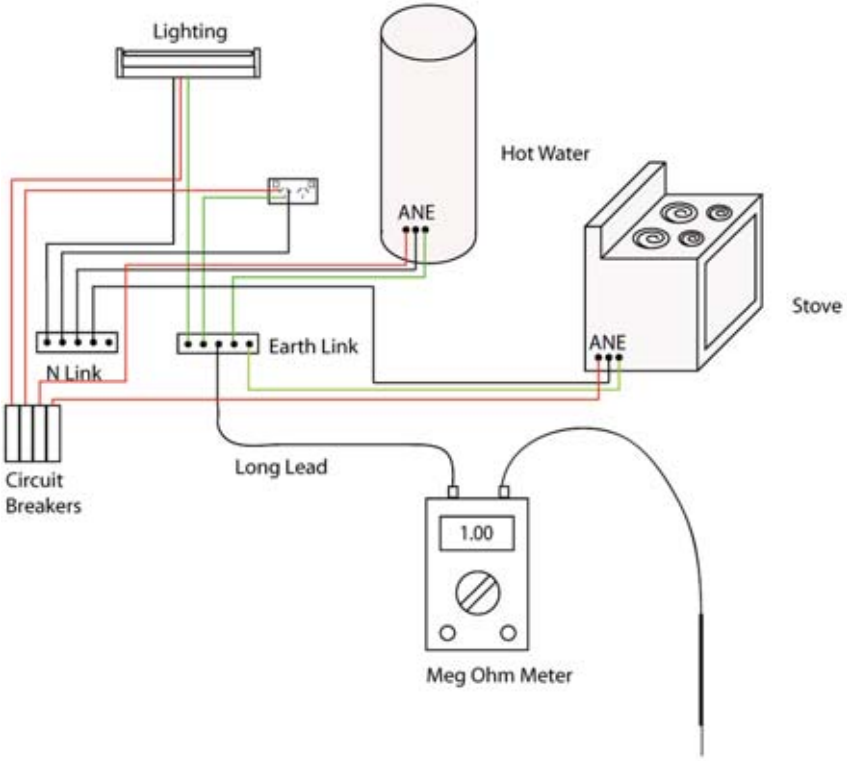
NOTE: Care may be required with the application of the insulation resistance test to electronic equipment and surge protective devices to prevent damage to the devices.

The insulation resistance between live and earthed parts of an electrical installation or parts is to be not less than 1 MΩ.

The value of 1 MΩ may be obtained with appliances disconnected.

The value of 1 MΩ may be reduced to 0.01 MΩ for sheathed heating elements of appliances.

Insulation Resistance Test



Testing Sequence

1. Ensure that supply is not connected
2. Connect meter test lead to earth link
3. Disconnect the active and corresponding neutral from the circuit breaker and neutral link
4. Connect the neutral and active conductors together
5. Where necessary disconnect the appliance
6. Test the A/N with Meg Ohm meter
7. Reading to be not less than 1 Meg Ohm (sheathed heating elements can be not less than 0.01 Meg Ohm).

Note: if the circuit contains electronic dimmers ensure that you follow the manufacturers specifications for testing of the installation.

Polarity

Polarity testing is to prevent —

(a) the transposition of active and neutral conductors of the consumers mains or sub mains, with an MEN connection at an outbuilding, resulting in the electrical installation earthing system becoming energized; and
(b) combinations of incorrect active, neutral and earthing conductor connections resulting in the exposed conductive parts of the electrical installation becoming energized; and
(c) the connection of switches or protective devices in neutral conductors, resulting in parts of appliances, such as heating elements and lamp holders, remaining energised when the switches are in the 'OFF' position.

Testing will ensure that all active, neutral and protective earthing conductors in the electrical installation are correctly connected to the corresponding terminals of electrical equipment.

Correct circuit connections

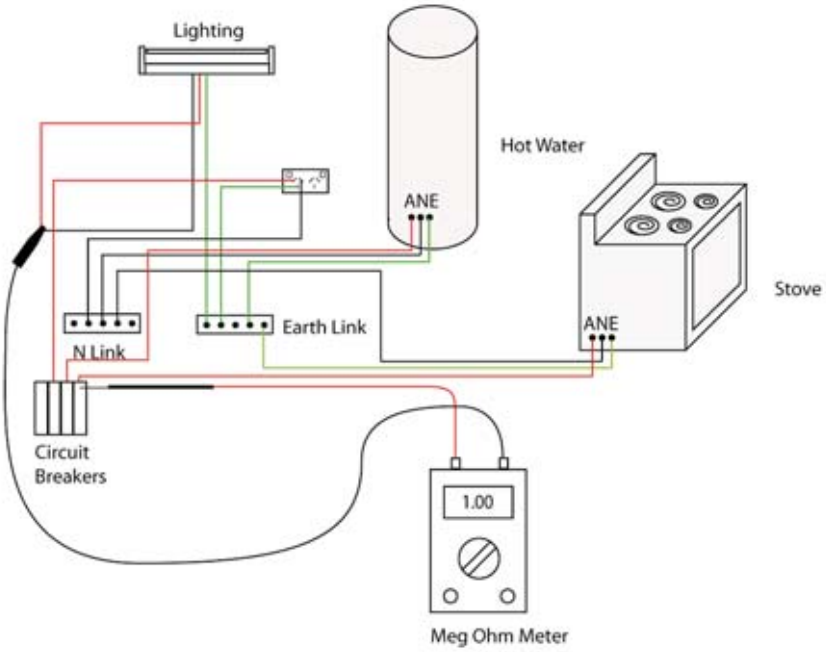
Tests for correct circuit connections are necessary to ensure the following:

(a) Protective earthing conductors do not normally carry current.
(b) No short circuit exists, because a short-circuit current flowing between live conductors and through part of the earthing system can cause considerable fire damage or personal injury, particularly in high current locations.

Testing will ensure that the active, neutral and protective earthing conductors of each circuit are correctly connected.

Note Testing must ensure that no ring circuits exist. See the following page for test procedure.

Ring Circuits



Test procedure

1. Ensure that supply is not connected
2. Disconnect and join the active and corresponding neutral conductors
3. Using a MegOhm meter with test voltage set on 500v, connect one lead to the active/neutral junction, and the other lead to each circuit active and neutral in turn and test.

No interconnections should be found.

Operation of residual current devices (RCDs)

The function of the RCD shall be verified by the operation of the integral test device, and by the use of special test equipment. Testing of the RCD shall be performed using a trip in time, an RCD tester can be used for this purpose.

Tests shall be performed on each final subcircuit protected by an RCD to verify that the RCD operates to disconnect the designated circuit.

Testing of RCDs is performed to ensure that the RCD operates and that the RCD disconnects the supply.

The RCD test maximum tripping times are as follows:

TEST CURRENT	RCD TYPE			
	I	II and III	IV	
	TRIPPING TIME, mS			
	MAXIMUM		MINIMUM	MAXIMUM
NO TRIP				
TRIP	40	300	130	500
FAST TRIP	40	40	50	150

Results are required to be recorded on appropriate form. A typical recording form has been provided two pages on.

A typical example of an RCD tester

How to Use an RCD Tester

The three pin plug is connected to a socket output protected by the RCD. A typical example of an RCD tester is provided on the previous page.

Two selector switches are provided:

(A) RCD Rated Trip Current (mA)

(B) Test Current Level:

- **Half Rated (No Trip)**
- **Rated (Trip)**
- **5 x Rated (Fast Trip)**

A selector switch (C) may be provided for reverse phase relationship, to test **polarity sensitive RCD's.**

A digital display (D) indicates the trip time in **milliseconds.**

RCD Testing Procedure:

1. Connect the tester lead to a socket outlet protected by the RCD.
2. Set the Trip Current Selector to the rated trip current of the RCD.
3. Set the Test Current Selector
4. Set the RCD ON.
5. Press the TEST button of the tester and note the trip time in milliseconds.

This test to be carried out at 0^0 and 180^0 respectively with the Trip Current selector set to:

Half Rated Trip Current
Rated Trip Current
5 times Rated Trip Current

This means that a total of 6 tests are required for each RCD.

Monthly Test of Residual Current Devices (RCD's

Company Name: ……

Site/Project Name or Location: ……

Tested tripping time of RCD's (using RCD Tester)

(FAST TRIP FOR TYPE 1, 2 OR 3 MUST BE LESS THAN 40 MS)

RCD Type and Location	NominalTrip Current mA	Test Results to include both reverse phase relationship readings in Milliseconds (mS)						Action Taken for Unsatisfactory Results
		X1/2 No Trip Time		X1 Trip Time		X5 Fast Trip Time		
		0^0	180^0	0^0	180^0	0^0	180^0	
		ms	ms	ms	ms	ms	ms	

Name of Licence Holder Conducting Tests: ……..

Wiring Licence No: ……. Date: ……..

Signature: ……

Verification of impedance (Earth fault-loop impedance).

The path followed by fault current as the result of a low impedance occurring between the phase conductor and earthed metal is called the earth fault loop. Current is driven through the loop impedance by the supply voltage.

The fault loop impedance measurement tests not only the electrical installation but also that of the network asset. This means that it measures the impedance of the entire LV installation including that of the distribution network all the way back to the substation.

The impedance required for automatic disconnection of supply shall be verified by one of the measurement methods as detailed over page.

The earth fault-loop impedance of each circuit is measured in order to verify that the protective device will operate to disconnect an earth-fault current within the time and touch voltage requirements.

NOTES:
1 The earth fault-loop impedance test can only be made when the electrical installation has been energised.
2 If an RCD operates during the test, the test result is considered satisfactory.
3 Further information on the maximum earth fault-loop impedance is contained in AS/NZS 3000 Appendix B.

This requirement is deemed to be satisfied if when tested in the earth fault-loop impedance does not exceed the specified value.

TEST- Fault Loop Impedance (supply is connected)

NOTE: Earth continuity and resistance tests should be carried out on protective earthing conductors before measuring the earth fault-loop impedance.

Method of measurement

Supply is available.

The impedance required for disconnection should be measured using an instrument that has a facility for measuring and indicating low values of impedance.

The MEN link is to be left intact.

Measurements can be made as follows:

Obtain the fault-loop impedance of each sub circuit using a quality fault- loop impedance meter (refer to manufacturers instructions on how to use the device). Compare the measured fault-loop impedance value with the maximum value provided at Appendix B, Table B4.1 of the *Wiring Rules*.

Notes:
1 If the application of a fault-loop impedance test onto an RCD protected sub circuit results in the RCD operating, then:

- the earth resistance and continuity test requirements are considered to be satisfied; and
- the fault-loop impedance value need not be considered further.

2 If the value measured is GREATER than the allowable maximum, then the following steps must be performed:

- Check the MEN connection, active, neutral and earth conductor/equipment connections are all solidly made.
- Repeat the fault-loop impedance test.

If the fault-loop impedance values exceed the requirements of the Wiring Rules, then perform an earth continuity measurement and confirm results. Repeat the fault-loop impedance test.

If the fault-loop impedance values do not satisfy the requirements of Table B4.1 then you must contact the supply authority advising them of the discrepancy.

Remember that the measurement includes the impedance of the network asset as well.

PERIODIC VERIFICATION

Following initial verification of the installation, periodic verification is required on the construction sites in relation to not only the electrical installation but also portable tools and equipment used on site.

The Industry Standard requires that following initial verification, the electrical installation shall be retested at intervals of 6 months and that results of the inspection will be recorded.

Table 2 specifies intervals for inspection and testing. Test sheets and testing procedures are covered elsewhere in this document.

1	2	3	4	5	6	7
Environment	Relocatable construction premises, Class 1 (earthed conductive parts) and Class II (double insulated) electrical equipment		Residual current devices (RCDs)			
	Relocatable construction premises, fixed and transportable equipment and construction wiring including switchboards	Portable equipment	Pushbutton test (by user)		Operating time (RCD tester)	
			Portable	Non-portable fixed	Portable	Non-portable fixed
Construction and demolition sites	6 months	3 months	After connection to a socket or before connection of equipment, and at least once every day in use.	1 month	1 month	1 month

AS/NZS 3012 requires **Hired equipment** to be inspected and tested on a monthly basis.

EMERGENCY EVACUATION LIGHTING INSPECTION & MAINTENANCE

The periodic inspection and maintenance procedures which are necessary to ensure that that emergency evacuation lighting systems are in a state of readiness for operation at all times is set out in AS/NZS2293.2:1995. It applies to central and single-point emergency lighting systems, as defined in AS/NZS2293.1.

Maintenance records

A logbook in a durable hard-bound cover, or an alternative system approved by the regulatory authority, shall be provided for the recording of maintenance information.
The following details shall be entered:

(a) All details which are required to be logged in accordance with Section 2 or Section 3, as appropriate.

(b) Any corrective action taken.

(c) The names of persons responsible for carrying out the maintenance work and the date the work was completed.

The logbook or alternative records system shall be kept on the premises at all times, or at such other location as may be approved by the regulatory authority.

Emergency evacuation battery back-up lighting (which includes internally illuminated signs) shall be inspected at intervals of:

- 6 monthly intervals – operate for a minimum of 90 minutes at not less than 20lux
- 12 month intervals – same as 6 months plus lamps are to be cleaned.

LIGHTING

AS/NZS 3012 specifies requirements in relation to control and protection of lighting circuits, including the provision, when required, for emergency evacuation lighting.

Light fittings connected on construction sites are required to be supplied from:

- A final subcircuit of construction wiring, provided with overcurrent protection and additional RCD protection; or
- permanent wiring, provided with additional RCD; or
- a stand alone power source.

It is recommended that lighting circuits be provided with their own RCDs to avoid cumulative leakage from power circuits causing unwanted tripping. This would also prevent nuisance tripping causing the general access lighting to turn off and the emergency evacuation lighting to function.

Given the type of work activity on a construction site and the generally fragile nature of lighting fittings, there is an increased likelihood of accidental damage. It is essential that luminaries be adequately guarded to protect them from such damage. Light fittings are required to be provided with guards made from impact resistant material eg wire cages, poly carbonate material.

Attention is drawn to the AS/NZS 2293 series of Standards which set out requirements for the lighting necessary to alleviate panic and to permit safe evacuation of the building occupants should this be required in the event of loss of the normal lighting.

WORKSITE LIGHTING CONSIDERATIONS

Where there is inadequate natural light, artificial lighting in work areas should be sufficient to allow the work to be performed safely. Individual, or task lights, may be used to improve the intensity of light in these areas if the natural or artificial lighting is insufficient.

Where work or amenities areas do not have natural daylight, sufficient battery powered evacuation lighting should be installed to allow safe exit from those areas in the event of emergency. The battery powered emergency lights should operate automatically during a loss of power supply to the normal lighting in the area and be designed to operate for a minimum of one hour following loss of supply.

Festoon lighting is restricted to underground use and then only with certain requirements.

ACCESS LIGHTING

As mentioned above, where there is inadequate natural light, artificial lighting in work areas should be sufficient to allow the work to be performed safely. This includes access and egress from work areas. Emergency evacuation lighting is installed to provide sufficient lighting during an emergency, access lighting is required for access to all work locations.

Task specific lighting is required where the task requires a higher intensity of light for the worker to be able to perform the task in a safe manner. Task lighting can therefore be plug-in where access lighting must be wired so that if this lighting should fail then the emergency lighting will turn on. This will ensure that access lighting is less likely to be tampered with or removed as the workers move to other areas.

Australian Standard AS/NZS 1680.2.4 requires that the maintenance illumination level required in walkways and access areas be **not less than 40 lux**. A higher illuminance on relevant surfaces may be required depending on the degree of hazard.

The definition of maintained illuminance is:

> *The defined level below which the average illuminance on any surface is not allowed to fall. It is the minimum illuminance at which maintenance operations, such as replacing lamps and cleaning the luminaires, windows, rooflights and room surfaces are to be carried out.*

Measurement of luminance

This information is provided to give clarity about the process of measurement, it is not expected that the electrical worker will be required to undertake the measurement. It should be left to a competent person with the appropriately calibrated equipment to undertake this assessment.

Measurement of the illuminance obtained with an electric lighting system should either be made after dark, or with daylight excluded from the interior. For new lighting systems and existing systems where group lamp replacement has been made, the lamps should be aged by operation for at least 100 h for discharge lamps (including fluorescent lamps) and 20 h for incandescent lamps.

Measurements of illuminance shall be made in a horizontal plane at floor level for a grid of points uniformly distributed within the interior. The interval between the measurement points, in longitudinal and transverse directions, shall be as near to equal as is practicable, but shall be not more than 1 m. The selected measurement grid shall differ from the luminaire spacing, in all directions.

NOTE: The objective is to avoid the coincidence of measuring points with luminaire locations.

Where illuminance measurements are made to verify values resulting from design calculations, the grid points used shall be those adopted in the design.

Irrespective of the measurement grid adopted, the first row of measurement points shall be as close as practicable to, but not less than 0.5 m from, the wall. However, for narrow corridors or the like, less than or equal to 1.5 m in width, illuminance measurements shall be made for a single row of points down the centre-line of the space.

For spaces having a floor area of less than 4 m^2, a single illuminance reading may be taken as near as practicable to the centre of the area.

For large areas of buildings where the design is of a consistent or repetitive basis, measurements need not be conducted for the entire space, provided that a representative area, comprising at least 20% of the total, is measured.

EMERGENCY EVACUATION LIGHTING

Emergency evacuation lighting, when required, shall be sufficient to allow safe egress from the site. Emergency evacuation lighting must either be on the same circuit as access lighting or such other means to ensure that where there is a loss of supply to the access lighting then the emergency lights will function.

As a minimum requirement, sufficient battery-powered lighting shall be installed in stairways and passageways and adjacent to switchboards to allow safe access to and egress from the area if there is insufficient natural lighting. Battery powered lighting shall have sufficient capacity to operate for 90 minutes if there is a loss of supply to the normal lighting in the area.

Although the Industry Standard and the Code of Practice refer to a time period of 1 hour, AS/NZS 2293.1 refers to a period of 90 minutes being the in-service test requirements. AS/NZS 2293.1 is called up in the Building Code of Australia as being a mandatory document, which then takes precedence over both the Industry Standard and the Code of Practice. **The minimum illumination level should be not less than 20 lux.**

Emergency evacuation lighting in the stairwell must be installed in such a manner that each flight of stairs, including the associated landings, receives direct light. This means that the emergency evacuation fitting will be located directly over the landing in the stairwell where the stairwell is entered from the floor.

Guidance on appropriate spacings for luminaries can be found in AS/NZS 2293.1.

EXIT SIGNS

Externally illuminated exit signs have been found to be more affected by smoke than other types of exit sign. Externally illuminated exit signs can only

be used in areas that are provided with appropriate means for automatically exhausting or excluding smoke. This means that their use on construction sites is therefore severely restricted. **This means that exit signs are required to be internally illuminated.**

Internally illuminated exit signs shall not be positioned any more than one metre directly above an exit, or any more than two metres directly in front of the exit.

Directional arrows on internally illuminated exit signs are required to be positioned in hallways to clearly indicate the direction to the emergency exit. This requirement need not apply where the hallways lead to emergency exits and do not branch off to other areas where they lead to a dead end.

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

Task Lighting

Australian Standard AS 1680, Lighting and Visual Environment, provides valuable information for workplace lighting and should be considered when lighting workstations.

Lighting levels where people work should be sufficient to allow the work to be performed safely and without straining to see. Individual, or task lights, improve the intensity of light in these areas and is excess to that of access lighting.

The lighting provided should improve the visual environment and be free from glare including reflective glare, flicker and stroboscopic effect which would distract attention from the task area.

The values of maintenance illuminance represent the lowest value of the average illuminance over the task area or throughout the interior, which should apply at any time during the life of the lighting system. The task area should be taken as that area within the space where the required tasks may be performed. The physical boundaries of the task area will vary depending on the shape of the space, the nature of the task, and the layout and type of equipment required to perform the task.

On building construction sites (interior) the maintenance illuminance measured in lux for task lighting which is usually provided by portable luminaries is not less than 160 lux. The illuminance should be provided on the plane of the task over the whole working area. Illuminance may be reduced if the task requires little perception of detail or is carried out for a short period. Additional local lighting or higher levels of general lighting may be needed for more difficult visual tasks.

Glare Hazard of Lamps

Of significant concern is the selection of lighting systems not only installed in the workplace but also used as task lighting. Many of the lights selected are inappropriate for the task and the environment in which we work.

Not only is there sometimes an issue in relation to the generation of heat which can burn a worker and damage wiring but also the intensity of the light which causes glare and can potentially damage a persons eyesight given certain circumstances. Task lights should be of adequate strength to do the work required but also need to take into account the OHS concerns.

LED lights have a place in construction and may perform a better function than halogen lights. Issues relating to glare may still have to be considered.

Glare—the discomfort or impairment of vision experienced when parts of the field of view (e.g. lamps, luminaires) are excessively bright in relation to the general surroundings.

> *NOTE: The degrees of discomfort or impairment of vision that can be anticipated in any given situation may be described or measured respectively as 'discomfort glare' and 'disability glare'.*

Halogen lamps are often used mounted on stands to provide local task lighting. Care must be taken in the positioning of such lamps to avoid hazardous glare or dazzle which can result in other workers being placed at risk through momentary loss of vision.

Such lamps should be shielded where necessary to avoid dazzling other workers or persons passing the workplace. In particular, if the surrounding area is relatively dull in ambient light terms, the reaction of the eye to the bright light may result in brief loss of effective vision once the brightly lit area is passed.

More serious is the effect of sudden exposure to very bright light – such as halogen lamps – at close range. 'Red eye' form of optic irritation caused by the rupture of small blood vessels in the eye, can result from such sudden exposure.

This constitutes a risk that must be addressed under Occupational Health and Safety requirements.

Further, Clause 2.7.7 of AS/NZS 3012 requires:

2.7.7 Portable luminaries

Portable luminaries shall be provided with the following:

(a) A minimum degree of protection IP2X in accordance with AS 1939
(b) A mechanical guard for the lamp
(c) Adequate stability

Restricted Installation of Suspended Luminaries

AS/NZS 3000 Clause 4.3.6.3 reads in part and requires;

> ***4.3.6.3***
> ***Lamps and Luminaries near Thermal Insulating Material***
>
> ***Thermal Insulating material shall not prevent free air flow around or through luminaries and their associated ancillary gear, and shall be separated by not less than –***
> ***(a) 25mm from low voltage lamps or luminaries; or***
> ***(b) 50mm from extra low voltage dichroic lamps or luminaries or associated transformers.***
>
> ***Thermal insulating material shall be separated by not less than 25 mm from any lamp or luminare…….***

Clause 4.3.6.1 of AS/NZS 3000 requires:

> ***4.3.6.1***
> ***luminaries and their associated ancillary gear shall be so installed as not to cause undue temperature rise, deterioration or ignition of the materials on which they are mounted.***

In relation to suspending luminaries AS 3000 1991 Clause 4.10 requires in part:

> ***4.10***
> ***Suspended Lamp Holders and Luminaries***
>
> ***A lamp holder or luminaire, suspended other than by means of a rigid pendent, shall be connected by means of a flexible cord or flexible cable.***

Therefore, all suspended luminaries must be connected by a flexible cable with the exception of a fixed pendent.

SUSPENDED SCAFFOLD

The following information is taken from Worksafe's *"What you need to know about Suspended Scaffolds February 2004".*

WHAT IS A SUSPENDED SCAFFOLD?

A suspended scaffold is defined in the Victorian ***Occupational Health & Safety (Plant) Regulations 1995*** as:

> *"… a scaffold incorporating a suspended platform which is capable of being raised or lowered when in use."*

Common types of suspended scaffolds likely to be encountered in the construction industry include:

- **Swing stages** which have cradles supported by a single row of suspension ropes.
- **Double-rope** scaffolds, with cradles supported by two rows of suspension ropes.
- **Work cages** which are small cradles supported by one suspension rope only.
- **Boatswain's chairs** where the platform is a seat for one person.
- **False cars** are specialised forms of suspended scaffolding, which are often used in the construction of lifts. Additional requirements for false cares are covered in Part 8 of this document.

WorkSafe's *Code of Practice for Plant*[4] provides recommendations on how those with obligations under the ***OHS (Plant) Regulations*** can comply with those Regulations.

In particular, the *Code of Practice for Plant* incorporates the following Australian Standards that deal with suspended scaffolding:

- AS 1418.2, *Cranes (Including Hoists and Winches)*, Part 2: *Serial Hoists and Winches*,
- AS/NZS 1576.1, *Scaffolding,* Part 1: *General Requirements*,
- AS 1576.4, *Scaffolding*, Part 4: *Suspended Scaffolding*,
- AS/NZS 4576, *Guidelines for Scaffolding*, and
- AS/NZS 4431, *Guidelines for Safe Working on New Lift Installations in New Constructions* (for false cars).

Other Australian Standards that are to be required to be followed include AS/NZS 3000 - "Wiring Rules" and AS/NZS 3012 – Electrical installations construction and demolition sites.

WorkSafe recommends that suppliers seeking to comply with these obligations should obtain and keep written confirmation that:

- The suspended scaffolding system has been designed in accordance with AS/NZS 1576.1 and AS 1576.4,
- Couplers supplied for use with suspended scaffolding have been designed, tested and marked in accordance with AS 1576.2, and
- Scaffolding hoists have been designed, manufactured and tested in accordance with AS 1418.2.

In particular, WorkSafe advises suppliers of the following:

1.1 The design of the powered scaffolding hoists being supplied must have been notified to WorkSafe Victoria or an equivalent interstate workplace safety authority.

1.2 All scaffolding hoists and secondary protective devices should have legible data plates bearing the following information:
• Type model identification
• Serial number
• Details of steel wire rope used with the hoist – nominal size, grade (quality), construction, and maximum length (where applicable)
• Classification of mechanism of the hoist
• Rated capacity hoisting
• Name or identification mark of the manufacturer of the hoist
• Reeving requirements, where applicable
• Power supply requirements, where applicable.

1.3 The Residual Current Device (RCD) for the cradle, should have a legible data label bearing the following information:
• Rating load in Amps
• Residual tripping current (not exceeding 30 mA)
• Power supply in Volts.

1.4 All hoisting controls must be labelled and, unless the function is obvious, the operational functions displayed. Labels should include:
• Operation instructions
• Emergency stop switch
• Up and down control.

1.5 The control box should be compatible with the operation of the specific type and model of hoist and, if multiple hoists are used, each hoist should have the same operating specifications.

1.6 The control box should be removable, unless an alternative method is used to isolate power to the cradle, for safety and security when the suspended scaffold is not in service.

1.7 Before each site delivery, each scaffolding hoist, each secondary protective device and each load-limiting device should have been inspected and subjected to an operational test in accordance with the recommendations given in AS/NZS 4576.
• Undergo inspection and testing
• If an electrically powered scaffolding hoist, be fitted with a load-limiting device that will prevent the hoist from lifting more than 125% of its rated load
• If a secondary protective device, be capable of preventing the cradle from falling due to a failure within the hoist.

1.8 Between hiring's of scaffolding equipment the supplier must ensure that all scaffolding components are inspected and maintained.

1.9 The supplier of the suspended scaffold must provide, for the users of the equipment, written operating and safe use instructions and the daily safety checklists.

NOTE: Adjusting the electrical overload is to be performed by a licensed electrician.

Part 2: Scaffold Vicinity

The scaffold designers, erectors and operators need to take into consideration the areas around the suspended scaffold during design, erection and operation. The following particular areas of concern should be considered and addressed prior to work commencing on the erection or operation of the scaffold.

2.1 Where the scaffold is erected adjacent or over public space or adjoining property, there may be the need to provide specific controls (e.g. hoardings, catch platforms, barricades, etc.)

2.2 Where the possibility exists for other workers to enter the area below the suspended scaffold, specific controls may need to be provided (e.g. catch platforms, barricades, signs, etc).

2.3 Power-lines are a major hazard and no part of the suspended scaffold including suspension and secondary ropes, which should be anchor, shall be closer than 4.6m to any power-line. Refer to the Office of the Chief Electrical Inspector's **NO-GO-ZONE** rules for erecting scaffolding near overhead powerlines for more detailed information.

Part 3: Installation Design

The scaffold designer needs to ensure that any scaffolding configuration which they design, modify or allow to be modified is suitable for the location and the intended use of the equipment. The designer of the scaffold should consider the following to ensure that during erection and when properly used it is not unsafe and a risk to health.

3.1 The building or structure to which the suspended scaffold is to be mounted must be capable of supporting the scaffold and all intended loads (dead, live and environmental loads). The supporting structure needs to be assessed by a competent person and a statement of assessment provided.

***Note:-This statement may be included in the design plan.**

3.5 To operate correctly an adequate power supply must be available for electrically powered hoists, the Victorian Electricity Safety Legislation prohibits voltage drop that exceed 5% of the nominal supply voltage unless an electrical installation is specifically designed to operate under reduced voltage conditions.

- This requirement is for the entire installation, the flexible cord/cable for the suspended scaffold is only part of this 5%.
- Additional information on the electrical requirements is provided in Part 5.

ETU Note: An agreed position has been reached with industry stakeholders in relation to proportional voltage drop. A voltage drop of 2% is permitted to the switchboard with the final 3% allocated to the length of flexible cord/cable down to the motor. Generally single phase motors with long runs will exceed the 3% permissible drop unless a large diameter cable is allocated. A 3 phase motor is a better alternative.

Part 4: Scaffold Erection

The scaffold erector needs to ensure that nothing in the way which the suspended scaffold is erected is unsafe or a risk to the health of the scaffolder(s) or others and when installed and properly used is not unsafe or a risk to health of the operators or others.

4.1 The person carrying out or directly supervising of erection or modification work on any suspended scaffold must have either Advanced Certificate in Scaffolding or Rigging.

4.2 The person supervising the work must have a copy of the design plan, which specifies the rigging requirements including the number, size and positioning of the counterweights, prior to the erection or modification of the suspended scaffold.

4.3 Ensure that fall protection is in position at the building edge or the scaffolders are using safety harnesses with adequate anchorage points if working near an exposed edge.

4.4 To prevent injury to workers the area around the support rig should be restricted to only those workers engaged in assembling the scaffold.

4.5 To prevent injury to persons, from dropped cables, rigging components or tools, a sufficiently large area below the scaffold should be barricaded off to prevent access.

4.6 During erection, where there is no physical barrier at edge to prevent objects falling off the supporting structure or when work is occurring over the edge, a safety observer should be positioned, if necessary, to prevent people accessing the barricaded area below the scaffold.

4.7 Any counterweight should be manufactured for that purpose, labelled with its mass in Kg, be placed directly on the needle or innermost support in the designed location, and secured in such a manner so as not to be displaced or removed with out the use of a tool.

4.8 When used, traversing tracks should be fitted with through-bolted stops at the ends, to prevent any trolley from running off and each trolley must have a rated working load of a least 500 Kg.

4.9 The outboard end of a needle should never be lower than the inboard end.

4.10 The suspension rig must form a structure that is rigid and stable under working conditions.

4.11 Only the wire rope recommended by the manufacturer for the hoist shall be used, details of the wire rope construction can be located on the hoist data plate. The use of the wrong construction of wire rope in a scaffold hoist has result in sudden failure, with the rope severing in the hoist.

4.12 A secondary protective device shall be provided for each scaffolding hoist, to operate on the suspension wire rope above the hoist or on a secondary wire rope. This device provides an emergency brake to hold the cradle if the hoist or wire rope within the hoist fails, some types may also prevent an over-speed decent.

4.13 It is essential that the secondary protective device's internal mechanism is adjusted for the size of wire rope fitted, as some devices are capable of using different sizes of wire rope.

4.14 If used, the secondary wire rope for any scaffolding hoist should be attached to the suspension rigging, at a point that is independent of the main suspension rope attachment.

4.15 All cradle components should be inspected, on site, prior to assembly and checked to ensure all locating pins and clips are fitted and in position.

4.16 A sign, clearly displaying the safe working load limit, in kilograms, should be fixed to the inside of each cradle.

4.17 The cradle should have guardrails, midrails and toe boards fitted, the working deck needs to be fixed, of a non-slip type and with adequate drainage holes. None of these components should have visible signs of mechanical damage (cracked or split welds, missing or broken decking, cut or bent guardrails, etc).

4.18 The finished suspended scaffold must conform to the design plan. Alterations due to installation conditions must be included on an amended plan. The designer or another competent person must review these variations and approve the modified plan before the scaffold is first used.

4.19 A competent person or the certificate holder responsible for erecting or altering the scaffold should supply a written statement that the scaffold is complete and safe for use before the scaffold is used for the first time and after every alteration.

Part 5: Electrical Installation

It is essential for safe operation of the suspended scaffold hoists and electrical protection devices to have an adequate power supply. The principal, electrical and scaffolding contractors should co-ordinate on the planning of the electrical installation to ensure appropriate voltage levels are provided.

5.1. This may include the positioning the power-board close to the scaffold, dedicated power circuits, larger sub-mains, alternative methods of positioning the power-board, etc.

5.2 To limit voltage drop the suspended flexible cord should:
- Not be of excessive length, or
- If extra length is required, have larger size conductors to compensate.

***Note:- An electrician or electrical inspector can provide guidance in this matter.**

5.3 The power supply for the suspended scaffold may need to be close to the scaffold, to limit the length of the flexible cord needed to descend to the platform; this will assist in limiting voltage drop.

5.4 The construction power-board should be designed so the removal of the suspension flexible cord from the socket-outlet requires a person to complete a deliberate act.

5.5 The suspended flexible cord should be supported in a manner that protects the cable from mechanical damage and prevents the cable

from bending at a radius less than the manufacturer's minimum. If manufacturer's information is not available, AS/NZS3000 gives the minimum internal radius as 6 times the cable diameter.

5.6 Any suspended flexible cord shall be the heavy-duty double insulated type and be able to support its own weight over the length of the drop.

5.7 The flexible cord must be supported in such a manner as to prevent the cradle from fouling or causing mechanical damage to the cable. The cable should be installed so that it is not pulled across the structure of the cradle.

5.8 The flexible cord must be long enough to allow the cradle to descend to the ground or a lower structure, for egress, in an emergency.

5.9 When in use the control box should be attached to the guardrail of the cradle on the side away from the working face.

5.10 The electrical cables installed in the cradle should not be excessive in length, to prevent mechanical damage occurring to the cables and to limit voltage drop.

5.11 Electrical cables from the control box to the hoists should be enclosed for protection from mechanical damage and securely attached to cradle. Additional mechanical protection may be required and is dependent on the work undertaken (e.g. demolition, grinding, abrasive blasting, etc).

5.12 There should be a system that allows the suspended scaffold to be effectively isolated from the power supply when not in use, to prevent unauthorized operation; this may be located within a locked power-board or by the use of a readily removable control panel on the cradle.

Part 6: Scaffold Operation

The employer of persons working in the suspended scaffold, prior to operating the equipment, should have procedures and safe systems of work in place to ensure that the equipment is not unsafe when properly used and persons are not exposed to risks to health.

6.1 A written statement that the scaffold is complete and safe for use must be supplied by a competent person or the certificate holder responsible for erecting or altering the scaffold, prior to operating the scaffold.

6.10 Where access and egress is not from the ground or a protected landing, safety harnesses and lanyards shall be provided and used when entering or leaving the cradle. During this procedure, safety harnesses shall be attached to suitable anchorage points on the main structure. The cradle should also be effectively secured to prevent movement.

Part 8: False Cars

The suppliers, erectors and operators of false cars, used in lift installation, should comply with the following specific requirements for false cars in addition to the relevant general sections of this document.

8.1 Written rescue and recovery procedures for a person supported by a safety harness must be in place, prior to installation. These procedures should be available onsite, distributed to all relevant persons and made available to all emergency services.

8.2 Unless the employer is granted an exemption, workers carrying out this work must hold or be directly supervising by a holder of an Advanced Certificate in Scaffolding or Rigging.

8.3 Lift shafts should have adequately light, guidance for lift shaft lighting is given in Part 6.3 & 6.4 of the Industry Standard for Electrical Installations on Construction Sites.

8.4 Emergency lighting shall be provided, for a minimum of one hour, to allow safe egress from the lift shaft upon loss of normal lighting.

8.5 Guidance for false-car wiring is given in Part 6.6 of the Industry Standard for Electrical Installations on Construction Sites.

8.6 The installer or other qualified person shall inspect and test the installation before the car is used for the first time. This procedure should be based on the requirements of AS/NZS 4431 Appendix B and include the false car, the hoisting system and safety gear.

8.7 Daily the operator should inspect the false car, the suspension systems and complete the manufacturer's checklist, prior to use.

8.8 The following should be tested to the manufacturer's specifications at 3 monthly intervals, the hoisting winch and the instantaneous safety devices.

8.9 Ever six months after commissioning the safety gear should be tested the details of these tests procedures are outline in Appendix B of AS/NZS 4431.

8.10 A written record of all maintenance, inspections and repairs should be signed by the individual(s) carrying out the procedures and kept on site for the life of the installation work.

8.11 An operational inspection and safety procedure should be attached to the platform.

8.12 A notice stating the safe working load in Kg should be prominently displayed on the platform.

8.13 All ropes should be protected against damage for least 2m above the floor of the platform such protection should be removable for inspection.

8.14 The platform should be fitted with edge protection, where the gap between the edge of the platform and the face of the wall exceeds 225 mm. Edge protection should include:

- Guardrail between 900 mm and 1100mm
- Toeboard at least 150 mm high
- Midrail approximately half way between the guardrail and toeboard
- Vertical bars with a gap of no more than 450 mm fitted between midrail and toeboard

Where the possibility exists of persons accessing the area beneath the platform while work activities are being undertaken, the platform should be fitted with toeboards.

SAFETY CHECKLIST FOR SUSPENDED SCAFFOLDS				
Ref.	**SCAFFOLD ERECTOR'S**	**Tick**		
Part	**SCAFFOLD ERECTION AND INSTALLATION**	**yes**	**n/a**	**no**
	ELECTRICAL INSTALLATION			
5:1	Has an adequate power supply been provided for the suspended scaffold?			
5:2	Has the voltage drop requirements for suspended flexible cable been taken into consideration?			
5:3	Is the construction power-board situated near the support rigging of the suspended scaffold?			
5:4	Can the suspended flexible cable be accidentally removed from power-board?			
5:5	Has the suspended flexible cable been correctly secured to the support rigging and the cradle?			
5:6	Is the suspended flexible cord the correct type?			
5:7	Has the suspended cable adequate running clearance?			
5:8	Is the suspended cable of sufficient length?			
5:9	Is the control box attached to the outside guardrail?			
5:10	Are the electrical cables from the control box to each hoist, correctly installed?			
5:11	Are the cables from the control box to each hoist adequately protected from mechanical damage?			
	HANDOVER OF SCAFFOLDS			
4:18	Has the completed or altered scaffold been inspected before being used for the first time?			
4:19	Has a written statement of completion been supplied?			
4:19	Has the user of the scaffold been supplied with all safe use information?			

GENERATORS

This section provides information in relation to the set up, inspection and testing of generating sets. Generating sets can also incorporate welding circuits as part of their configuration.

Generating sets can be either those that provide supply to tools and equipment or those that provide supply to a fixed electrical installation, or a combination of both.

There are various Australian Standards that provide information in relation to the set up, inspection and testing of generating sets and associated equipment.

PORTABLE GENERATORS TO THE PRINCIPLES OF AS 2790

AS/NZS 3012 requires portable generators driven by internal combustion engines to comply with the principles of AS 2790 – electricity generating sets – transportable (up to 25 kW) where the generator only provides supply to tools and equipment.

Where the generator provides supply to a fixed installation it will be in accordance with AS/NZS 3010 (Electrical installations – generating sets)(covered later).

In Victoria, the Industry Standard for Electrical Installations on Construction Sites requires that socket outlets mounted on generators are to be protected by an Residual Current Device (RCD) with a maximum rated tripping current not exceeding 30mA

Earth and bonding connections

The Industry Standard requires where 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 electrode if there is no internal link (equipotential bond) between the neutral output and the metallic frame of the generator and the earth pin on the socket outlet .

Equipotential Bond

Equipotential, means equal potential at all points. In relation to the generator the following parts shall be in effective electrical contact with each other:

(A) The engine frame.

(B) The generator frame.

(C) All external metal enclosing electrical equipment or wiring.

(D) The 'earth' terminals of all outlet plug-sockets and any earth leakage device.

(E) The main frame terminal (marked ⏚ or 'FRAME').

(F) The main winding, *only* as specified in Clause 6.1.9 of AS 2790-1989

The 'earth' point of any electronic circuitry may need to be connected to the above items.

The diagram (Figure 1) below shows the equipotential connections.

AS 2790-1989 Clause 6.1.9 requires connections between main winding(s) and the frame shall be as follows:

(A) Single-phase winding (without earth-leakage protection). The winding shall not be connected to the frame.

(B) Single-phase winding connected to a current-operated (core balance) earth-leakage device complying with AS 3190. The input neutral terminal of the device shall be connected to the earth terminal of the device (where that terminal exists) or to a frame terminal (see Figure 1).

NOTE: *This should be the only connection between the winding and the frame.*

(C) Three-phase winding (star- connected). The star point shall be connected to the frame via a removable connection or link.

(D) Two-phase winding (or single-phase centre-tapped winding). The neutral or centre-tap shall be connected to the frame via a removable connection or link.

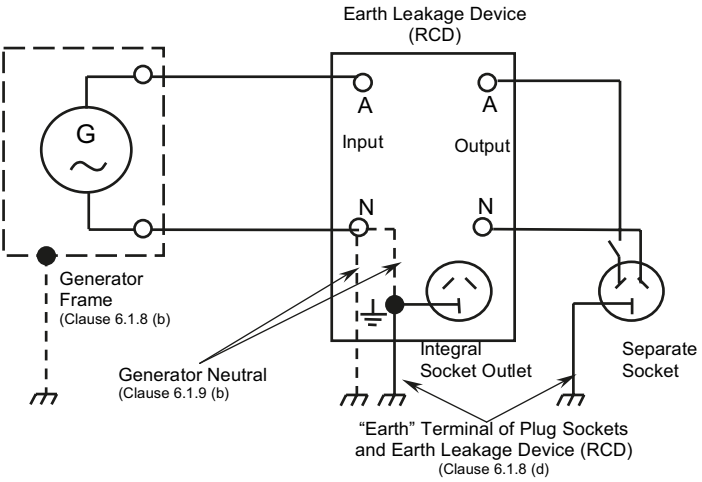


Figure 1 AS 2790

Information to Be Supplied.

As indicated before, 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.

The following information to be indelibly and legibly marked on a generating set:

(A) The name of the manufacturer of the set.

(B) The model number and serial number of the set.

(C) The type of fuel or fuel-oil mixture.

(D) Rated output in watts or kilowatts at a stated power factor.

(E) The voltage and frequency.

(F) Output terminal markings (unless all outputs are plug-sockets).

(G) The frame terminal: Symbol ⏚ or 'FRAME'.

(H) On a set intended for undercover or weather protected usage, the words 'NOT WEATHERPROOF'.

(I) On a set intended for outdoor use without further protection, the IP classification of its electrical equipment.

(J)A warning as follows:

THE OUTPUT OF THIS GENERATING SET IS POTENTIALLY LETHAL. THE SET SHOULD NOT BE CONNECTED TO A FIXED ELECTRICAL INSTALLATION EXCEPT BY AN APPROPRIATELY LICENSED PERSON.

In addition to the warning detailed in (J) above, the following warnings shall be either-

(A) marked on a generating set in accordance with Clause 9.1; or

(B) provided in documents supplied with a generating set.

The warnings need not be phrased as set out below but should convey the same sense:

(i) DO NOT OPERATE IN A HAZARDOUS LOCATION, e.g. WHERE THERE MAY BE A RISK OF EXPLOSION OF PETROL FUMES, LEAKING GAS OR EXPLOSIVE DUSTS.

(ii) DO NOT OPERATE IN A CONFINED AREA WHERE EXHAUST GASES, SMOKE OR FUMES COULD REACH DANGEROUS CONCENTRATIONS.

(iii) DO NOT REFUEL WHILE ENGINE IS RUNNING.

Additionally each generating set shall be supplied with a technical manual that provides comprehensive instructions concerning installation, operation and maintenance procedures.

A generating set shall be supplied with a technical manual that provides comprehensive instructions concerning installation, operation and maintenance procedures.

Design and Construction

Electrical components, accessories and wiring shall be protected against ingress of objects, dust and water insofar as such might occur in normal use. The enclosure of electrical equipment of a generating set shall have a minimum classification of IP22 in accordance with AS 1939 or, for the generator, with AS 1359.20.

The enclosure of electrical equipment of a generating set intended for outdoor use without further protection from the weather shall have a minimum classification of IP23.

Inspection and Testing

Not withstanding any additional requirements that may be required by the manufacturer, importer, supplier or hirer of the generator, the following testing regime applies to generators. Where the generator has additional facilities installed such as a welding circuit, additional tests will need to be performed – see Section on Welders.

Inspection and tests are required on:

- Equipotential (earthing) facilities
- Connections between windings and frame
- Ratings – see Information to be Supplied –previous page
- Warnings – see Information to be Supplied – previous page
- Instructions – a supplied manual is available

Where an RCD is used with, or connected to, a generator, the integrity of the connection between the generator windings and the equipotential bonding system on the generator (Refer to Figure 1) shall be tested using an RCD tester.

This test may be performed in conjunction with the test for operating time of an RCD used with a portable generator.

Where an isolated winding generator (double pole switch, no RCD) is used, the continuity of the connection from the frame to the equipotential bonding system shall be tested. (See Figure 2.2, AS/NZS 3012).

RCD's installed on portable generators are required to:

(A) be operated by means of their in-built test facility (push-button); and

(B) be subject to an imbalance of current not less than the rated residual current and shall trip in a time not exceeding that specified in AS 3190

All RCD's should be tested for tripping current and time by a licensed electrician each calendar month while being used on a construction site.

Testing of RCD's

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.

Periodic Inspection and Testing

The time frames specified for inspection and testing are required to be in accordance with periods specified in Australian Standards and from the manufacturer's specifications in relation to maintenance.

Australian Standard AS/NZS 3760 – In service inspection and testing of electrical equipment specifies some of the inspections, tests and time periods in relation to periodic inspection.

AS/NZS 3012 specifies some of the inspections, tests and time periods in relation to periodic inspection for tools and equipment used on construction sites.

Periodic Inspection Time Frames

Inspection/test	Construction	
	Hired	Not Hired
Equipotential bond	Monthly	Monthly
Connection winding to frame	Monthly	Monthly
Ratings	Monthly	3 Monthly
Warnings	Monthly	3 Monthly
Instructions	Monthly	3 Monthly

The inspections and tests required above shall be recorded. Tested RCD's shall be tagged and all test results should be recorded and kept on site or be available for audit.

ELECTRICAL INSTALLATIONS – GENERATING SETS TO AS/NZS 3010

AS/NZS 3010 applies to electricity generating sets that are driven by internal combustion engines, and which are used for the supply of electrical installations in buildings or items of electrical equipment.

Whilst this AS/NZS 3010 is primarily focused on co-generation installations, it also provides information on installations where the generator is the only electrical source.

In addition to complying with this Australian Standard, the generating set installation is required to comply with the requirements of the Electricity Safety Act and Electricity Safety (Installations) Regulations 1999.

Generating sets providing supply to a fixed electrical installation are defined as being prescribed work in the Regulations.

Regulation 406 includes wiring systems, switchgear, control gear and accessories installed to provide control and protection of standby generation or cogeneration electricity supply systems.

The fixed installation shall be:

- installed to the requirements of AS/NZS 3000 and AS/NZS 3010
- installed and inspected by a licensed electrical contractor and a certificate of electrical safety provided.
- inspected by a licensed electrical inspector prior to it being used for the first time, and after relocation.

Location

Generating sets shall not be operated in locations where exhaust gases, smoke or fumes could reach dangerous concentrations or enter either directly or indirectly any enclosed areas occupied by persons.

In addition, generating sets shall not be installed—

(a) in damp situations or exposed to the weather unless suitably protected; or

(b) in hazardous areas, unless the equipment and method of installation complies with AS/NZS 3000 and the additional requirements of Energy Safe Victoria. (Consideration of fuel storage may define the area as hazardous. See sections on fuel and fuel storage).

Generating sets installed to AS/NZS 3010 not only are required to be installed in a suitable location but also are required to be provided with suitable fences, screens etc to prevent the entrance of, or interference by unauthorised persons.

These barriers should not impede persons from performing maintenance, testing or inspection of the generator. As such adequate space is to be provided around the generating set to allow persons to perform this work.

Connection of generating set bonding system

Where a generating set supplies an electrical installation that incorporates an earthing system, the bonding system of the generating set shall be earthed by connection to the earthing system of the electrical installation.

Connection to earth shall not be made by means of a separate earth electrode.

The earthing system of a high voltage generating set shall be in accordance with the requirements of AS/NZS 3000 and, where applicable, any additional requirements of the Electricity Distributor.

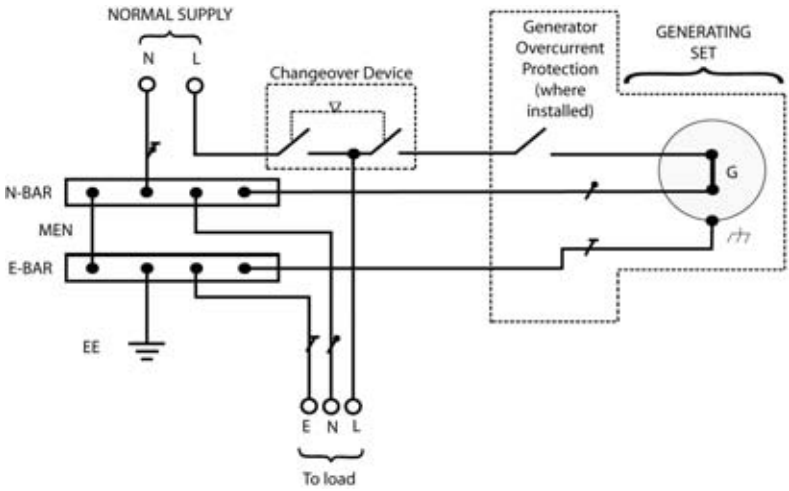
Connection of generating set windings

Where generating set supplies an electrical installation that incorporates an earthing system, the following points, as applicable, shall be connected to the relevant neutral conductor of the electrical installation and not be directly connected to the generating set bonding system:

(A) The generating set winding connections.

(B) One side of an otherwise unpolarized single-phase generating set winding.

Alternatively, the generating set winding referred to in items (A) and (B) above may be arranged through a protective system in a manner that ensures the disconnection of the electrical installation in the event of an earth fault.



One pole/one pole changeover arrangement for a single-phase generating set installed on a switchboard with a MEN link

STAND ALONE POWER SUPPLIES

Generators to the requirements of AS/NZS 3010 may also be utilised especially on construction sites as stand alone power supplies. In addition to the provisions of AS/NZS 3010 as mentioned previously, the provisions of AS 4509.1 and AS4509.3 would also apply.

Wiring and Circuit Protection

All Low Voltage wiring shall be installed and maintained by a licensed person and shall be in accordance with the requirements of the Electricity Safety Act, Electricity Safety (Installations) Regulations and the provisions of AS/NZS 3000.

One such provision of the Regulations relates to the recording of the underground route of electric lines. Regulation 404 requires:

> *A person who carries out electrical installation work on an underground electric line must, in accordance with this regulation, record in a permanent form on durable card or other durable material and fix within the meter box or in a position approved by the Office the route of that underground electric line.*

The following additional protective measures shall be taken:

(a) Within the system, wiring shall be protected from short circuit and overload by high rupturing capacity (HRC) fuses or appropriate type circuit-breakers (a.c. or d.c.), sized to limit the current below the maximum current-carrying capacity of any part of the connected circuit.

NOTE: Attention is drawn to the possibility of the battery providing high currents due to faults in renewable inputs or associated wiring.

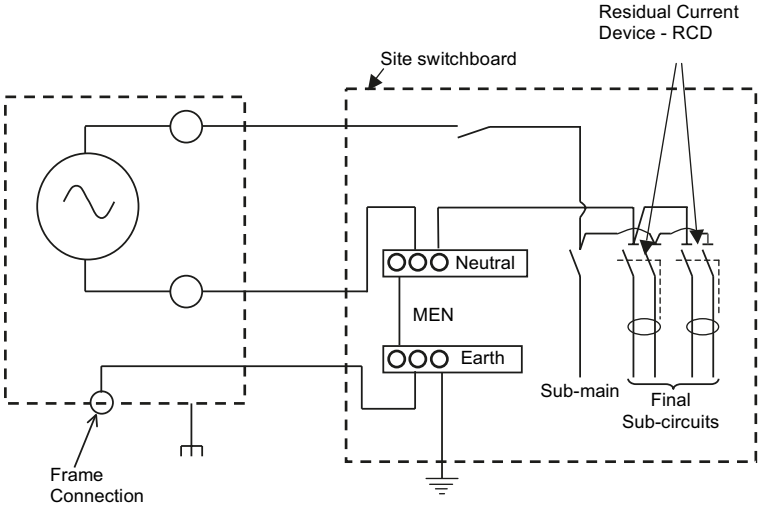
(b) Where the system is deemed to be lightning prone in accordance with AS 1768, lightning protection complying with that Standard shall be provided.

(c) On construction sites the provisions of AS/NZS 3012 would apply. This would include such things as the provisions of RCDs on final sub-circuits and the restriction of HRC fuses to supplying fixed appliances rated at 50A per phase or greater.

Where generators are supplying fixed switchboards, the RCD's may be mounted on the switchboard.

Earthing

The system shall be adequately earthed. LV equipment shall be earthed in accordance with AS/NZS 3000. Where practicable, all the earthing points, other than for lightning protection, should be electrically bonded together.



Low Voltage connection from stand alone single phase generator to site switchboard

Generating Sets

For generating sets, the following shall apply:

(a) All generating sets shall be restrained from movement during normal operation.

(b) Where a generating set is capable of automatic or remote manual starting, a warning notice shall be clearly visible on approach to, and located within 1 m of, the generating set, bearing the words—

DANGER: THIS EQUIPMENT STARTS AUTOMATICALLY

(c) The generator engine shall be provided with a device to prevent the starting of the generator set when inspection, repair or maintenance is carried out.

Fuel

Fuel storage shall comply with the requirements of AS 1940 and any other local requirements for the storage of fuel and leakage prevention.

Fuel tanks and filling facilities associated with flammable fuel shall not be installed—

(a) in the vicinity of high temperature surfaces or equipment that may emit arcs, sparks or hot particles; or

(b) in such a position that spilled or leaking fuel could fall on high temperature surfaces or equipment.

NOTE: This requirement is not intended to prohibit properly designed engine-generator sets with integral fuel tanks.

Fuel storage

Minor fuel storage shall be in accordance with Table 1. Local authorities might have additional requirements for the storage and prevention of leakage of large supplies of fuel and should be consulted.

Where the storage capacity is above that listed in Table 1 reference shall be made to AS 1940.

The class of liquid is defined in AS 1940. Petrol (both leaded and unleaded) and LPG are typically class Flammable PG1. Diesel fuel is typically class Combustible C1.

TABLE 1
MINOR STORAGE

litres

Location	Class of liquid	
	Flammable PGI	Combustible C1
Within a residential dwelling of any type	5	50
In a garage attached to a dwelling with a 60/60/60 FRL rating separation wall	25	100
Outdoors or in a shed or garage, separated from the dwelling or any other building by 1 m of space	100	500
Outdoors, uncovered, or in a shed or garage, separated from the dwelling or any other structure or boundary by either 3 m of space or a 180/180/180 FRL rating separation wall	250	500

NOTE: AS 1530.4 gives fire resistance level (FRL) rating of structures.

Information for Emergency Services

A sketch shall be prominently displayed in, or immediately adjacent to, the main LV switchboard indicating the location, in relation to the main LV switchboard, of—

(a) the emergency de-energisation procedure; and

(b) the battery bank and fuel tanks,

unless they are immediately adjacent to the LV switchboard.

Signs

Signs shall be indelible. They shall be legible from a distance of 2 m except where otherwise stated, and shall comply with AS 1319.

Maintenance of Generating Sets

Maintenance of the engine and alternator, including routine maintenance requirements such as oil and filter changes and adjustments, tune-ups and overhauls, should be carried out in accordance with the manufacturer's instructions.

Generating set operation (including auto start and remote start, where fitted) should be checked at the completion of any engine maintenance.

Shut Down Procedure

Each installation shall have a 'shutdown procedure' sign, which need not comply with the requirements of Clause 1.5, displayed prominently in the equipment area. The sign shall include instructions for the following procedures:

(a) Emergency de-energisation procedure to isolate the system, including the location(s) of all isolation devices.

(b) Maintenance shutdown procedure, including the following:

(i) Isolation of the battery bank by disconnecting battery fuses or opening battery circuit-breakers.
(ii) Isolation of generating set and prevention of operation by automatic or remote start.

(iii) Isolation of the renewable power inputs.

System Documentation

The following documentation is to be provided:

(a) System manual. A manual complete with the following:

(i) List of equipment supplied. A complete list of installed equipment, with model description and serial numbers for future reference.

(ii) System performance estimate/guarantee. Including daily energy consumption for both a.c. and d.c. loads, design load energy requirement, maximum and surge power demand, an estimate of each renewable energy input, showing expected seasonal variation and an estimate of generator run time.

(iii) Operating instructions—system and components. A short description of the function and operation of all installed equipment. More detailed information should be available from the manufacturers' documentation (see Item (x)).

(iv) Shutdown and isolation procedure for emergency and maintenance. A copy of the shutdown procedure (see AS 4509.1).

(v) Maintenance procedure and timetable. A maintenance checklist for the installed equipment (see Section 11).

(vi) Commissioning records and installation checklist. A record of the initial system settings at the time of system installation and commissioning checklists for quality assurance.

(vii) Warranty information. A statement of the system warranty period and limitation complete with period and limitation of supplied

equipment warranties.

(viii) Original energy usage estimate. A copy of the initial energy usage estimate supplied by the customer and used to design the stand-alone power system.

(ix) System connection diagram. A diagram showing the electrical connection of the power system. In larger installations separate schematic (circuit) and unit wiring diagrams might be required.

(x) Equipment manufacturers' documentation and handbooks. For all equipment supplied.

(b) Battery record logbook. A separate logbook for ongoing recording of battery operating parameters, such as battery voltage, ambient temperature and cell specific gravity, voltage and temperature.

(c) Generating set service logbook. A separate logbook to record periodic generating set maintenance.

NO GO ZONE

No Go Zones for working near overhead powerlines were officially launched on 4 October 1999. They apply throughout Victoria to:

- the operation of cranes, concrete placing booms and excavating equipment
- the operation of elevating work platforms
- the erection of scaffolds

They do not apply to workers in, or engaged by companies of, the Victorian electricity supply industry as they are covered by separate specific safety guidelines.

The new rules are endorsed by the Energy Safe Victoria, the electricity industry, key construction industry, Unions, the Victorian Crane Association and WorkCover.

For cranes, concrete placing booms, excavating equipment and elevating work platforms, there are specified zones around power lines where a spotter is required.

A “spotter” is a safety observer who is competent for the sole task of observing and warning against the unsafe approach to overhead power lines and other electrical apparatus.

Task-specific industry training for spotters is available and is required before any spotting work is commenced.

The requirements for a competent spotter:

- The spotter must hold a valid ticket or certificate of competency for the piece of plant being spotted for.
- The spotter’s sole task is observing and warning against the unsafe approach of the plant and/or load to overhead power lines or other electrical apparatus
- The spotter must also hold a current Level Two First Aid qualification.

Special provisions apply when working within the No Go Zones. These are:

- Notify the power authority before commencing work.
- Obtain written permission from the power authority.
- DO NOT commence work until a pre-start/job meeting and a risk assessment have been completed.

Since the inception of the No Go Zone provisions incidents involving contact with overhead powerlines has significantly reduced. In July 2004 the provisions of the No Go Zone was increased to include underground assets. These new guidelines also provide further explanation to the provisions that currently relate to overhead electrical assets.

There is also new terminology that is used in the document titled "Framework for Undertaking Work Near Overhead and Underground Assets". This can have an impact on how and what plant is used in and around assets.

Envelope:

The space encapsulating a plant item, including attachments such as rotating/flashing lights or radio aerials and is categorised as:

> ***Design****:* the space encapsulating all possible movements of the plant and any load attached under maximum reach.
>
> ***Operating****:* the area encompassing the movement of plant and any load under controlled and managed circumstances or encompassing engineering solutions controlling the movement of plant and its load.
>
> ***Transit***: the area encompassing the normal height and width of a vehicle or plant when travelling to or from a worksite.

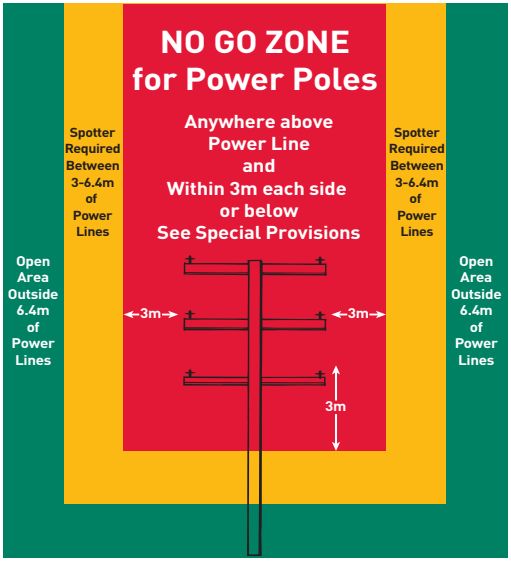
No Go Zone:

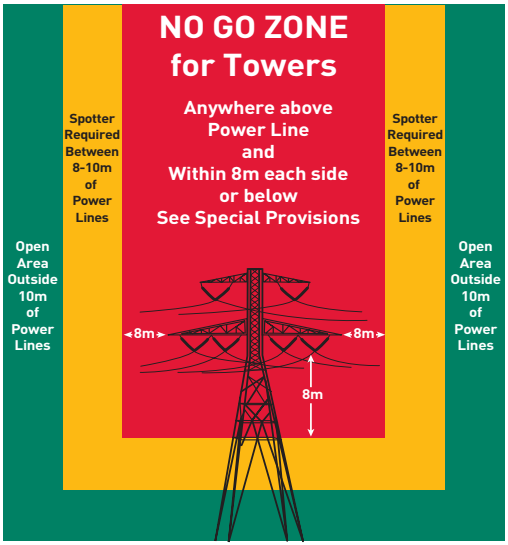
The area surrounding:

> **overhead** electricity cables on poles anywhere above or within 3000 mm to the side and below overhead power lines in the case of power lines up to and including 66Kv and 8000 mm in the case of voltages above 66Kv (tower lines); or
>
> **underground** services being 300 mm for individuals and 500 mm for plant or equipment or 3000 mm of any underground assets registered under the *Pipelines Act* or an underground electricity cable with an in-service voltage of greater than 66Kv.

The following Diagrams are excerpts from WorkSafe Victoria's "Framework For Undertaking Work Near Overhead And Underground Assets".

Diagram 1: Clearances from Overhead Electrical Cables





Before starting work, you must determine:
a) Your scope of work.
b) If you are working near overhead or underground services.
c) If in undertaking this work, you will encroach into the No Go Zone clearances surrounding these services.

(This means you must consider what work you are going to do and how you will do it at the planning stage of a project. See Diagram 3.)

Diagram 3: FLOW CHART: Work Near Overhead or Underground Assets

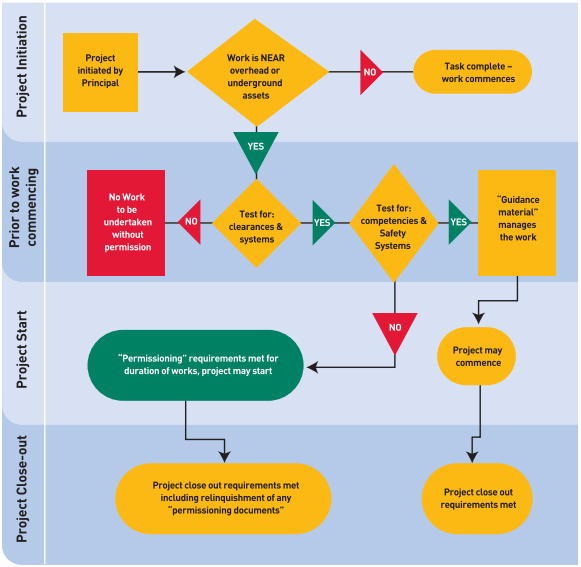


Diagram 4:

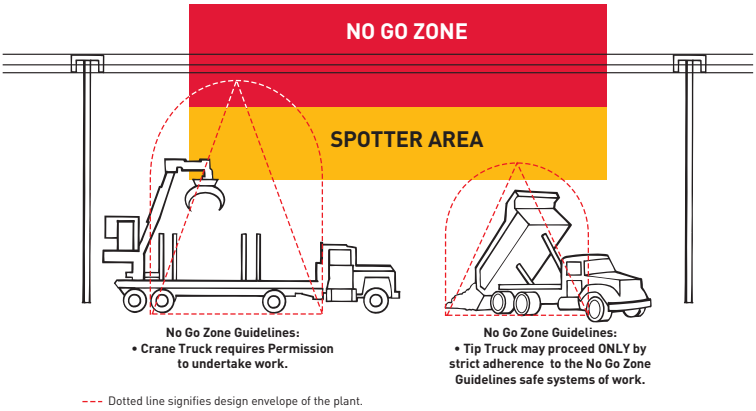
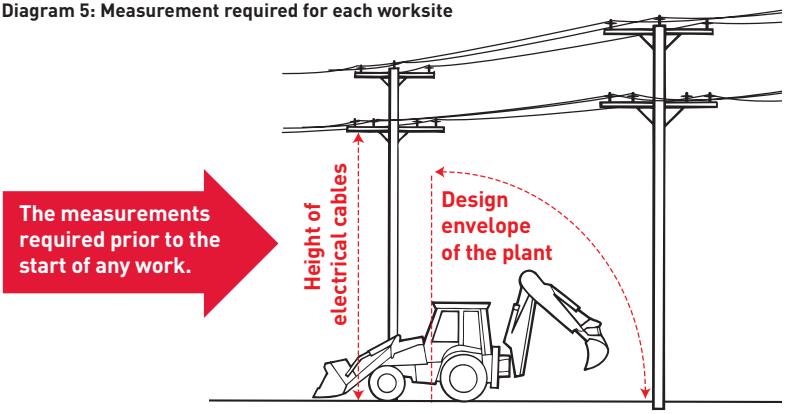


Diagram 5: Measurement required for each worksite



Types of overhead electrical & communications assets. Nominal voltage ('U') both alternating current and direct current	Minimum clearances for the design envelope of plant and equipment under these guidelines before permission is required. Permission will also be required where the conditions in Table B cannot be met.	Safety Controls required for the Deemed to Comply guideline provisions to take effect.
1. Insulated low voltage electricity conductors	500 mm	Training and safety systems
2. Uninsulated low voltage electricity conductors	1000 mm	Training and safety systems
3. High voltage electricity conductors up to and including 66kV	2000 mm	Training and safety systems
4. High voltage electricity conductors above 66kV	6400 mm	Training and safety systems
5. Communications cabling - Broadband and telephony	300 mm	Training and safety systems

TYPES OF UNDERGROUND ASSETS (Note: The owners of assets registered with the Dial Before You Dig service and covered by this guide require an enquiry through this free service and the compliance with any directive issued with information regarding the asset).	Minimum clearances for individuals (A), and the operating envelope of plant and equipment (B) under the guidelines.(Refer to Table B)	Safety Controls required for the Deemed to Comply guideline provisions to take effect or where specific permission has been granted.
6. Assets listed under the Pipelines Act.	3000 mm	Must contact the Asset Owner for specific conditions
7. All electricity conductors greater than 66kV	3000 mm	Must contact the Asset Owner for specific conditions
8. All electricity conductors up to and including 66kV	300 mm (A), 500 mm (B)	See specific requirements in the underground guidelines
9. Telecommunications Cables	300 mm (A), 500 mm (B)	Must contact the Asset Owner for specific conditions
10. All gas pipelines other than 6 above	300 mm (A), 500 mm (B)	See specific requirements in the underground guidelines
11. Water, Drainage & Sewerage pipelines.	300 mm (A), 500 mm (B)	Must contact the Asset Owner for specific conditions

TABLE B: GUIDELINE FRAMEWORK FOR WORKING NEAR OVERHEAD AND UNDERGROUND ASSETS – EXCLUDING ELECTRICITY ASSETS ON TOWERLINES.

OVERHEAD ELECTRICAL ASSETS

OPERATING ENVELOPE	DESIGN ENVELOPE			
	OUTSIDE NEAR	SPOTTER ZONE	NO GO ZONE	
			OUTSIDE TABLE A CLEARANCES	INSIDE TABLE A CLEARANCES
OUTSIDE NEAR	NO GUIDELINE REQUIREMENTS	SAFE SYSTEMS OF WORK	SAFE SYSTEMS OF WORK	SAFE SYSTEMS OF WORK
INSIDE SPOTTER OR NO GO ZONE	N/A	SAFE SYSTEMS OF WORK	SPOTTER & SAFE SYSTEMS OF WORK	PERMISSION SPOTTER & SAFE SYSTEMS OF WORK *See Note

UNDERGROUND ELECTRICAL ASSETS

OPERATING ENVELOPE	
OUTSIDE NEAR	NO GUIDELINE REQUIREMENTS
INSIDE 'NEAR', OUTSIDE TABLE A	SAFE SYSTEMS OF WORK
AT OR INSIDE TABLE A	Permission Spotter & Safe Systems of Work *See Note

*Note: Separate Industry Sector guidelines may have been developed for work in this area.

For information regarding access to Tower Line easements, you must contact the Asset Owner. No work may be undertaken near a Tower Line without Permission from the Asset Owner.

- The Utility Safety Committee (USC) is responsible for endorsement of any guidelines and no work shall be undertaken without Industry Sector development and endorsement from the USC
- Consideration must be given to any load being slung by the plant or equipment.

WELDING POWER SOURCES

A power source (welding machine) is a device that supplies welding current and output characteristics that are suitable for arc welding or allied processes and include transformers, rectified transformers, inverters and electric motor generators that are connected to a 415 V supply and diesel or petrol motor generators.

The following is applicable to arc welding and allied process equipment designed for industrial and professional use, It sets out the safety requirements to reduce the possibility of electric shock and minimize associated hazards.

Allied processes are typically electric arc cutting and arc spraying.

General visual inspection

An inspection by eye to verify that there is no visual damage to the welding machine or auxiliary equipment used in conjunction with its operation, Eg; damage to the case, covers, doors and latches, switches and knobs, electrode holder, torches, wire feeders, and damage including burns and cuts etc to supply and welding leads.

Environment

Safe welding use generally depends on the environment category in which the welding power source is being used. Categories A and B are specifically designed and controlled where the risk of electric shock is low. In all other areas or where the working environment varies, it must be considered to be a Category C. Portable welding power sources must be considered Category C unless evidence is provided to the contrary. **Construction sites will in most instances be Category C.**

The categories are:

Category A environment

A Category A environment is an environment without increased hazard of electric shock.

Category A environments are usually limited to carefully designed workstations.

Category B environment

A Category B environment is an environment with an increased hazard of electric shock.

Category B environments include general fabrication activities, large workpieces, steel building structures, inside pressure vessels, processing tanks, storage tanks, conductive confined spaces and on board ships.

Whenever a welder works without an observer a category B environment will automatically become a category C environment, and will require the use of a V.R.D.

Category C environment

An environment where the risk of an electric shock or electrocution by arc welding is greatly increased due to the presence of water, be that from rain, splashing or partial submersion.

NOTE: In wet, moist or hot locations, humidity or perspiration considerably reduces the skin resistance of human bodies and the insulating properties of accessories and clothing.

An observer who is capable of responding correctly in an emergency shall be appointed to monitor the welder, the observer shall be trained in rescue and emergency procedures.

For manual metal arc welding or similar equipment, the power source needs to have an additional hazard reducing device, which shall be either a trigger switch that opens the welding circuit, unless it is held closed, or a V.R.D.

Hazard reducing device

A hazard reducing device shall reduce the electric shock hazard that can originate from no-load voltages exceeding the allowable rated no-load voltages.
Examples are a Voltage reducing device or a AC to DC switching device.

If the unreduced no-load voltage falls between the allowable rated no-load voltages, the hazard reducing device shall operate within 2 seconds.

If the values are exceeded, the hazard reducing device shall operate within 0.3 seconds. Refer Table (1)

Voltage reducing device

A voltage reducing device shall have automatically reduced the rated no-load voltage to a level not exceeding the prescribed values at the moment the resistance of the external welding circuit exceeds 200Ω.

Conformity shall be checked by connecting a variable load resistor across the welding output connections of the welding power source. Voltage measurements are taken while the resistance is being increased. Refer Table (1)

Externally fitted VRD

Switching device for a.c. to d.c.

A switching device for a.c. to d.c. shall have automatically switched the rated a.c. no-load voltage to a rated d.c. no-load voltage not exceeding the prescribed values at the moment the resistance of the external welding circuit exceeds 200Ω.

To test use a device such as the Welder OCV Level Test Pen below

Connection of a hazard reducing device

The design shall be such that the operator cannot disconnect or by-pass the hazard reducing device without the use of a tool.

Interference with operation of a hazard reducing device

Remote controls, as specified by the manufacturer, and arc striking or arc stabilizing devices of the welding power source shall not interfere with the proper functioning of the hazard reducing device, i.e. no-load voltage limits shall not be exceeded.

Indication of satisfactory operation

A reliable device, e.g. a signal lamp, shall be provided which indicates that the hazard reducing device is operating satisfactorily. Where a signal lamp is used, it shall light when the voltage has been reduced or changed to d.c.

To test use a device such as the VRD Tester below.

Fail to a safe condition

If the hazard reducing device fails to operate in accordance with clause 13 within 1 s, it should fail to a safe condition (e.g. switching to a reduced voltage condition).

Daily or pre-start checks are described. The operator should carry out daily or pre-start inspections, based on observation of indicators, to verify operation of the VRD before commencing work.

Routine verifications of the function of the VRD are described. A competent person, equipped with instruments capable of measuring voltage against time, is necessary for these tests.

VERIFICATION PROCEDURES
Safety

All personnel involved in the testing and operation of welding machines shall be made aware of the inherent hazards of the secondary circuit which may be at potentially harmful voltages. Routine safety inspections require connection of electrical testing instruments to parts of the secondary circuit of a welding machine. Verification of the operation of a VRD requires operation of the welding machine.

Test equipment shall be appropriately rated for the environmental conditions, maximum voltages and currents that the instrument could be subjected to during the inspection process.

Wherever possible the instructions of the original equipment manufacturer (OEM) shall be followed when verifying the performance of the VRD.

RECORD OF RESULTS

Results of the tests carried out should be kept in a suitable register.

Output

Rated no-load voltage (U_o)

NOTE: The electrical worker conducting the rated no-load voltage tests shall test all welding power sources to a category C environment, unless the power source is in a fixed position within a controlled environment other than C, and at no time is it possible for the power source to operate under any other environmental conditions.

The rated no-load voltage at all possible settings shall not exceed the prescribed values summarized in table 1.

Table 1 – Summary of allowable rated no-load voltages

Working conditions	Rated no-load voltage
Environment with a greatly increased hazard of electric shock Category C as per AS 1674.2	d.c. 113 V peak a.c. 35 V peak and 25 V r.m.s.
Environment with increased hazard of electric shock Category B	d.c. 113 V peak a.c. 68 V peak and 48 V r.m.s.
Environment without increased hazard of electric shock Category A	d.c. 113 V peak a.c. 113 V peak and 80 V r.m.s.
Mechanically held torches with increased protection for the operator	d.c. 141 V peak a.c. 141 V peak and 100 V r.m.s.

Welding power sources, which are electronically controlled, shall be

a) designed to ensure that the output voltages given in table 1 cannot be exceeded should any fault occur in an electronic circuit

or

b) fitted with a protection system, (hazard-reducing device) which switches off the voltage at the output terminals within 0,3 s and shall not be reset automatically.

If the no-load voltage is higher than these values, the welding power source shall be fitted with a hazard reducing device.

Insulation resistance

The insulation resistance shall be not less than the values given in table 2:

Table 2 – Insulation resistance

Parts to be tested			Minimum insulation resistance (MΩ)
Input circuit (including control circuits connected to it)	To	Welding circuit (including control circuits connected to it)	5
All circuits	To	Exposed conductive parts	2.5
Welding circuit (including control circuits connected to it)	To	Any auxiliary circuit which operates at a voltage exceeding extra low voltage	10
Welding circuit (including control circuits connected to it)	To	Any auxiliary circuit which operates at a voltage not exceeding extra low voltage	1
Separate welding circuit	To	Separate welding circuit	1

Protection provided by the enclosure

The minimum degree of protection for welding power sources shall be IP21S for indoor and IP23 for welding power sources specifically designed for outdoor use.

Output connections
Protection against unintentional contact

Welding output connections, with or without welding cables connected, shall be protected against unintentional contact by persons or by metal objects.

The following are examples of how such protection can be afforded:

a) any live part of a socket-outlet is recessed behind the plane of access openings

b) a hinged cover or protective guard is provided

Isolation of the input circuit and the welding circuit

The welding circuit shall be electrically isolated from the input circuit and from all other circuits having a voltage higher than the allowable no-load voltage by reinforced or double insulation or equivalent means. If another circuit is

connected to the welding circuit, the power of the other circuit shall be supplied by an isolating transformer or equivalent means.

The welding circuit shall not be connected internally to the connecting means for the external protective conductor, the enclosure, frame or core of the welding power source, except, if necessary, by an interference suppression network or protection capacitor. The leakage current between the welding outlets and the protective conductor terminal shall not exceed 10 mA a.c. r.m.s.

Power supply

Welding power sources which are designed to operate from different supply voltages shall be fitted with one of the following:

a) an internal voltage selection panel where the adjustment for the supply voltage is made by links. A marking shall indicate the arrangement of links for each supply voltage;

b) an internal terminal box or panel in which the terminals are clearly marked with the supply voltages;

c) a switch for tap selection which shall be fitted with an interlocking system which prevents the switch being moved to an incorrect position. The interlocking system shall be adjusted only by the use of a tool;

d) a system to automatically configure the welding power source in accordance with the supply voltage.

NOTE Welding power sources may be fitted with an external indication of the supply voltage selected.

In the case of welding power sources with several supply connections, the points of connection not provided with covers which are secured by the use of a tool are tested with a voltage tester, using all possible supply connections and switch positions. The requirements are met if no voltage or only a voltage below 12 V is measured between the points of connection not provided with covers and between these points and the enclosure.

Input supply on/off switching device

Where an integral input supply on/off switching device (e.g. switch, contactor or circuitbreaker) is provided, this shall:

a) switch all ungrounded mains conductors, and

b) plainly indicate whether the circuit is open or closed, and either

c) be rated as follows:

- voltage: not less than the values given on the rating plate,

- current: not less than the highest effective supply current as given on the rating plate,

Or

d) be suitable for this application.

Three-phase a.c. multi-operator welding transformer

All welding output connections intended to be connected to the workpiece shall have a common interconnection within the welding power source.

Welding output connections of the same phase shall all be marked the same as each other.

Marking

Connections designed specifically for attachment to the work piece or to the electrode shall be so identified.

For d.c. welding power sources, the polarity shall be clearly marked, either on the welding output connections or on the polarity selector. This requirement is not relevant for plasma cutting power sources.

Auxiliary power output

In the case of welding power sources designed to supply electrical power, e.g. for lighting or electric tools, these auxiliary circuits and accessories shall comply with the standards and regulations relating to the use of this equipment.

The welding circuit shall be electrically isolated and insulated from such supply circuits.

Near the output terminals or outlets of such power the available current, the voltage, the duty cycle (duty factor) if less than 100 %, the frequency, the number of phases or d.c. and the status of the neutral (for example earthed or unearthed) as appropriate shall be clearly and indelibly marked.

Instructions and Markings

Rating plate

A clearly and indelibly marked rating plate shall be fixed securely to or printed on each welding power source.

NOTE: The purpose of the rating plate is to indicate to the user the electrical characteristics, which enables the comparison and correct selection of welding power sources.The marking shall be easily legible. It shall not be easy to remove the rating plate and it shall show no curling.

Description

The rating plate shall be divided into sections containing information and data for the

a) identification;
b) welding output;
c) energy input;
d) auxiliary power output, if applicable

The dimensions of the rating plate are not specified and may be chosen freely.

It is permissible to separate the above sections from each other and affix them at locations more accessible or convenient for the user.

For welding power sources to be used for several welding processes or for rotating welding power sources, either one combined or several separate rating plate(s) may be used.

NOTE Additional information may be given. Further useful information, for example class of insulation, pollution degree or power factor, may be given in technical literature supplied by the manufacturer.

Instructions

Each welding power source shall be delivered with instructions and markings.

The instructions shall include the following (as applicable):

a) general description;

b) mass of the welding power source and its various parts and correct methods of handling them, e.g. by fork-lift or crane, and precautions to be taken with gas cylinders, wire feeders, etc.;

c) the meaning of indications, markings and graphical symbols;

d) information for selection and connection to the input supply; e.g. suitable supply cables, connection devices or attachment plugs, including the fuse and/or circuit-breaker rating;

e) correct operational use relating to the welding power sources; e.g., cooling requirements, location, control device, indicators, fuel type;

f) welding capability, static characteristic (drooping and/or flat), duty cycle (duty factor) limitations and explanation of thermal protection if relevant;

g) limitations of use relating to the degree of protection provided; e.g. a welding power source with a degree of protection of IP21 is not suitable for use in rain;

h) basic guidelines regarding protection against personal hazards for operators and persons in the work area; e.g. electric shock, fumes, gases, arc rays, hot metal, sparks and noise;

i) conditions under which extra precautions are to be observed when welding or cutting;(e.g. environment with increased hazard of electric shock, flammable surroundings, flammable products, closed containers, elevated working positions, etc.);

j) how to maintain the welding power source;

k) adequate circuit diagram together with a list of recommended spare parts; in the case of special processes, e.g. plasma cutting;

l) information for a circuit designed to supply electrical power at normal supply voltage; e.g. for lighting or electric tools;

m) precautions against toppling over, if the welding power source shall be placed on tilted plane;

n) warning against the use of a welding power source for pipe thawing;

o) type (identification) of plasma cutting torches that are specified for use with the plasma cutting power source;

p) pressure, flow rate and type of plasma gas and if relevant, of cooling gas or cooling liquid;

q) steps or range of the output current and the corresponding plasma gas as a set of values.

Other useful information may also be given, e.g. class of insulation, pollution degree, power factor, etc.

Markings

Each welding power source shall be clearly and indelibly marked on or near the front panel or near the on/off switching device with the warning symbol combination,

Caution! Read operator's manual

Indicating that arc welding and plasma cutting can be injurious to the operator and persons in the work area and that the instructions shall be consulted before opening.

The following equivalent wording may be used:

Warning: Read instruction manuals before operating and servicing this equipment.

Internal insulation

Power sources designated Class I Protection, as designated by AS/NZS 3000, shall be connected to the power supply earth bonding system.

Power sources designated Class II Protection, as designated by AS/NZS 3000, do not require connection to the power supply earth bonding system.

NOTE: Where a power source has a Class II Protection, it shall show the double insulated symbol on its rating plate.

Control

The power source shall be controlled by a switch that is incorporated in its primary circuit. The switch shall have a designated OFF position and be mounted on or adjacent to the power source framework. Where the power source is connected to the supply by means of a power supply cord and plug, any switch mounted on the power source shall open all live conductors, including the neutral.

Connection to Electricity Supply

Power sources shall be connected to the electricity supply –

a. via an approved supply flexible cord with plug and socket; or

b. by a licensed electrical worker, if the power source is permanently connected to the supply.

Power supply cords should be kept as short as possible.

Electrical wiring connecting a power source to an electricity supply, wiring connecting a frame of a power source to earth and any permanent wiring connected to terminals to which output leads are connected shall comply with the relevant requirements of AS/NZS 3000.

Earthing

Depending on the application a licensed electrical worker shall ensure the frame of the power source is earthed in accordance with AS/NZS 3000 or is bonded to the power supply earth bonding system in accordance with AS/NZS 2790 for a generator.

INSPECTION and MAINTENANCE

POWER SOURCE

Routine inspection and testing

An inspection of the power source, an insulation resistance test and an earthing resistance test shall be carried out –

(a) for transportable equipment, at least once every 3 months; and
(b) for fixed equipment, at least once every 12 months.

The owners of the machine shall keep a suitable record of the periodic tests and a system of tagging, including the date of the most recent inspection.

NOTE: A transportable power source is any equipment that is not permanently connected and fixed in the position in which it is operated.

Earthing

The resistance shall not exceed 1Ω between any metal of a power source, where such metal is required to be earthed, and –

(a) the earth terminal of a fixed power source; or

(b) the earth terminal of the associated plug of a transportable power source.

NOTE: Because of the dangers of stray output currents damaging fixed wiring, every 12 months the integrity of the fixed wiring should be inspected by a licensed electrical worker .

Repairs

Electrical work inside a welding power source shall be undertaken by a licensed electrical worker.

Accessories

Accessories equipment, including output leads, electrode holders, torches, wire feeders and the like, shall be inspected at least monthly by a competent person, to ensure that the equipment is in a safe and serviceable condition. Unsafe and unserviceable accessories shall not be used.

ITEMS TO BE VISUALLY INSPECTED	COMPLETED		
	Y	N	N/A
Rating Plate			
Clearly & Indelibly Marked			
Identification Model Number_____ Serial Number			
Welding Output			
Energy Input			
Auxiliary Power Output			
S Symbol for B, C Environments			
Rated no load Voltage			
Double Insulation Symbol for Class II Equipment ⧈			
IP Rating			
Instruction Manual			
Markings			
Caution! Read Operators Manual or Warning Symbol			
Accessories – visually inspect welding leads, hand piece			
ITEMS TO BE TESTED	**COMPLETED**		
	Y	**N**	**N/A**
Control Switch Double Pole			
Insulation Resistance			
Input Circuit to Welding Circuit 5MΩ			
All Circuits to Exposed Conductive Parts 2.5MΩ			
Welding Circuit to Aux Circuits Exceeding Extra Low Voltage 10MΩ			
Welding Circuit to Aux Circuits Not Exceeding Extra Low Voltage 1MΩ			
Separate Welding Circuit to Separate Welding Circuit 1MΩ			
Earthing Resistance of any Metal Required to be Earthed and the Earth Terminal Less Than 1Ω			
Operation of VRD – (use VRD tester)			
Test Readings of all Tests Performed Must be Recorded and Kept on Site for Audit Purposes.			

PROCEDURES for SAFELY ENERGISING or ISOLATING ELECTRICAL EQUIPMENT

1. Prior to Energising

2. Energising procedure – Main Switchboard, Sub-boards

3. Energisation procedure – mechanical or other services switchboards

4. Danger tag isolation procedure

5. Procedures for switching on circuits at sub boards

ATTACHMENTS

1. Energisation Procedure Notification

2. Equipment Tag Register

3. Signage **"EQUIPMENT IN SERVICE"**

4. Signage **"LIVE EQUIPMENT UNDER COMMISSIONING"**

5. Signage **"Danger- Authorised Personnel Only – Do not Enter"**

6. Sample "Equipment Danger Tag"

7. Sample "Personal Danger Tag"

Note All signs and tags are to be made of durable material eg. Laminated. Equipment Danger tags must be uniquely numbered for safety and audit purposes.

PRIOR TO ENERGISING

1. Where construction work is incomplete and may impact on the integrity of the electrical installation, an assessment is required to be carried out by the electrical contractor to assess the mechanical protection that may be required for additional protection of electrical equipment, including cabling that may be damaged due to the ongoing construction activities.

2. Each Contractor associated with energising electrical services and following these procedures must have at least one current level 2-first aider as part of the energising crew with CPR refresher within the 12-month period as per the requirements of the First Aid Certificate.

3. Any employee associated with the energising team is to be inducted in these procedures prior to any energising taking place.

4. Minimum of team should be no less than two.

5. The first aider should have direct contact with first aid facility or provided with quick response mechanism to emergency services.

6. All members of the energising and commissioning team shall be holders of a current (E) Electricians License issued by Energy Safe Victoria (ESV).

ENERGISING PROCEDURE - MAIN SWITCHBOARD.

1. Carry out relevant inspections and tests as required by AS/NZS 3000 Wiring Rules and AS/NZS 3017 Electrical installations – Testing guidelines.

2. A switchboard manufacturers' compliant to Australian Standards AS/NZS 3439 document for the main switchboard to be provided.

3. Fill out Certificate of Electrical Safety for Prescribed Electrical Installation Work and obtain services of Electrical Inspector.

4. Principal Electrical Contractor to provide a completed "Energisation Procedure Notification" (Attachment 1) of intent to commence testing/commissioning to workplace occupier and relevant ETU Site Representative at least 48 hours prior to commencement.

5. ***Safety procedures Implemented***

   The immediate area around the switchboard is to be barricaded off where it is located in a hall or open areas to prevent ingress by other trades during the initial testing and "first time" energising of the switchboard. In a main switchboard room, the room is to be complete including lockable doors.

   Main Switch(es) opened, padlocks and equipment danger tags (Attachment 6) applied. Keys controlled by nominated persons.

   Isolations logged (refer form "Equipment Tag Register", Attachment 2)

6. Prescribed Certificate to be submitted to Energy Safe Victoria.

7. Main switchboard now ready for energisation.

8. Switchboard doors, mains cabling and room to be appropriately signposted with "In –Service" (Attachment 3), Commissioning (Attachment 4), and "Danger- Authorised Personnel Only – Do not Enter"(Attachment 5) prior to energising.

ENERGISING PROCEDURE - SUB-BOARDS

1. Carry out relevant inspections and tests as required by AS/NZS 3000 Wiring Rules and AS/NZS 3017 Electrical installations – Testing guidelines.

2. A switchboard manufacturers' compliant to Australian Standards AS/NZS 3439 document for the switchboard to be provided.

3. Fill out Certificate of Electrical Safety for Prescribed Electrical Installation Work or Non-Prescribed Certificate as required, and obtain service of Electrical Inspector (if prescribed work).

4. Principal Electrical Contractor to provide a completed "Energisation Procedure Notification" (Attachment 1) of intent to commence testing/commissioning to workplace occupier and relevant ETU Site Representative at least 48 hours prior to commencement.

5. ***Safety procedures Implemented***

   The immediate area around the switchboard is to be barricaded off to prevent ingress by other trades during the initial testing and "first time" energising of the switchboard.

   Main Isolating Switch(es) opened, padlocks and equipment danger tags (Attachment 6) applied. Keys controlled by nominated persons.

   Isolations logged (refer form "Equipment Tag Register", Attachment 2)

6. Prescribed /Non-Prescribed Certificate to be submitted to Energy Safe Victoria.

7. Sub-switchboard now ready for energisation.

8. All equipment to have "in service" (Attachment 3) and "Commissioning" (Attachment 4) signposted prior to energising.

9. No sub-board to be energised until Items 2 and 3 of "PROCEDURES FOR SWITCHING ON CIRCUITS AT SUB BOARDS" are completed.

MECHANICAL OR OTHER SERVICES – SWITCHBOARDS

1. Carry out relevant inspections and tests as required by AS/NZS 3000 Wiring Rules and AS/NZS 3017 Electrical installations – Testing guidelines.

2. Fill out certificate of Electrical Safety for Prescribed Electrical Installation Work or Non-Prescribed Certificate as required, and obtains service of Electrical Inspector (if prescribed work).

3. Electrical contractor to provide a completed “Energisation Procedure Notification” (Attachment 1) of intent to commence testing/commissioning to workplace occupier, principal electrical contractor and relevant ETU Site Representative at least 48 hours prior to commencement.

4. ***Safety Procedures Implemented***

   The immediate area around the switchboard is to be barricaded off to prevent ingress by other trades, during the initial testing and "first time" energisation of the switchboard.

   Carry out all necessary inspections and tests on the circuit/equipment to make certain that such may be operated without danger to persons or equipment. Main switch(es) opened, padlocks and “Equipment Danger Tags” (Attachment 6) applied. Keys controlled by nominated persons.

   Isolations logged, (Refer form “Equipment Tag Register”, Attachment 2)

5. A switchboard manufacturers’ compliant to Australian Standards AS/NZS 3439 document for the switchboard to be provided.

6. Functional/operational test(s) CBs), RCD(s), isolators, contactors, relays, etc completed. Mechanical or other Services Electrical Contractors to submit test results to principal contractor as required.

7. Prescribed/Non-Prescribed Certificate to be submitted to Energy Safe Victoria.

8. Mechanical or other services switchboard ready for energisation.

9. Mechanical or other Services Electrical Contractor to complete and issue “Energisation Procedure Notification” (Attachment 1) form, advising works complete and requesting power.

10. No Sub-board supply to be closed by main Electrical Contractor until “Energisation Procedure Notification” (Attachment 1) form received from Mechanical or other Services Electrical Contractor.

11. All equipment to have "in service" (Attachment 3) and “Commissioning” (Attachment 4) signposted prior to energising.

DANGER TAG ISOLATION PROCEDURE

This procedure shall be implemented when working on or near: -

a) Equipment and circuits in service.
b) Equipment and circuits being repaired or modified.
c) Equipment and circuits being commissioned and tested after installation.

1. When a circuit or equipment has been isolated to enable work to be carried out on or adjacent to such equipment, an “Equipment Isolation Tag” (Attachment 6) and lock is to be attached, signed and dated by the Company Authorised officer.

2. It is of utmost importance to note that the “Equipment Isolation Tag” (Attachment 6) and lock bearing the employee Company Authorised Officer’s signature is attached prior to any company employee attaching their “Personal Danger Tags” (Attachment 7), irrespective of any other tags that may be attached.

3. A circuit is not to be accepted as isolated unless a company “Equipment Isolated Tag” (Attachment 6) and lock is attached signed and dated.

4. A log of all equipment (Attachment 2) isolated, tags and locks in use on the project is to be maintained by the Company Authorised Officer.

5. All employees must attach their own “Personal Danger Tags” (Attachment 7) and locks prior to their commencement of work on the relevant equipment.

   Note: A personal lock must not be able to be opened by anyone else apart from the worker it has been issued to. A reserve key shall be kept on site in a locked box under the control of the electrical supervisor.

6. No switch may be operated whilst a danger tag is attached.

7. A danger tag must only be removed by the person whose signature appears on it. The person it has been issued to can only remove a personal lock. (Except in circumstances where the person is unavailable due to absence, illness or other causes).

   Should this situation arise the Company Project Supervisor and Company safety representative may remove the tag and lock after ensuring compliance with the following.

(a) They shall fully acquaint themselves with the reasons for the tag and lock being attached.

(b) They shall carry out all necessary inspections and tests on the circuit/equipment to make certain that such may be operated without danger to persons or equipment.

(c) They shall ensure that all personnel associated with the work are informed of their actions.

(d) They shall ensure that the person whose tag and lock was removed via this process is fully informed of this action immediately upon their return.

8. Only approved danger tags whether equipment or personal (Attachments 6&7) in good condition are to be used. Tags with erasures and alterations are not permitted.

9. Danger tags are to be securely fixed to the operating handle or isolated device of the equipment so there is no risk of them being accidentally dislodged or of an operator being able to operate the equipment without seeing the tags.

PROCEDURE FOR SWITCHING ON CIRCUITS AT SUB BOARDS

1. The Foreman/Leading Hand supervising the area to control access to sub-boards.

2. Cable identification, including a full visual inspection of all cabling that originate from the switchboard must be performed prior to any sub-circuits being energised. Carry out relevant inspections and tests as required by AS/NZS 3000 Wiring Rules and AS/NZS 3017 Electrical installations – Testing guidelines. All cables to be appropriately terminated at both ends, and marked for ease of identification.

3. Where a junction box has been fitted to the end of a cable, any cable insulation is to be stripped off prior to being put in a connector, this cable is not to be connected to supply, including the neutral and earth. The circuit breaker number and switchboard number is to be clearly and legibly marked on the junction box lid.

4. Schedule noting which circuits are energised or otherwise must be included in switchboard.

5. Only leading hands/foreman in control of area to energise circuits.

6. All circuits to be treated as energised when sub board energised.

7. People working in the area where circuits are to be connected to supply and energised are to be informed prior to this occurring.

8. Foreman/Area leading hand only to authorise power to sub-boards after checking safe to do so.

ATTACHMENT 1

ENERGISING PROCEDURE NOTIFICATION

CONTRACTOR NAME ----------
(Requesting Energisation)

CONTACT DETAILS ----------

REC No ----------

RESPONSIBLE PERSON ----------

CONTACT PHONE No ----------

AREA ----------

SWITCHBOARD DESTINATION ----------

REQUESTED DATE OF ENERGISATION ----------
(2 Days Notice Required)

EQUIPMENT DISCRIPTION ----------

ELECTRICAL SAFETY TESTS COMPLETED ---------- ***(Date)***--------
(Attach copies of Certificates of Electrical Saftey)

EQUIPMENT OK FOR ENERGISATION ---------- ***(Date)***--------

ISSUED TO:

NAME OF RESPONSIBLE PERSON ----------

POSITION ----------

COMPANY AUTHORISATION

(Name)----------***(Signature)***----------

(Date)----------

Note: Where the Energisation Procedure is being completed by the Main Electrical Contractor, the Issued To: Section is to be completed by the Principal Building Contractor.

ATTACHMENT 2

EQUIPMENT TAG REGISTER

Circuit Ready to be Isolated					Circuit Ready for Energisation	
Padlock Number	Danger Tag No.	Tagging Officer Sign On	Date Isolated	Switchboard, Circuit and Purpose of Isolation	Tagging Officer Sign On	Date Isolation Removed

ATTACHMENT 3

THIS EQUIPMENT IS IN SERVICE

Danger Tag Isolation Procedure is essential

To Safeguard Your Life

Should you not understand the requirements for safe isolation it is essential for you to contact the authorised equipment isolation officer.

ATTACHMENT 4

LIVE EQUIPMENT UNDER COMMISSIONING

ATTACHMENT 5

ATTACHMENT 6 SAMPLE EQUIPMENTCARDS

ATTACHMENT 7 SAMPLE PERSONALCARDS

DE-ENERGISATION PROCEDURE FOR DEMOLITION WORKS

All workers are to work under the belief that any cable in a demolition area is "LIVE", and they are to be treated as such. Any cable not required is to be removed.

Scenarios for building demolition can be broken down into three typical categories.

1) Complete demolition of the entire single/multiple building where the permanent electrical installation is disconnected from supply for the entire worksite.

2) Complete demolition of a stand-alone building or structure, which is as part of a multiple building complex (eg. schools, hospitals).

3) Partial demolition of a building, possibly as part of refurbishment of an area within a building (eg shopping centres, multistorey) where the other parts of the building are still occupied. Energised permanent wiring may still run through the demolition area. Where this occurs, a separate on-site procedure is required to be developed.

The use of these de-energising procedures should be dependant on the type and category of demolition work that best fits the site situation.

Scenario 1

Note: Construction wiring may still be located on the demolition site. Such wiring is marked with "construction wiring" tape.

Complete demolition of the entire single/multiple building where the permanent electrical installation is disconnected from supply for the entire worksite.

The following is a recommended procedure to control the de-energisation of the demolition area.

1) The area of demolition is to be defined & established with the Head Contractor in conjunction with the Demolition Contractor and Electrical Contractor(s).

2) An investigation is required to be conducted to identify any overhead and underground services that may be impacted upon by the demolition and associated activities (Dial 1100 before you dig).

3) All electrical circuits within the demolition area to be identified as far as possible and checked with existing drawings.

4) When the Electrical Distribution Business has isolated the main incoming supply to the Main Switchboard from the street connection

(point of supply), the incoming mains are to be positively tested by an electrician (not using a volt stick) and disconnected from or cut off above the Main Switchboard. This cable will be completely removed or appropriately terminated in a junction box. An isolation sticker will then be attached to the Main Switchboard and an entry detailing the disconnection will be recorded in a Switchboard isolation logbook.

5) All Distribution Boards including all Mechanical, Lift, Fire Switchboards within the demolition area are to be tested to confirm their de-energisation status.

6) When the demolition area has been completely isolated and tested a letter of clearance and a copy of the isolation log shall be provided to the demolition contractor, the head contractor and the relevant OH&S Rep/s.

No demolition works affecting any part of the electrical installation shall commence until the sign off letter and isolation log has been received from all electrical contractors involved in the testing and isolation of the demolition area.

Volt sticks should not be used to test a circuit for de-energisation

Scenario 2

Note: Construction wiring may still be located on the demolition site. Such wiring is marked with “construction wiring” tape.

Complete demolition of a stand-alone building or structure, which is as part of a multiple building complex (eg. schools, hospitals).

Note: Disconnection and removal of circuits from switchboards/load may be achieved, if it is safe to do so, by cutting cables off where they enter the switchboard/load.

The following is a recommended procedure to control the de-energisation of the demolition area.

1) The area of demolition is to be defined & established with the Head Contractor in conjunction with the Demolition Contractor and Electrical Contractor(s).

2) An investigation is required to be conducted to identify any overhead or underground services that may be impacted upon by the demolition and associated activities (Dial 1100 before you dig).

3) All electrical circuits within the demolition area to be identified as far as possible and checked with existing drawings.

4) All cables (mains, sub mains and final sub-circuits) providing power into the demolition area are to be disconnected and removed from the

supplying switchboard and from the load or distribution board. The mains or sub-mains are to be removed or appropriately terminated at both ends. An isolation sticker will then be attached to the distribution board and an entry detailing the disconnection will be recorded in a Switchboard isolation logbook.

5) All Distribution Boards within the demolition area are to be tested (as per 4 above).

6) All mechanical, Lift, Fire Switchboards etc, are to be tested (as per 4 above).

7) All electrical take off boxes and major electrical equipment is to be tested, cables are to be disconnected and removed from the equipment and an isolation sticker affixed to the equipment.

8) When the demolition area has been completely isolated and tested, letters of clearance from each REC, and a copy of the isolation log shall be provided to the demolition contractor, the head contractor and the relevant OH&S Rep/s.

No demolition works affecting any part of the electrical installation shall commence until the sign off letter and isolation log has been received from all electrical contractors involved in the testing and isolation of the demolition area.

Volt sticks should not be used to test a circuit for de-energisation

Scenario 3

Note: Construction wiring may still be located on the demolition site. Such wiring is marked with “construction wiring” tape.

Partial demolition of a building on site, possibly as part of refurbishment of an area within a building (eg shopping centres, multistorey) where the other parts of the building are still occupied. Energised permanent wiring may still run through the demolition area. Where this occurs, a separate on-site procedure is required to be developed. A staged demolition may be necessary before a letter of clearance can be provided.

Note: Disconnection and removal of circuits from switchboards/load may be achieved, if it is safe to do so, by cutting cables off where they enter the switchboard/load.

The following is a recommended procedure for control of de-energisation for the demolition area.

1) The area of demolition is to be defined & established with the Head Contractor, Demolition Contractor and Electrical Contractor(s).

2) An investigation is required to be conducted to identify any overhead or underground services that may be impacted upon by the demolition and associated activities (Dial 1100 before you dig).

3) All electrical circuits within the demolition area to be identified as far as possible and checked with existing drawings.

4) Equipment and switchboards that are outside the demolition area but are supplied from within the demolition area are to be re-supplied from an alternative power supply before demolition works commence. Where this is not possible, the cabling is required to be suitably mechanically protected against any construction activity that may damage the cable and signposted as “LIVE”.

5) Cabling supplying power to the demolition area are to be disconnected and removed from the supply switchboard or if unable to be disconnected or removed the cable must to be appropriately terminated , provided with suitable mechanical protection and labelled along its length at intervals not exceeding 5 metres.

6) All cables, which includes data, phone and fire alarm cables, cable ducts, cable trays and conduits traversing the demolition area which cannot be disconnected and removed are to be provided with suitable mechanical protection and sign posted as “LIVE”. If the installation’s main earth wire passes through the demolition area suitable mechanical protection is to be provided to ensure that the cable is not damaged or removed during the demolition process.

7) At the edge of the demolition area all cables, which includes data, phone and fire alarm cables, cable ducts, cable trays and conduits are to be cut off and have a physical separation of at least 300mm to enable visual identification of isolation.

8) All cut off electrical cables crossing into the demolition area are to be terminated in a junction box at least 300mm outside of the demolition area. All cabling irrespective of whether it is phone, fire alarm or power is to be considered “live” and appropriately terminated.

9) Where applicable, when the Electrical Distribution Business has isolated the main incoming supply to the Main Switchboard from the point of supply, the incoming mains are to be positively tested by a licensed electrician (not using a volt stick) and cut off above the Main Switchboard. This cable will be removed or appropriately terminated and labelled, in a junction box. An isolation sticker will then be attached to the Main Switchboard and an entry detailing the disconnection will be recorded in a Switchboard isolation logbook.

10) All Distribution Boards within the demolition area are to be tested. Incoming Sub Mains and outgoing circuits are to be cut off and when complete isolation stickers are to be fixed to the boards and the isolations logged.

11) All Mechanical, Lift, Fire Switchboards etc within the demolition area, are to be tested before incoming Sub Mains cables are to be cut off and an isolation sticker is to be fixed to the Switchboard. (These isolations are to be performed and logged by the relevant electrical sub contractor).

12) All electrical take off boxes and major electrical equipment are to be tested, cables cut off and an isolation sticker affixed to the equipment. Other electrical equipment including power outlets and light fittings are to be tested and have isolation stickers affixed.

13) Any electrical equipment/cable that is identified as still being energised are to be traced back to the source of supply outside of the demolition area, isolated, and cut off or terminated in a junction box outside of the demolition area.

    All conductors, including Neutrals and Earth wires are to be tested and terminated.

14) There is no such thing as a “DEAD” cable, it is either “live” (with suitable mechanical protection and identified) or it’s removed.

15) Non-electrical trades shall not cut electrical cables. A licensed electrician is to be on stand by at all times for use by the demolition contractor whenever cables are encountered. If cables are found, they shall be disconnected as per the ETU Energisation Procedure and then cut off and isolated from supply as detailed above in point 6. <u>This section will not apply in unsafe areas of the site where demolition is being performed by powered plant such as demolition hammers, excavators or similar.</u>

16) When the demolition area has been completely isolated and tested letters of clearance from each relevant REC, and a copy of the isolation log shall be provided to the demolition contractor, the head contractor and relevant OH&S Rep/s.

No demolition works affecting any part of the electrical installation shall commence until the sign off letter and isolation log has been received from all electrical contractors involved in the testing and isolation of the demolition area.

Volt sticks should not be used to test a circuit for de-energisation

PROCEDURES for SAFELY ENERGISING or ISOLATING CONSTRUCTION WIRING and ASSOCIATED ELECTRICAL EQUIPMENT

1. Prior to Energising
2. Energising procedure – Main Switchboard, Sub-boards
3. Energisation procedure – electrical equipment and other services switchboards
4. Danger tag isolation procedure
5. Procedures for switching on circuits at sub boards

ATTACHMENTS

1. Energisation Procedure Notification
2. Sample "Equipment Danger Tag"
3. Sample "Personal Danger Tag"

Note All signs and tags are to be made of durable material eg. Laminated.
Equipment Danger tags must be uniquely numbered for safety and audit purposes.

PRIOR TO ENERGISING

1. Ensure that the installation is compliant with AS/NZS 3000, AS/NZS 3012 and the Industry Standard for Electrical Installations Building and Construction Sites.
2. Each Contractor associated with energising electrical services and following these procedures must have at least two current level 2-first aiders as part of the energising crew with CPR refresher within the 12-month period as per the requirements of the First Aid Certificate.
3. Any employee associated with the energising team is to be inducted in these procedures prior to any energising taking place.
4. Minimum of team should be no less than two.
5. The first aider should have direct contact with first aid facility or provided with quick response mechanism to emergency services.
6. All test equipment to be calibrated at least once every calendar year.
7. All members of the energising and commissioning team shall be holders of a current 'Electrical Installations on Construction and Demolition Sites' Accreditation Card. This requirement does not apply to apprentices.

ENERGISING PROCEDURE MAIN SWITCHBOARD.

1. Carry out relevant inspections and tests as required by AS/NZS 3000 Wiring Rules and AS/NZS 3017 Electrical installations – Testing guidelines.

2. A switchboard manufacturers' compliant to Australian Standards AS/NZS 3439 document for the main switchboard to be provided.

3. Fill out Certificate of Electrical Safety for Prescribed Electrical Installation Work and obtain services of Electrical Inspector.

4. ***Safety procedures Implemented***

   The immediate area around the switchboard is to be barricaded off where it is located in a hall or open areas to prevent ingress by other trades during the initial testing and "first time" energising of the switchboard.

   Main Switch(es) opened, padlocks and equipment danger tags (Attachment 2) applied. Keys controlled by nominated persons.

5. Prescribed Certificate to be submitted to Office of the Chief Electrical Inspector.

6. Main switchboard now ready for energisation.

ENERGISING PROCEDURE SUB-BOARDS.

1. Carry out relevant inspections and tests as required by AS/NZS 3000 Wiring Rules and AS/NZS 3017 Electrical installations – Testing guidelines.

2. A switchboard manufacturers' compliant to Australian Standards AS/NZS 3439 document for the switchboard to be provided.

3. Fill out Certificate of Electrical Safety (Non-Prescribed Certificate).

4. ***Safety procedures Implemented***

   Distribution Board Isolating Switch opened, padlocks and equipment danger tags (Attachment 2) applied. Keys controlled by accredited construction wiring persons. Locks on switchboards, not to be CL001 key type.

5. Non-Prescribed Certificate to be submitted to Office of the Chief Electrical Inspector.

6. Sub-switchboard now ready for energisation.

ELECTRICAL EQUIPMENT and OTHER SERVICES – SWITCHBOARDS

1. Carry out relevant inspections and tests as required by AS/NZS 3000 Wiring Rules and AS/NZS 3017 Electrical installations – Testing guidelines.

2. Fill out certificate of Electrical Safety (Non-Prescribed Certificate).

3. ***Safety Procedures Implemented***

   Carry out all necessary inspections and tests on the circuit/equipment to make certain that such may be operated without danger to persons or equipment. Main switch(es) opened, padlocks and "Equipment Danger Tags" (Attachment 2) applied. Keys controlled by nominated persons.

4. A switchboard manufacturers' compliant to Australian Standards AS/NZS 3439 document for the switchboard to be provided.

5. Functional/operational test(s) CBs), RCD(s), isolators, contactors, relays, etc completed. Mechanical or other Services Electrical Contractors to submit test results to principal contractor as required.

6. Non-Prescribed Certificate to be submitted to Office of the Chief Electrical Inspector.

7. Electrical equipment or other services switchboard ready for energisation.

8. No Sub-board supply to be closed by main Electrical Contractor until "Energisation Procedure Notification" (Attachment 1) form received from other Services Electrical Contractor. The Electrical Contractor and the ETU site representative must be notified at least 48 hours prior to supply being required.

DANGER TAG ISOLATION PROCEDURE

This procedure shall be implemented when working on or near: -

a) Equipment and circuits in service.
b) Equipment and circuits being repaired or modified.
c) Equipment and circuits being commissioned and tested after installation.

1. When a circuit or equipment has been isolated, an "Equipment Isolation Tag" (Attachment 2) and lock is to be attached, signed and dated by the construction wiring electrician.

   A circuit is not to be accepted as isolated unless a company "Equipment Isolated Tag" (Attachment 2) and lock, or a "Personal Danger Tag" (Attachment 3) and lock is attached signed and dated.

2. It is of utmost importance to note that a "Personal Danger Tag" (Attachment 3) and lock bearing the construction wiring electrician's signature is attached prior to any work commencing on the isolated equipment. Each person working on the equipment must attach their own tag and lock, irrespective of how many other tags and locks may be attached.

   Note: A personal lock must not be able to be opened by anyone else apart from the worker it has been issued to. A reserve key shall be kept on site in a locked box under the control of the electrical supervisor.

3. No switch may be operated whilst a danger tag is attached.

4. A danger tag must only be removed by the person whose signature appears on it. The person it has been issued to can only remove a personal lock. (Except in circumstances where the person is unavailable due to absence, illness or other causes).

   Should this situation arise the Company Project Supervisor **and** elected ETU safety representative may remove the tag and lock after ensuring compliance with the following.

   (a) They shall fully acquaint themselves with the reasons for the tag and lock being attached.

   (b) They shall carry out all necessary inspections and tests on the circuit/equipment to make certain that such may be operated without danger to persons or equipment.

   (c) They shall ensure that all personnel associated with the work are informed of their actions.

(d) They shall ensure that the person whose tag and lock was removed via this process is fully informed of this action immediately upon their return.

5. Only approved danger tags whether equipment or personal (Attachments 2&3) in good condition are to be used. Tags with erasures and alterations are not permitted.

6. Danger tags are to be securely fixed to the operating handle or isolated device of the equipment so there is no risk of them being accidentally dislodged or of an operator being able to operate the equipment without seeing the tags.

PROCEDURES FOR SWITCHING ON CIRCUITS AT SUB BOARDS

1. Cable identification, including a full visual inspection of all cabling that originate from the switchboard must be performed prior to any sub-circuits being energised. Carry out relevant inspections and tests as required by AS/NZS 3000 Wiring Rules and AS/NZS 3017 Electrical installations – Testing guidelines. All cables to be appropriately terminated at both ends, and marked for ease of identification.

2. Where a junction box has been fitted to the end of a cable, any cable insulation is to be stripped off prior to being put in a connector, this cable is not to be connected to supply, including the neutral and earth. The circuit breaker number and switchboard number is to be clearly and legibly marked on the junction box lid.

3. Schedule must be included in switchboard.

ATTACHMENT 1

ENERGISING PROCEDURE NOTIFICATION

CONTRACTOR NAME ----------
(Requesting Energisation)

CONTACT DETAILS ----------

REC No ----------

RESPONSIBLE PERSON ----------

CONTACT PHONE No ----------

AREA ----------

SWITCHBOARD DESTINATION ----------

REQUESTED DATE OF ENERGISATION ----------
(2 Days Notice Required)

EQUIPMENT DISCRIPTION ----------

ELECTRICAL SAFETY TESTS COMPLETED ---------- ***(Date)***--------
(Attach copies of Certificates of Electrical Saftey)

EQUIPMENT OK FOR ENERGISATION ---------- ***(Date)***--------

ISSUED TO:

NAME OF RESPONSIBLE PERSON ----------

POSITION ----------

COMPANY AUTHORISATION

(Name)----------***(Signature)***----------

(Date)----------

ATTACHMENT 2 SAMPLE EQUIPMENTCARDS

ATTACHMENT 3 SAMPLE PERSONAL CARDS

PERIODIC TESTING OF ELECTRICAL EQUIPMENT

All electrical tools and equipment are required to be inspected and tested to ensure that they are safe to use **prior to first use** and thereafter at regular intervals.

Time Periods

1	2	3	4	5	6	7
Environment	Relocatable construction premises, Class 1 (earthed conductive parts) and Class II (double insulated) electrical equipment		Residual current devices (RCDs)			
	Relocatable construction premises, fixed and transportable equipment and construction wiring including switchboards	Portable equipment	Pushbutton test (by user)		Operating time (RCD tester)	
			Portable	Non-portable fixed	Portable	Non-portable fixed
Construction and demolition sites	6 months	3 months	After connection to a socket or before connection of equipment, and at least once every day in use.	1 month	1 month	1 month

AS/NZS 3012 requires **Hired equipment** to be inspected and tested on a monthly basis.

Inspection and testing Requirements

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.

The Industry Standard specifies that Inspection and testing should be undertaken by a Licensed Electrician or Electrician Supervised (ES or L 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. The tag is to be non-metallic, non-reusable and durable.

Three aspects of recording of inspection/test results are required to be followed:

- **every item of equipment is to be allocated and marked with a unique identifying plant number;**
- **the results of inspections and tests recorded in a book kept for the purpose;**
- **the equipment fitted with an appropriate tag to indicate compliance or non-compliance with test requirements.**

The tag, which may be colour coded to identify the period in which the test was performed is to include:

(a) The name of the person or company who performed the tests; and
(b) the test or inspection date, and may also include a re-test date.

Appendix F of AS/NZS 3012, provides details on appropriate tag colour coding periods, is shown below:

APPENDIX F
TESTING SCHEDULE
(Informative)

This Appendix gives a recommended colour coding schedule for tags on tested equipment. The tag should indicate, by its colour, the period in which the test was performed in accordance with the following schedule:

(a)	***Red***	***January – March***
(b)	***Green***	***April – June***
(c)	***Blue***	***July – September***
(d)	***Yellow***	***October – December***

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

The details recorded shall include the following:

(a) date of inspection.
(b) plant number of the item inspected.
(c) licence number of the inspecting electrician
(d) any repairs required as a result of the inspection

Where in-service inspection or testing identifies equipment which fails to comply with the criteria given, the equipment shall be appropriately labelled to indicate that the equipment requires remedial action and warn against further use, and withdrawn from service.

Typical Log Book Layout

A typical Log Book layout for periodic inspection of plant and equipment is illustrated below (*note that full page has been abbreviated*).

Company Name
Periodic Inspection of Plant and Equipment

Site/Project Name or Location: ……

Owner of Plant/Equipment: ……

Plant Number	Description	Inspection/Test Results	Repairs Required Action Taken

Date: ……
Name of Licence Holder
Conducting Tests: ……

Wiring Licence No: ……
Signature: ……

NOTE 1: That this layout is suitable for inspection/testing of multiple items. Where single items need to be inspected/tested at one time, an alternative arrangement may be suitable, e.g., landscaped page (page laid out sideways) with additional columns for Date/Licence No./Name/Signature on each line, for each item inspected/tested.

Supervision Guidelines for Apprentices Working on Electrical Installations

OFFICE OF THE CHIEF ELECTRICAL INSPECTOR
7th November 2002

CABLE TRAY INSTALLATION LADDER, TRAY & DUCT, LADDER, TRAY SUSPENSION BRACKETS, FIXINGS. **CONDUIT INSTALLATION** CONDUIT, CONDUIT FITTINGS (J/BOXES, BENDS, ETC).	**FIRST YEAR** **SECOND YEAR** **THIRD YEAR** **FOURTH YEAR**	DIRECT GENERAL GENERAL BROAD
ROUGH-IN LIGHT & POWER CATENARY WIRE/FIXINGS, BUILDING WIRE, TPS CABLES & TIES, PLUG BASES. STUD BRACKETS, TPS CABLE DRESSING (Not accessible to contact with electricity supply)	**FIRST YEAR** **SECOND YEAR** **THIRD YEAR** **FOURTH YEAR**	DIRECT DIRECT GENERAL BROAD
SUBMAIN INSTALLATION CABLE PULLING, FIXINGS. (Not accessible to contact with electricity supply)	**FIRST YEAR** **SECOND YEAR** **THIRD YEAR** **FOURTH YEAR**	DIRECT DIRECT GENERAL BROAD
MAINS INSTALLATION CABLE PULLING, MAIN EARTH, MAIN EARTH ELECTRODE, FIXINGS. BUSDUCT. (Not accessible to contact with electricity supply)	**FIRST YEAR** **SECOND YEAR** **THIRD YEAR** **FOURTH YEAR**	DIRECT DIRECT GENERAL BROAD
DISTRIBUTION BOARD INSTALLATION INSTALL SWITCHBOARD, LUGS, GLANDS, ALL TERMINATIONS (INCLUDING SUB CIRCUITS), FIXINGS, SERVICE PILLARS, TAKE OFF BOXES. (Not accessible to contact with electricity supply)	**FIRST YEAR** **SECOND YEAR** **THIRD YEAR** **FOURTH YEAR**	DIRECT DIRECT DIRECT GENERAL

MAIN SWITCHBOARD INSTALLATION INSTALL SWITCHBOARD, LUGS, GLANDS, ALL TERMINATIONS (INCLUDING SUB CIRCUITS), FIXINGS. (Not accessible to contact with electricity supply)	**FIRST YEAR** DIRECT **SECOND YEAR** DIRECT **THIRD YEAR** DIRECT **FOURTH YEAR** GENERAL
LIGHTFITTING AND BAKELITE INSTALLATION LIGHTS, FIXINGS, SUPPORTS, TRUNKING, SUSPENSIONS, TUBES & LAMPS, SOCKET OUTLETS, SWITCH PLUGS, MOUNTING BLOCKS, PLASTER BRACKETS. (Not accessible to contact with electricity supply)	**FIRST YEAR** DIRECT **SECOND YEAR** DIRECT **THIRD YEAR** GENERAL **FOURTH YEAR** BROAD
TESTING TESTING OF INSTALLATION FOR COMPLIANCE, LABELLING, PREPARATION OF D/B LEGENDS (Not accessible to contact with electricity supply)	**FIRST YEAR** DIRECT **SECOND YEAR** DIRECT **THIRD YEAR** DIRECT **FOURTH YEAR** GENERAL
FAULT FINDING (Accessible to contact with electricity supply) **During the fault finding process, the supervising electrician must demonstrate to the apprentice the correct procedures for fault finding** **Note 1** – the 3rd year apprentice in the immediate presence of the supervising electrician can carry out basic fault finding task E.g. on single phase light & power circuits & apparatus. **Note 2** – the 4th year apprentice can carry out basic fault finding activities. In the immediate presence of the supervising electrician the 4th year apprentice can carry out more advanced fault finding task on power and control circuits and equipment.	**FIRST YEAR** NOT PERMISSIBLE **SECOND YEAR** NOT PERMISSIBLE **THIRD YEAR** DIRECT (see note 1) **FOURTH YEAR** DIRECT (see note 2)
CONFIRMATION OF ISOLATION * The supervising electrician is responsible for the isolation of the installation. During the isolation process the supervising electrician must demonstrate to the apprentice the correct testing procedures for electrical isolation. After isolation, the supervising electrician is to ensure the apprentice carries out the testing procedures to confirm isolation, under direct supervision, before work commences.	**FIRST YEAR** NOT PERMISSIBLE* **SECOND YEAR** NOT PERMISSIBLE* **THIRD YEAR** NOT PERMISSIBLE* **FOURTH YEAR** DIRECT

Direct Supervision

This means the electrician is to work with the apprentice, constantly reviewing the work practices and standard of the apprentice's work. The electrician shall be readily available in the immediate area, within audible range (earshot) and where possible within visual contact of the apprentice.

General Supervision

This means the apprentice does not require constant attendance of the on site supervising electrician but requires face to face contact on site during the day with the supervising electrician to check on the work being performed and to provide the apprentice with additional instructions and assistance.

As part of General Supervision, the supervising electrician shall provide the apprentice with instruction and direction for the tasks being performed with progressive checks and tests being made during the work being undertaken

Broad Supervision

This means the apprentice does not require constant attendance of the on site supervising electrician but requires face to face contact with the supervising electrician on site to check on the apprentice and the work being carried out by the apprentice.

As part of Broad Supervision, the supervising electrician shall provide the apprentice with instruction and direction for the tasks being performed with checks and tests being made prior to commissioning and/or energising of circuit(s) and or apparatus/equipment.

Accessible to contact with electricity supply

This means that the person is in a position where they can personally make contact with live electrical equipment and wiring including making contact via tools or conductive material with live electrical components.

Application of these guidelines

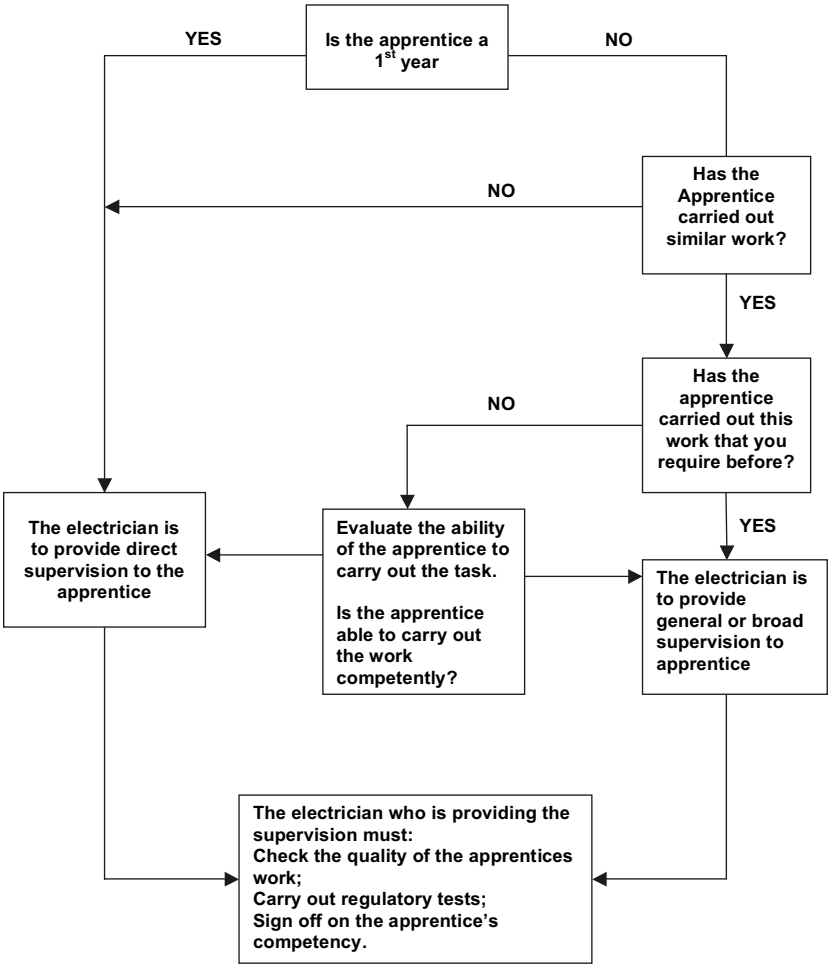
The above guidelines have been developed to assist electricians and electrical contractors in providing supervision to apprentice electricians during their on the job training. The guidelines reflect the intent of *"effective supervision"* as defined in the Electricity Safety (Installations) Regulations 1999 and assist with the compliance of the Electrical Safety Act.

- Note - Supervision practice – the goal of supervision should be to progressively diminish from direct to broad in the fourth year off the apprenticeship with the exception on conducting the activities of fault finding & confirmation for isolation. This condition is subject to successful completion of all trade school subjects by the apprentice.

Not covered by these guidelines

The Occupational Health and Safety Act 1985 places a duty on employers to provide such supervision to employees as necessary to enable the employees to perform their work in a manner that is safe and without risks to health. The use of the above guidelines in no way removes or limits the employer's duty under Occupational Health and Safety legislation.

Guide to site supervision of apprentices by the supervising electrician



SUPERVISION GUIDELINES

FOR LINEWORKER APPRENTICES IN THE

VICTORIAN ELECTRICITY SUPPLY INDUSTRY

(DISTRIBUTION)

November 2005

Contents

INTRODUCTION

These Guidelines have been developed and established by the Victorian Electricity Supply Industry, (VESI). Any changes to these Guidelines can only be made with the agreement of the VESI.

These Guidelines also augment the "National Code of Good Practice for New Apprenticeships" released December 2000, by the Commonwealth Government.

The National Code can be found at:
http://www.newapprenticeships.gov.au/brochures/default.asp

PURPOSE

These Guidelines have been developed to assist both parties (employers and apprentices) entering into a training contract, to understand each others obligations and expectations in regard to apprentice workplace supervision.

SCOPE

These Guidelines apply to the supervision of all apprentices employed in the VESI who are undertaking Units of Competency related to the national "UTT 30101 – ESI (Distribution) Powerline 3" qualification or equivalent

BACKGROUND

Entry into the lineworker trade is typically through State/Territory approved apprenticeships. Electricity Supply Industry, (ESI) apprenticeships generally take four years to complete and utilise an on-and-off-the-job training regime to develop the full range of competencies. The appropriate level of supervision that should be applied to an apprentice during the on-the-job component should be applied with respect to the welfare of the apprentice in terms of safety and competency development.

Determining the appropriate level of supervision to apply is generally dependent on the balance between assuring the safety of the apprentice, the work to be carried out and the experience of the apprentice. The level and pattern of supervision to be applied is not one that is time based but takes into account a range of factors such as:

- knowledge and skills (on-and off-the-job technical training/learning) attained, and
- previous experience/learning and training/practice and repetition the apprentice has had relative to each particular task, skill or work function to be performed.

During the course of an apprenticeship it is expected that apprentices will have worked across a representative range of plant & equipment, consistently and to industry requirements with supervision ranging from direct to general to

broad. They will also have concurrently attained the relevant underpinning knowledge and skills to support workplace performance.

RESPONSIBILITIES

EMPLOYER

The employer shall:

a) Provide a safe workplace, free from bullying and verbal, physical, racial and sexual abuse.
b) Ensure that all occupational health and safety requirements are addressed.
c) Provide an appropriate induction to the workplace, stressing those core occupational health & safety requirements essential to work place safety.
d) Establish a coaching/mentoring program for all apprentices.
e) Ensure that safety requirements essential to workplace safety are met.
f) Lodge training contract documentation with the relevant authorities, select a Registered Training Organisation and enrol the apprentice within the timeframe determined by the State Training Authority.
g) Provide opportunities to develop knowledge and skills.
h) Ensure that training records are maintained.
i) Ensure that the relevant authorities are notified on the completion of the training contract, or advise them in instances where the Training Contract is in danger of not being completed.

APPRENTICE

The apprentice shall:

a) Attend and perform his or her work in a professional and courteous manner in accordance with the employer's requirements.
b) Take care of workplace property and resources.
c) Respect the rights of other apprentices and employees in the workplace.
d) Remember that information obtained from the employer must be kept confidential and not disclosed without approval from the employer.
e) Make all reasonable efforts to achieve the competencies specified in the training plan
f) Undertake any training and assessment required.
g) Participate in the development of the training plan.
h) Attend training sessions or supervised workplace activities and take advantage of learning opportunities.
i) Maintaining records of training as required.

PROCEDURE

Supervisors should use these Guidelines when planning work or allocating work functions and activities in the workplace for apprentices.

Apprentices should not assume responsibilty for tasks unassisted unless they have received relevant training. However this does not restrict an apprentice from observing or assisting qualified personnel undertaking tasks, for which the apprentice is not qualified, eg,

a) A first year apprentice should not undertake LV cable jointing, yet can assist a qualified jointer for example by cutting lengths of cable, or applying a heat shrink under direct supervision.

b) A second year apprentice should not perform metering and testing work, but can assist a qualified tradesman for example by hanging and wiring a meter under direct supervision

c) A first year apprentice should not install overhead or underground services, but can assist a qualified tradesman for example by hanging the house end under direct supervision in preparation for testing

Table 1 provides guidance on the activities apprentices can and cannot undertake. It has been aligned to the training package as delivered for the ESI (Distribution) Powerline 3 qualification, ie it shows apprentices as being able to perform live metering and servicing during the second year, which is when they complete that relevant module.

In relation to the supervision of apprentice lineworkers undertaking work on Victorian electricity networks employers should:

a) Establish programs, ie coaching or mentoring to ensure apprentices receive technical and individual support throughout the training agreement.

b) **Take all reasonable steps to ensure supervision of apprentices is carried out by a person that is competent and approved to carry out the work in question**

c) **Take into consideration the kind of work being undertaken, especially with regard to live work or work in the vicinity of live apparatus; and**

d) **Have regard to the level of competence of the apprentice for the particular task, skill or activity to be performed, with the goal of supervision progressively diminishing to broad in the fourth stage.**

e) **Take into consideration issues relating to the use of apprentices as competent assistants or Safety Observers, such as prevailing legislation, the obligations of employers supervising apprentices and, where applicable, Regulatory Requirements.**

In determining the level and pattern of supervision for an apprentice several factors are taken into account. These are knowledge attained and, previous experience and training the apprentice has had relative to each particular task, skill, or work function to be performed. The pattern of supervision will typically range from direct, general to broad.

SUPERVISION TYPES

During the term of their apprenticeship the apprentice shall be under either Direct, General or Broad Supervision as defined below at all times.

Direct (Constant) Supervision

This means the tradesperson is to work with the apprentice at all times, constantly guiding and reviewing the work practices and standards of the apprentice's tasks/work. The tradesperson shall be in direct visual & audible contact with the apprentice whilst the task/s is being performed.

Note: All "Live Work" requires **Direct Supervision** on a one to one basis.

General Intermittent Supervision

This means the apprentice does not require direct (constant) supervision but, requires frequent face to face contact during the task/s to provide progressive instructions and to check on the work being performed.

Broad Supervision

This means the apprentice does not require the continuous direct or general supervision of the on site supervising tradesperson. However the supervising tradesperson shall maintain regular face to face contact with the apprentice to inspect and assess the work being carried out by the apprentice.

As part of Broad Supervision the supervising tradesperson shall provide the apprentice with instruction and direction for the tasks to be performed.

Supervision Practice

The goal is for supervision to progressively diminish from direct to broad in the third or fourth year of the apprenticeship (depending on the task) with the exception of performing "Live Work"

RECOGNITION OF PRIOR COMPETENCIES

There are situations where a person undertaking an apprenticeship has previously been assessed as competent and / or authorised to undertake activities that a 'junior apprentice' would not be permitted to undertake (or at a minimum would require some level of supervision).

For example a person employed as an 'adult apprentice' may have existing competencies, eg HV Operator, Cable Jointer or licences/authorisations and significant experience to operate items of plant eg Fork Lift, EWP etc.

Exemptions from these guidelines are permitted for 'adult apprentices' to undertake relevant activities provided licences/authorisations and appropriate refresher training records are current and up to date.

In these cases the person and the particular activity being allocated should be recorded as part of the Pre Job Risk Assessment process.

SAFETY OBSERVER ROLE

Apprentices who are new entrants into the industry and who have not acquired relevant skills and knowledge are not to be used as safety observers in their initial period, (6 months) of training as per Commonwealth, State or Territory legislative or regulatory requirements.

Thereafter, they may be utilised as a competent safety observer but only if they have

a) Been suitably trained in rescue and/or escape techniques,
b) Been suitably trained in Safe Approach Distances
c) Attained an adequate awareness of the task being performed, and
d) An understanding of the functions and movements of plant and equipment.

Under no circumstances are apprentices to perform the role of sole Safety Observer for a person undertaking live LV work until they have completed the relevant training in Block 8 during the second year of their apprenticeship.

AVAILABILITY

The Apprentice must have successfully completed their Live LV module and have started their 3rd year.

An apprentice can only take on the duties of a 'second call' availability lineworker.

The person in charge must be able to adequately supervise the apprentice at all times as outlined in Table 1 below.

ACCESS AUTHORITIES

An apprentice cannot be a 'Recipient in Charge' of an Electrical Access Permit.

1st Year. If working in a shutdown situation must be bracketed on to the Access Authority with a registered lineworker as an NAR (Non Authorised Recipient).

2nd Year. Can be authorised as an authorised recipient. This means that they can sign onto access permits in their own right and work within the bounds of the access permit but must remain under supervision as outlined in Table 1. Prior to being authorised, an apprentice must have successfully completed first year of apprenticeship, received appropriate First Aid training and have been bracketed on to the minimum number of EAP's as designated by the network Operator.

Post Apprenticeship. Upon successful completion of apprenticeship can sign on as Recipient in Charge.

HIGH VOLTAGE OPERATING

3rd Year. Can be classified as an 'Operator in Training' following successful completion of High Voltage Operating module. Can undertake operation on the overhead network only under direct supervision.

4th Year: Can be authorised as a HV switching operator after successful completion of National Unit of Competency (UTTNTD 301B). This means they can switch assets as authorised by Network Operator and issue Access Permits to persons eligible to sign on as a recipient in charge. Must be under the general supervision of a HV Operator authorised to level appropriate to the HV operating being undertaken.

For switching of metal clad switchgear, underground network and within zone substations can only be classified as an 'Operator in Training' and must be under the direct supervision of an authorised HV Operator at all times.

TABLE 1 WORK TYPES

NOTE: NO TASKS CAN BE UNDERTAKEN UNASSISTED UNTIL THE APPRENTICE HAS BEEN TRAINED BY AN RTO OR APPROPRIATE TRAINER / ASSESSOR AND PASSED THE RELEVANT COURSE. (SEE PROCEDURE)

Type of Work		First Six Months	Second Six Months	Year Two	Year Three	Year Four
General	Yard Work	General	Broad	Broad	Broad	Broad
	Ground Work at Job Site	Direct	General	General	Broad	Broad
	Pole Dressing	Direct	General	General	Broad	Broad
	Traffic Control	*No*	General	General	Broad	Broad
	Install Stays	Direct	Direct	General	General	Broad
Working Aloft	LADDER Work Aloft (Under EAP or Not Commissioned).	***Direct***	Direct	General	General	Broad
	EWP Work Aloft [1] (Under EAP or Not Commissioned or).	Direct (Not Operating EWP)	Direct	Direct	Direct / General	Broad
Earthing	Install Substation / Switch Earths	Direct	Direct	Direct	Direct / General	Broad
	SWER Earth maintenance	Direct	Direct	Direct	Direct / General	Broad
Public Lightin	New Public Lighting Installations. (De-energised)	Direct	Direct	General	General	Broad
	Public Lighting Maintenance & Repair (Live)	**No**	**No**	**No**	**No** / Direct	Direct
Metering & Servicing	Install / Replace Metering (De-energised)	Direct	Direct	Direct	Direct / General	Broad
	Install / Replace Metering (Live)	**No**	**No**	**No**	**No** / Direct	Direct
	Install Services Overhead and Underground (De-energised)	Direct	Direct	***General***	General	Broad
	Install Services Overhead and Underground (Live)	**No**	**No**	**No** / Direct	Direct	Direct
	Undertake NST/Polarity Test	**No**	**No**	*No* / Direct	Direct	Direct
Live LV Work	Live Low Voltage Work	**No**	**No**	**No** / Direct	Direct	Direct
	Make LV Dead	**No**	**No**	**No** / Direct	Direct	Direct
	LV Bridging	**No**	**No**	**No** / Direct	Direct	Direct
	Change LV Cross Arm Alive	**No**	**No**	**No** / Direct	Direct	Direct
Cable Jointing	LV Cable Jointing (Under EAP or Not Commissioned).	Direct	Direct	Direct / General	General	Broad
	Live LV Cable Jointing	**No**	**No**	**No**	**No** / Direct	Direct
	HV Cable Jointing	**No**	**No**	**No**	**No** / Direct	General
	Undertake Vegetation Control (EAP)	**No**	**No**	**No** / Direct	Direct	General
	High Voltage Operating [2]	**No**	**No**	**No**	**No** / Direct	General

[1]	Must be at least 18 years of age and hold a WorkSafe EWP licence prior to operating an EWP.
[2]	Network Operator issued HV Operating Authority must be held

TABLE 2 PLANT TYPES

Type of Work	First Six Months	Second Six Months	Year Two	Year Three	Year Four
Chainsaw	**No**	Direct	General	Broad	Broad
Self-Loading Cable Trailer	**No**	Direct	General	Broad	Broad
Cable Recovery Unit	**No**	Direct	Direct	General	Broad
Truck-mounted crane < 10 tonne	*No*	Direct	Direct	General	Broad
Forklift	Prior to operation must meet all regulatory requirements, ie age, training and appropriate Worksafe licence. (*See Recognition of Prior Competencies for further information*)				
EWP					
Truck-mounted crane ≥10 tonne					

FREQUENTLY ASKED QUESTIONS

Type of Work	First Six Months	Second Six Months	Year Two	Year Three	Year Four
Can they go on availability?	No	No	No	Yes [1]	Yes [1]
Can they climb new poles and structures (not commissioned) ?	Yes	Yes	Yes	Yes	Yes
Can they climb commissioned poles and structures under EAP?	Yes	Yes	Yes	Yes	Yes
Can they work live (LV) ?	No	No	No / Yes	Yes	Yes
Can they be a safety observer – HV Live Line Work?	No	No	No	No	No
Can they be a safety observer - Live LV work?	No	No	No / Yes [2]	Yes [2]	Yes [2]
Can they undertake polarity/NST testing?	No	No	No / Yes	Yes	Yes
Can they perform LV switching?	No	No	No / Yes	Yes	Yes
Can they supervise contractors?	No	No	No	No	No
Can they perform Traffic Control?	No	Yes	Yes	Yes	Yes
Can they conduct a Safe to Approach test?	No	No	No / Yes	Yes	Yes
Can they undertake HV operating?	No	No	No	No / Yes [3]	Yes [3]
Can they sign on an Electrical Access Permit?	Yes [4]	Yes [4]	Yes [4]	Yes [4]	Yes [4]
Can they be a Recipient in Charge of an Electrical Access Permit?	No	No	No	No	No

[1] – Refer to Availability requirements

[2] - Refer to Safety Observer requirements

[3] - Refer to High Voltage Operating requirements

[4] - Refer to Access Authorities requirements

ALERT

NUMBER 1 DATED 4 FEBRUARY 2000

SWITCHBOARDS ON BUILDING AND CONSTRUCTION SITES

The ETU requires that all switchboards on building and construction sites (including site amenities), have a locked cover over the RCDs and circuit breaker.

This is to ensure that the reason for the fault is positively identified by the appropriately qualified personnel and rectified.

Authorised by

Allan Mulvena

OH&S Officer ETU

ALERT

NUMBER 5 DATED 22ND June 2000

WORKING LOAD LIMITS

In a number of recent incidents, wrong assumptions about loading of equipment have resulted in workplace accidents.

As a result, a recent meeting of OH&S Representatives have unanimously supported the following requirements for load shifting equipment.

1. That the load that is intended to be lifted, has its weight marked on the load (eg cable drums, large switchboards). **If the weight is not marked, then it should not be accepted at the workplace.**

2. That all load shifting equipment has been designed and manufactured to the relevant Australian Standard.

3. That a working load (either SWL- safe working load, or WLL- working load limits) be permanently displayed on any equipment used to support loads. This would include such things as cable stands/jacks and associated bars.

4. The weight must not exceed the SWL/WLL for the load bearing equipment. If it is exceeded, then it is not to be lifted.

5. That load shifting equipment is regularly inspected, (as per manufacturer requirements by a competent person) and a readily accessible log kept of such inspection.

ALERT

NUMBER6 DATED 23 August 2000

NO LIVE WORK ON CONSTRUCTION WIRING

Last year it was reported to the Office of The Chief Electrical Inspector that there had been 14 incidents where licensed electrical workers either came into contact with an energised source, or were in close proximity when an incident occurred and an explosion ensued.

Recently one of our members was severely injured in an explosion. The practice of live work must cease before more workers are injured or killed.

The ETU requires that **all members not work live**.

There should not be any instance where a person would have to work on an energised construction (temporary) wiring circuit. Unfortunately some of our members have a belief that an RCD will protect them in all instances, this is not the case.

An RCD will not trip out where: -

- the rated trip current is not reached; or
- where a person or object is connected to active and/or neutral but not earth.

Don't become a statistic. Work Dead or Be Dead.

ALERT

NUMBER 7 **DATED 14th August 2001**

RELOCATABLE BUILDINGS

No puncturing of site sheds with any fixing attachments (screws, nails etc) as this can change the integrity of the electrical installation.

No unauthorised electrical alterations to be made to the site shed. Authorisation to be in writing by the hirer/owner.

ALERT

NUMBER 8 **DATED 15th August 2001**
(Amended 1 June 2007)

ANGLE GRINDERS

All angle grinders above 100mm must incorporate a deadman switch or such other device which will ensure that should the power be turned off that the device cannot restart by itself. Such devices need a deliberate action such as turning off the switch, before the angle grinder is operational.

All angle grinders must have a guard.

Buffers do not require deadman switches or guards, but the responsibility of proof as to whether the piece of plant is a grinder or buffer rests on the owner of the equipment to provide suitable manufacturers documentation to support their case.

ALERT

NUMBER 9 **DATED 15th August 2001**

TESTING AND TEST EQUIPMENT

There have been several accidents recently which have prompted the ETU to remind its members that when testing to check if electrical equipment is de-energised:

1. Test on a known live source
2. Test electrical equipment (wiring, switchboards etc)
3. Test on a known live source

All equipment used for testing of an installation must be regularly calibrated to the manufacturer's specifications (normally yearly) as required by AS/NZS 3760 In Service Safety Inspection and Testing of Electrical Equipment.

ALERT

NUMBER 10 **DATED 15th August 2001**
(Amended 11 December 2002)

VOLT STICKS

BE AWARE THAT THE VOLT STICK DOES NOT WORK IN ALL CIRCUMSTANCES

Many people rely on this equipment to their detriment.

Volt sticks do not work on steel wire and lead armoured cable, M.I.M.S. (PYRO), Direct Current.

Volt sticks may also not work on PVC conduits containing energised cables or on orange circular cable.

Volt sticks are the same as any other test equipment; ensure they are operating properly (See ALERT 9 Test & Testing Equipment).

ALERT

NUMBER 11 DATED 29 November 2001

TESTING & TAGGING

Recently a worker was injured when he came into contact with a damaged cord on a radio.

All electrical equipment on construction sites including **radios** and **battery chargers** are required to be electrically inspected, tested and tagged to the requirements of Australian/New Zealand Standard, AS/NZS 3760 In service safety inspection and testing of electrical equipment.

On construction sites, all equipment will be inspected to the time frames specified in AS/NZS 3012 Electrical installations – building and demolition sites.

ALERT

NUMBER 12 DATED 9 May 2002

UNSAFE EXTENSION LEADS

It has been bought to the attention of the ETU by one of our members that a particular brand of extension lead has a hard brittle plug top and plug socket.

The plug socket on several leads had sustained severe damage, rendering them unsafe and unsuitable for use. On further investigation it was revealed that the plug socket had only been dropped to the floor. The damage had occurred on new leads only having been purchased a few weeks prior.

The brand of the lead is "YONGHUA" which is marked on the side of the lead. The lead is being distributed by a company called INTEX.

ETU members are requested not to test and tag these leads and have them removed from service until the reason for the fault has been identified. The leads can be used if the plug top and socket are replaced and retested and tagged.

ALERT

NUMBER 13 DATED 29 August 2002

CONSTRUCTION WIRING INSTALLED IN CONCRETE SLABS

The ETU has been advised of incidents occurring where construction wiring which has been installed in a concrete slab has been damaged when it has been drilled in to or cut when coring was occurring.

The concern being that generally the cable is a sub-main feeding the field switchboard, and this cable does not have RCD protection which provides personnel protection (30mA) to ensure the safety of the workers involved.

The general principle of the “Industry Standard for Electrical Installations on Construction Sites” is for the cable to be marked every 5 metres. Since this can’t be done as the cable is not visible, the cable route is to be clearly identified by permanent marking or by some other method which affords the same level of identification for the life of the installation.

ALERT

NUMBER 16 DATED 11 December 2002

ELECTRIC OVENS

An ETU OH&S Representative on a construction site has raised concerns in relation to the potential for exposure to synthetic mineral fibres when electricians take the back off the ovens to connect them to supply.

The synthetic mineral fibre (SMF) used in a particular brand of oven has been identified as GLASSFIBRE. As with any SMF it is important not to work in a manner where the worker can possibly inhale respirable fibres. SMF's can also cause skin irritation.

By using the "HEIRACHY OF HAZARD CONTROL", elimination of the risk of exposure is the first priority.

The connection of the oven should be redesigned so that the worker is not required to access the rear of the stove. Providing a terminal box on the outside of the stove or providing a lead on the oven is a way of ensuring that the electrician installing the oven is not exposed to the fibres.

ALERT

NUMBER 17 DATED 7 March 2003

INSPECTION AND MAINTENANCE OF LADDERS

All ETU members should ensure that prior to using a ladder, they inspect the ladder to ensure that it is safe to be used. The inspection should check to see if there is any visible damage (cracked or bent) to the stiles or treads. Whether the stays are missing or damaged, the ladder is missing supports, pop rivets or bolts, or that the feet of the ladder are severely worn or missing.

Under no circumstances should the employees attempt to carry out the rectification themselves, or to use a ladder where the manufacturer or the manufacturers nominated service agents have not carried out rectification.

Any ladder, which is found to be in an unsafe condition should be removed from service immediately, and taken to the employers designated area. This will ensure that the ladder can not be returned until the ladder has been rectified to the manufacturer's specifications. The authorised agent is to provide documentation to confirm the ladder has been repaired and is now compliant with Australian Standards.

All ladders are required to comply with the requirements of Australian Standards 1892 series. AS/NZS 1892.5 Section 4.1 requires, under no circumstances shall any temporary repairs be made to any ladder.

ALERT

NUMBER 18 DATED 19 March 2003
(Amended 5 April 2004)

HIRE EQUIPMENT

It has been brought to the attention of the ETU that there is some confusion in relation to the time period required for testing of electrical equipment that is hired.

Australian Standard *AS/NZS 3012: 2003 - Electrical installations-construction and demolition sites* requires:

3.2 FREQUENCY OF INSPECTION AND TESTS

Equipment shall be inspected and tested –
(c) prior to each hire (for hire equipment, inspection only) and additionally tested at not greater than monthly intervals;

This inspection and testing period applies regardless of the actual term of the hire.

All ETU members who test and tag hire equipment for use in the construction industry, should ensure that they carry out the tests in accordance with the requirements of AS/NZS 3760.

ALERT

NUMBER 20 DATED 24 June 2003

TESTING & TAGGING ELECTRICAL EQUIPMENT ON CONSTRUCTION SITES

There appears to be some confusion amongst workers on construction sites as to the time period between tests for electrical equipment on building and construction sites.

The Industry Standard for Electrical Installations on Construction Sites March 2002, Section 4.3 requires:

> ***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.*

Problems occur during the change over period between tests because there is a perception of leeway from this time frame. As stated, the test period is 3 calendar months. This is the maximum period permissible, electrical equipment is to be tested and tagged so that the time between tests does not exceed 3 months.

Note : Only those suitably trained are to test and tag electrical equipment. Temp Wiring (Construction Wiring) Ticket Holders are those suitably trained to carry out this work.

ALERT

NUMBER 21 DATED 24 June 2003

PORTABLE LIGHT TOWERS SUPPLIED BY GENERATORS

Problems have arisen on site where portable light towers, supplied by generators, have not been protected by Residual Current Devices (RCD).

In some circumstances the portable light towers also have socket outlets installed on them, which were not protected by RCD.

The Industry Standard for Electrical Installations on Construction Sites March 2002,
Section 5.1 requires:

> ***5.1 RCDs on generators***
>
> *Electrical socket outlets mounted on generators shall be protected by RCDs not exceeding 30 mA.*

Also Australian Standard AS/NZS 3012 Electrical installations – construction and demolition sites, Clause 2.4.6.2, requires all electrical equipment supplied from permanent wiring shall be protected by a maximum rated RCD of 30mA.

RCDs, must be tested for tripping current and time each calendar month, as per the Industry Standard for Electrical Installations on Construction Sites Section 4.4.

It is important that the generator units are designed as such to allow the testing of RCDs as AS/NZS 3760 requires that equipment, without being dismantled, needs to be subjected to routine inspection and testing to detect obvious damage, wear or other conditions which might render it unsafe.

ALERT

NUMBER 22 DATED 26 February 2004

INSPECTION OF LEADS FOR DAMAGE pigtail leads (extension and tools)

It is imperative when performing an inspection during testing and tagging of electrical equipment, that the assessment clearly identifies any physical damage that may render the equipment immediately unsafe to be used, or potentially unsafe to be used for the period being tested for eg. 3 months for construction sites.

Australian Standard AS/NZS 3760:2003 requires in part:

2.3.2 Inspection

The following equipment checks shall be made by visual and physical inspection on all equipment:

(c) Check for damage to flexible cords –

(i) the inner cores of flexible supply cords are not exposed or twisted;
(ii) the external sheaths are not cut, abraded, twisted, or damaged to such an extent that the insulation of the inner cores is visible; and
(iii) unprotected conductors or insulation tape are not in evidence.

NOTE1: Carefully running the supply cord through the hand will often detect internal damage such as twisted conductors or broken core filling.

ALERT

NUMBER 24 DATED 29 April 2004

Correct Plug top – Plug socket arrangement

It has come to the attention of the ETU that persons are installing different rated plug top and plug socket arrangements on extension cords.

The following provisions of Australian Standards require that:

AS/NZS 3123 requires in Clause 8.2 in part:

> 8.2 Protection against improper connections
>
> It shall not be possible to engage plugs with socket-outlets or connectors having lower ratings, or having fewer contact combinations. In addition, it shall not be possible to engage appliance connectors with appliance inlets having higher ratings, or having a larger number of contact combinations.

AS/NZS 3199 requires. Clauses 5.1 and 5.2 requires:

> ***5.1*** General
> The plug and cord extension socket shall be each of the same current rating and configuration, and in no case greater than the current- carrying capacity of the flexible cord.
>
> 5.2 Plug
> The plug shall be a three-pin flat-pin plug complying with AS/NZS 3112, and have a current rating of not less than 10 A.

ALERT

NUMBER 25 DATED 03/08/2004

Action Following Electric Shock

Problems have arisen where workers have received an electric shock and have not sought medical treatment.

The ETU recommends to all of its members that if a person receives an electric shock that they seek immediate medical treatment to ensure that no abnormalities have occurred.

A person is not to drive himself or herself to either a doctor or hospital but should be transported where appropriate by ambulance. A qualified first aider will make the determination about the best mode of transport.

It will be up to the medical practitioner to determine whether an electrocardiograph (ECG) is appropriate or not.

The ETU wishes to be advised of these events to ensure that the workers health and safety is not being compromised. There are also legal requirements on the employer to ensure that Worksafe and the OCEI are notified of the event.

FAULTY EQUIPMENT NOTICE

Date:	Date of Concern: Time:
Person reporting concern/fault: Phone number:	
Site name:	
Project name: Address:	
Contractor Involved: Address: Phone:	
Supervisor or OHS Rep: Phone number:	
Product Type:	
Product Model:	
Product Serial No:	
Brief description of concern:	

Notify ETU by fax 03 8329 0066 – attention Allan Mulvena

***NB:** It is important to complete this form as soon as possible to enable the ETU OHS Unit to collate the information and relay concerns to Energy Safe, the manufacturer or importer.

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