Electricity Standards
and Safety

Electrical Contractor's Service and Installation Guide

There are 2 parts to this guide with shared responsibility. For comments please contact the relevant organisation.

Part (1) is available from the link below, Part (2) follows on from this page.

Part (1) Aurora Energy
Requirements and Guidelines
(Link to be advised)

Part (2) Electricity Standards *and* Safety
Regulatory Requirements and Guidelines

Tasmania
DEPARTMENT *of*
INFRASTRUCTURE ENERGY
and RESOURCES

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Service and Installation Guide

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Part 2: Regulatory Requirements and Guidelines

Acronyms used in Part 2 of this guide

ESS	**Electricity Standards *and* Safety**
ESAA	**Electricity Supply Association of Australia Ltd**
SA	**Standards Australia**
EL/1	**The name of the Standards Australia committee responsible for The Wiring Rules and some associated standards**

Section 1.0

Regulation

1.0 Regulation

1.1 ABOUT THE OFFICE OF THE TASMANIAN ENERGY REGULATOR

1.1.1 INTRODUCTION

The Tasmanian Energy Regulator was established as part of the reform of the Tasmanian electricity supply industry.

The Regulator is independent of the Tasmanian Government and the electricity industry and is responsible for the administration of the *Electricity Supply Industry Act 1995* (the ESI Act).

The ESI Act is supported by detailed consumer protection and price control regulations. The Act creates the Tasmanian Electricity Code, which establishes the technical specification of network security, reliability and connection standards.

1.1.2 RESPONSIBILITIES

The Energy Regulator is responsible for:

- setting maximum prices for the sale and supply of electricity services including charges for generation, transmission, distribution and retail supply
- issuing licences
- ensuring that electricity retailers comply with strict service and supply standards
- standards and conditions; and
- administering and enforcing the Tasmanian Electricity Code.

Contraventions of the ESI Act or Code, including failure to comply with an order made by the Regulator, may attract a penalty of $100,000. A further $10,000 may be payable for each day a breach continues.

1.1.3 WHO IS THE TASMANIAN ENERGY REGULATOR?

The Regulator is Mr Andrew Reeves, an Associate Commissioner of the Australian Competition and Consumer Commission, who brings extensive experience in public utility and price regulation to this role.

1.1.4 CUSTOMER PROTECTION

A comprehensive legislative framework has been developed to protect consumers. This ensures minimum standards of service and reliability and the determination of the setting of the maximum prices.

Under the legislation, retailers are required to prepare standard customer contracts for the supply of electricity, which identify the level of service and standards of supply a customer can expect to receive. These contracts are legally enforceable and must first be approved by the Regulator. Contracts are supported by Customer Charters, which are also approved by the Regulator, providing guarantees of performance.

As it is often difficult for customers to take an electricity company to court to enforce their rights, the Regulator has been given the power to take action on behalf of consumers.

1.1.5 CONSULTATION

The Energy Regulator actively seeks community input to his investigations.

In administering the Act and the Tasmanian Electricity Code, independent bodies, which provide advice to the Regulator include:

- a Customer Consultative Committee consisting of representatives of peak community and industry bodies; and
- the Network Planning and Reliability Panel.

1.1.6 REPORTING

The Regulator has extensive reporting obligations covering power system security, equipment testing, code breaches and sanctions. To protect the interests of electricity consumers, the Regulator will produce regular reports on standards of customer service, complaints received and the response by the electricity supplier and the Electricity Ombudsman.

The Regulator produces reports on electricity price determinations with reasons for his decision and takes into account matters raised in submissions before producing a final determination.

1.1.7 COMPLAINTS

Electricity companies must have their own procedures to handle customer complaints. These must be consistent with recognised Australian Standards.

If a customer is dissatisfied with the way a complaint has been handled, the complaint may be lodged with the Electricity Ombudsman. (See in section 1.1.8)

For details of the responsibilities and functions of the Regulator please refer to the *Electricity Supply Industry Act 1995* and Regulations and the Tasmanian Electricity Code.

1.1.8 CUSTOMER RIGHTS

Introduction

The Tasmanian electricity supply industry has undergone significant reform in recent years resulting in the separation of HEC and the establishment of an independent Energy Regulator on 1 July 1998.

Customers are at the centre of these reforms but require regulatory support in dealing with a monopoly supplier. Most customers cannot negotiate effectively on price with a monopoly. Therefore there must be price control with a tariff including conditions of supply.

Customer rights, quality and reliability of supply, prices and service standards are set out in public documents. This ensures that customers are aware of, and can exercise, their rights. The companies are required to report on their performance.

Industry Structure

The revised industry structure has three separate electricity entities:

- Hydro Tasmania (controls and manages the generation assets and is responsible for system control);
- Transend Networks Pty Ltd (the transmission network owner); and
- Aurora Energy Pty Ltd (the distribution network owner and electricity retailer).

Energy Regulator

The Regulator is concerned with the security and reliability of the electricity system, the quality of electricity supplied, and the prices and conditions of the supply of electricity and related services.

The functions include:

- issue of licences to electricity companies
- setting of maximum prices charged to tariff customers
- setting and enforcing standards for reliability and quality of supply
- setting the rules for the integrated operation of the generation transmission and distribution system; and
- approval of the minimum terms of supply between Aurora and the tariff customer.

Customer dealings with Aurora

The rights and obligations of customers and Aurora are set out in two documents approved by the Regulator and published by Aurora:

- and approved by the Energy Regulator Standard Tariff Agreement; and

- Customer Charter.

Standard Tariff Agreement

The tariff is made up of two components: price and conditions of supply. Price is established by the Energy Regulator as the result of a public enquiry process including scrutiny of the costs and performance of the electricity companies.

The contractual conditions of supply are set by the Standard Tariff Agreement. It is required by statute to address such issues as:

- connections and re-connections
- interest payments on overdue accounts
- services a customer is entitled to receive
- procedures for handling enquiries and complaints
- technical matters like voltage fluctuations and power factors.

It is an important aspect of the regulatory arrangements that the tariff is seen as a 'safety net', ie minimum standards and conditions of service and supply. All customers can, and many do, contract outside the standard tariffs on both price and terms and conditions of supply.

Credit conditions are an important aspect of the retailer/customer relationship. There are specific provisions in respect of the most important aspects of credit policy, eg interest rates, security deposits and arrangements for 'payment plans' where customers find difficulty in meeting their obligations.

Customer Charter

The Customer Charter is a statement by Aurora of service standards and conditions it will provide which exceed those provided for in the tariff agreement. It provides guarantees of service standards including payments where Aurora fails to meet the services standards it has promised. Copies of both the Standard Tariff Agreement and the Customer Charter are available free upon request from Aurora Energy.

Electricity Ombudsman

The Electricity Ombudsman deals with complaints that customers may have in their dealings with electricity companies. Customers should initially approach the company with any complaints. In the event that a dispute cannot be resolved, the Ombudsman can be asked to investigate and resolve the complaint.

The Ombudsman may:

- investigate and resolve complaints;
- make awards for payments to customers;
- identify and review issues arising out of complaints; and
- assist electricity companies to develop procedures to resolve complaints.

1.1.9 FOR MORE INFORMATION ABOUT THE FOLLOWING

Energy Regulator

Regulatory Framework
Licensing
Tasmanian Electricity Code

- Chapter 1 - Introduction and Code Supervision
- Chapter 2 - Code Participants and Fees
- Chapter 3 - Scheduling and Dispatch Process
- Chapter 4 - Power System Security
- Chapter 5 - Network Connection + Schedules
- Chapter 6 - Network Pricing for Transmission and Distribution Systems + Schedules
- Chapter 7 - Non-retail Metering + Schedules
- Chapter 8 - Distribution System Operation
- Chapter 9 - Retailing + Schedules
- Chapter 10 - Generation Pricing
- Chapter 11 - Ring Fencing
- Chapter 12 - Administrative Functions
- Chapter 13 - Derogations
- Chapter 14 - Tasmanian Electricity Code Glossary

Legislation
Go to Internet site: www.energyregulator.tas.gov.au
www.thelaw.tas.gov.au

Email to otter@tres.tas.gov.au
or by mail to GPO Box 770, Hobart, TAS 7001
Level 5, 111 Macquarie Street, Hobart
Telephone (03) 6233 6323
Facsimile (03) 6233 5666

1.2 ABOUT THE OFFICE OF ELECTRICITY STANDARDS *AND* SAFETY

Electricity Standards
and Safety

1.2.1 INTRODUCTION

Responsibility for regulation of all electricity industry activities in Tasmania is carried out by an independent Regulator under the *Electricity Supply Industry Act 1995* (ESI Act). In line with national reforms, the *ESI Act* became law in November 1996. The Act transferred responsibility for electrical safety from the Hydro to the independent regulator of the Tasmanian electricity industry. The Regulator is Mr Andrew Reeves, Director of the Office of the Tasmanian Energy Regulator. Tasmania is one of several States that has transferred these responsibilities from electricity utilities to independent regulators.

1.2.2 ELECTRICITY SAFETY REGULATION IN TASMANIA

Structure

The Regulators responsibilities for electrical safety are encompassed in another Act, *The Electricity Industry Safety and Administration Act 1997* (EIS&A Act), which was proclaimed on the 25

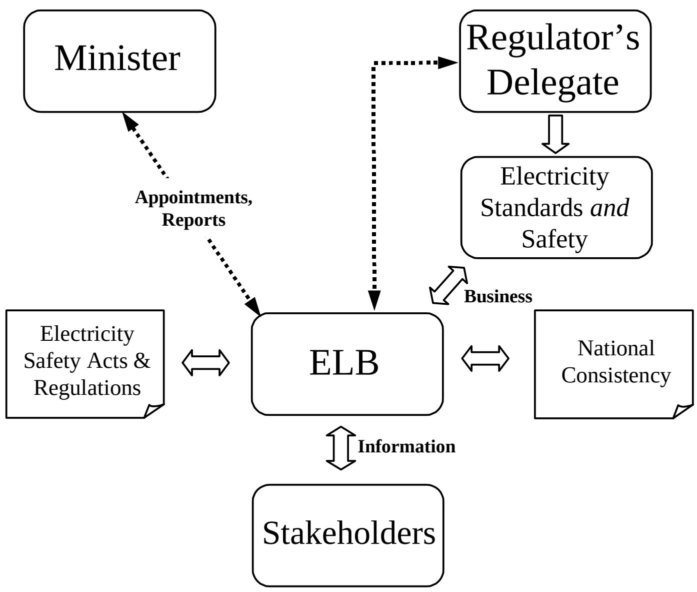
February 1998. A separate office to the regulator, Electricity Standards *and* Safety, managed by the Chief Electrical Inspector and under the Regulators delegate Mr Steve Hyam carries out the functions of this Act. These functions include the previous electrical safety regulatory role carried out by the then Hydro Electric Corporation which encompassed the licensing of electrical contractors and mechanics (electrical workers), accident investigation, product regulation, appliance approvals, and inspection and compliance monitoring. New regulations for the licensing of persons carrying out electrical work were introduced on 24 February 1999.

Aurora Energy's Electrical Compliance Group, under authority from the Regulator still carries out the functions of inspection and compliance monitoring. Inspectors are Aurora employees but are called authorised officers and have been appointed by the Regulator's delegate. They have signed identity cards, which they are required to produce if necessary. The Electricity Standards *and* Safety logo appears on their identity cards, on all licences and on all forms issued by the Electricity Standards *and* Safety. The Hydro's By-laws, including those that deal with installation notices are still in force as are the 1992 Electrical Approvals Regulations.

Electrical Licensing Board

The EIS&A Act formally establishes the Electrical Licensing Board to assist the Regulator in administration of the licensing scheme created under the Act. The EIS&A Act also provides for disciplinary panels, which have been established to make recommendations to the Regulator in determining actions for breaches of the EIS&A Act and regulations by licence holders. Prosecutions for breaches of the EIS&A Act and regulations are on behalf of the Crown and not Aurora Energy.

Electrical Licensing Board Context



Electricity Standards *and* Safety Functions

Electricity Standards and Safety's main functions are:

- Electrical Technician and Contractor Licensing
- Electrical equipment safety
- Installation & Infrastructure safety
- Accident investigation, and
- Compliance issues

Future Changes

In future, there will be more changes in the way electrical safety is managed in Tasmania, and new regulations will be introduced for notification of electrical work, infrastructure safety, electrical approvals and other areas. The changes will follow nationally agreed standards, where possible. Electrical contractors and electricians will have the opportunity to examine proposed changes and to discuss them with the Regulator and staff at the Office of Electricity Standards *and* Safety.

In summary, the Regulator's responsibilities encompass some electricity market areas, and the safety and technical aspects of generation, transmission and distribution of electricity, in order to ensure a safe supply to consumers.

Enquiries

Enquiries on safety related matters should be directed to the Electricity Standards *and* Safety office, 30 Gordons Hill Road Rosny Park Tasmania 7018. Phone (03) 6233 7831, Fax (03) 6233 8338, e-mail robert.steedman@dier.tas.gov.au or visit the Electricity Standards *and* Safety web site www.wst.tas.gov.au/electricity

Enquiries for day to day inspections, wiring rules interpretations and lodgement of notices (EINs) should be made to Aurora Energy's Electrical Compliance group.

Enquiries on other electricity regulatory matters should be directed to the Office of the Tasmanian Energy Regulator. See section in this guide.

Acts And Regulations

Relevant Acts and Regulations:

Electricity Supply Industry Act 1995
Electricity Supply Industry Restructuring (Savings and Transitional Provisions) Act 1995
Electricity Industry Safety and Administration Act 1997
Electricity Industry Safety and Administration (Consequential and Transitional Provisions) Act 1997
Electricity Industry Safety and Administration Regulations 1999
Hydro Electric Commissions Approvals Regulations 1992
Hydro Electric Commissions Service and Installation By-laws 1993

Copies of the above Acts and regulations can be downloaded from the Internet at www.thelaw.tas.gov.au

1.3 STANDARDS AUSTRALIA

Standards Australia International Limited is a registered Australian corporation, limited by guarantee. (ACN 087 326 690). Members of the company represent a broad cross-section of Australia's technical and commercial infrastructure, industry, unions, academia and government.

There are currently over 6,000 Standards maintained by approximately 9,000 voluntary experts serving on around 1,700 technical committees, supported by a full-time staff of 280.

1.3.1 ELECTRICAL SAFETY STANDARDS

Generally, electrical safety standards adopted by reference under the *Electricity Industry Safety and Administration Act 1997* are prepared by technical committees including:

- Committee EL/1 - Wiring Rules
- Committee EL/2 - Electrical Approval Standards
- Committee EL/3 - Electric Wires and Cables
- Committee EL/4 - Electrical Accessories and other specialised committees

These committees have wide industry representation including electrical manufacturers and importing interests, regulatory and supply authorities and testing laboratories.

Electricity Standards *and* Safety has representation on Committees EL/1, EL/2 and EL/4.

1.3.2 INTERNATIONAL LIAISON

Standards Australia represents Australia on the two major international standardizing bodies, the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Participating extensively in the preparation of a wide range of international Standards. Standards Australia is extremely active within the international standardization movement and a number of senior management team members hold important voluntary offices on international Standards bodies.

Standards Australia has a policy of adopting International Standards wherever possible. This policy is in line with Australia's obligations under the World Trade Organization's Code of Practice, which requires the elimination of technical Standards as barriers to international trade. As a result, approximately 33% of current Australian Standards are fully or substantially aligned with International Standards. (It is important to understand that there are some areas of industry where no significant International Standards exist, such as building, construction and occupational health and safety. Around one third of Australian Standards simply have no international equivalent).

1.3.3 SAI GLOBAL ASSURANCE SERVICES

Assurance Services provided independent assessment and certification services that offer confidence in business transactions and to consumers.

Third party certification schemes provide for assuring ongoing quality in manufacture.

The aim of the scheme is to make products right first time and encourage consistent product quality and supplier reliability.

1.3.4 THE AUSTRALIAN STANDARDS MARK

The most widely recognisable symbol of excellence and independent assurance, the "five ticks" Standards Marks are licensed to companies and products that have meet the rigorous requirements of management systems and product standards. Only businesses independently assessed through Assurance Services can gain the right to display it.

The general purpose of the Australian Standards Mark (known as the AS Mark) is to provide an independent assurance, reinforcing the claim by the manufacturer, that articles have been manufactured to comply with an Australian Standard.

Standards Australia is the owner of this Mark, which has been registered as a certification trade mark under the Trade Marks Act. It is available, under licence, to any manufacturer who can satisfy Standards Australia that the article is being produced consistently to comply with an appropriate published Australian Standard. The manufacturer agrees to enter into undertakings, which include observance of general rules and of specific supervision and control requirements.

The scheme under which the Mark is applied is administered by Standards Australia. It includes regular audit inspection and testing, but with emphasis on the maintenance of an adequate system of quality control by the manufacturer.

The ‘AS’ Mark has many benefits:

For the manufacturer: it is an assurance to customers that goods have been produced to meet a given standard, it provides protection against substandard products and it reduces the need for special testing.

To the purchaser: it provides an assurance of continuing production of goods to a standard and under an effective system of supervision and control; it reduces the amount of check testing. It provides an assurance that goods are fit for their purpose and will be reliable in service.

The national economy: benefits through the encouragement of more effective production supervision and quality control in manufacturing industry, through the re-lease of technical human resources from needless, repetitive and uncoordinated testing by the provision of assurance of quality for exported products.

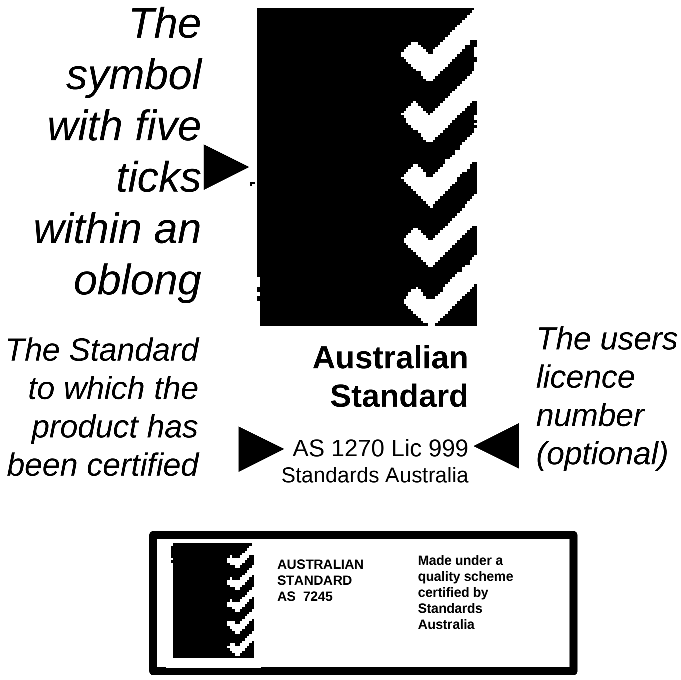


Figure 1.3 The new standards Mark

1.3.5 QUALIFICATION FOR THE 'AS' MARK

The qualifications of a manufacturer for a licence is judged on the basis of:

1. Evidence in the form of independent tests, that articles being produced comply with the relevant Australian Standard. Such tests are made on samples selected by an officer of Standards Australia.

2. Survey and assessment of the manufacturers plant and equipment to ensure that systems of production, quality control and record keeping are adequate to ensure continued quality and reliability, in the sense of maintaining conformity to the Standard.

3. Agreement by the manufacturer to abide by a scheme of supervision and control, related to the Australian Standard, to production methods and to an appropriate quality assurance program. The details of the scheme of supervision and control in respect of a particular Standard are established by Standard Australia after the survey and assessment as described in point 2 above. This scheme continues all the time the article remains in production.

4. An undertaking by the manufacturer that the "AS" mark will be supplied only to articles, which conform to the relevant Australian Standard.

5. Regular follow-up audit inspection by Standards Australia officers to establish that necessary conditions are being observed for check testing for compliance with the Standard.

There is an annual fee, together with such additional charges as are necessary to cover the costs to Standards Australia of audit inspections and testing associated with each application of the Mark.

It should be noted that:

- The AS Mark may only be used by persons licensed to do so by Standards Australia. An approval given by a State Regulatory Approvals Authority does not connote approval to use the AS Mark.

- Generally, a licence to use the AS Mark will not be given on the basis of compliance with Approval and Test Specifications alone.

1.3.6 THE ‘AS’ MARK AND APPROVALS

Compliance with appropriate SAA Approval and Test Specifications and issue of a Certificate of Approval or Suitability allows for the use of an allotted approvals or suitability marking. The issue of such certificates and the allocation of relevant marking by the approving authority does not allow for the use Of the "AS Mark" certification by Standards Australia.

However, if a manufacturer proposes to apply for and to establish the right to use the “AS" Mark in respect of the Approval and Test Specification which is adopted as the "Published Specification" for that prescribed class of appliance, both procedures - "AS" mark and Approval - will be expedited and much of the testing will be common.

1.3.7 STANDARDS APPLICABLE TO MATERIALS AND EQUIPMENT

The Standards applicable to materials and equipment are listed in AS/NZS 3000.

1.3.8 APPROVAL AND TEST SPECIFICATIONS

The Approval and Test Specifications applicable for electrical materials, equipment and appliances are listed in AS/NZS 3000 and A/NZS 4471.2.

Section 2.0

Electrical Licensing in Tasmania

2.0 Electrical Licensing In Tasmania

In order legally to perform electrical wiring work in Tasmania, an appropriate electrical licence is required. This section details the categories of licences available and the requirements of applicants.

2.1 ELECTRICAL TECHNICIAN'S LICENCE

This licence entitles the holder to perform all classes of electrical work that the holder is competent to undertake but not to enter into contracts to perform electrical work.

Note: the *Electricity Industry and Safety Administration Regulations 1999* permits the use of the terms 'electrician' and 'electrical technician' to be interchanged.

Requirements

- Completion of an apprenticeship as an electrical technician.
- Successful completion of an associated TAFE Course acceptable to the Licensing Board and The Regulator.
- Evidence of not less than 12 months experience in electrical wiring work involving the application of the Wiring Rules (AS3000).
- Nominally 4 years on-the-job experience relevant to the above course.

OR

- Is the holder of a current corresponding interstate licence.

2.2 PROVISIONAL ELECTRICAL TECHNICIAN'S LICENCE

Provisional licences are issued for a defined period only, being no greater than 12 months. It is the intention that the holders of such a licence gain the additional skills necessary to apply for an Electrical Technicians licence.

Provisional Electrical Technician's Licences may be issued to:

1. persons who have completed their apprenticeship but have insufficient experience for the issue of an Electrical Technicians Licence, or have not completed their technical training.

2. holders of a Tradesman's Rights Certificate (electrical mechanic).

In 1 and 2 above, persons must subsequently pass a licensing examination (currently set by Electricity Standards *and* Safety) and gain the necessary period of relevant on the job experience for an Electrical Technician's Licence. An examination may not be necessary if the Regulator is satisfied that all the necessary criteria has been met.

The applicant must show proof of having passed an approved "Installation Testing Course" such as:

- Electrical Module NE171
- Electrical module 87097 (Electrical installation - Safety testing)
- or equivalent.

A provisional electrical technician's licence entitles the holder to perform electrical work as an Electrical Technician, but only while working under the supervision of a licensed Electrical Technician, if such a condition is imposed on the Licence holder.

2.3 RESTRICTED ELECTRICAL TECHNICIAN'S LICENCE (REL)

With the availability of suitable training courses, restricted licences are available to allow appropriately trained and competent workers to undertake limited electrical work which is incidental to their principal function in the workplace, eg. disconnection and reconnection of electrical equipment.

Requirements

- Evidence of experience in a related non-electrical occupation (nominally exceeding 4 years).
- Demonstration of a need to obtain a restricted licence as evidenced by a submission from the applicant or the applicant's employer describing the requirement for a restricted licence.
- Completion of the training course relevant to the category of licence required.
- Demonstration of relevant on-the-job-experience.

If applicants believe they have the competence to meet the requirements for a licence and supporting evidence is provided, they may be permitted to directly undertake the REL assessment. Please discuss these issues with TAFE Tasmania.

Restricted electrical licences are available in the following categories:

- plumbing and gas fitting equipment
- commercial equipment
- industrial equipment
- Refrigeration and/or air conditioning equipment
- instrumentation and process control equipment
- communication/computing equipment
- laboratory/scientific equipment.

2.3.1 WHAT RESTRICTED ELECTRICAL LICENCE HOLDERS CAN AND CAN'T DO

The requirements of the *Electricity Industry Safety and Administration Act 1997* and the *Electricity Industry Safety and Administration Regulations 1999* apply and all licence holders must comply with this legislation and maintain their competence to perform the electrical work permitted by the licence category.

Work carried out under a restricted licence is normally limited to the disconnection and reconnection of existing electrical equipment so that a non-electrical task can be performed. However, at times, specific categories of this licence may be permitted to perform limited fault finding (to determine component failure) and replacement of some electrical equipment or components, "like with like". "Like with like" is defined as the replacement of a component or item of electrical equipment that is similar in size, operation, performance and of the same current rating and voltage range as the original item. "Like with like" does not mean the brand must be the same.

The holder of an REL must not work on electrical work outside the boundaries of their licence category as endorsed on the licence card. A restricted licence does not authorise the holder of the licence to carry out the installation or alteration of fixed wiring supplying the equipment. Holders of a REL must not enter into a contract to perform electrical work. REL holders may enter into contracts for non-electrical work and utilise the REL for a small electrical component of that work. **Any electrical work must be incidental to the primary nature of the contract. Any electrical work that is beyond the scope of this licence shall be performed by persons with an unrestricted licence.**

Examples

The following are examples of electrical work that is acceptable under the most common categories of this class of licence. Primarily the task shall be to disconnect and reconnect an electrical connection in order to carry out the non-electrical work or to replace or repair what has failed. The list is not intended to limit the scope of work and in most cases disconnection and reconnection of items similar to the examples would be permitted, provided the same principals apply. Replacement of a complete unit may be undertaken in some cases if repairs or component replacement is inappropriate. Should any related work cause an accident or incident then any workers involved would be required to prove that they are competent to perform the task.

Plumbing And Gas Equipment

- Electric hot water cylinder or the electrical connections to a gas hot water cylinder.
- Electric hot water cylinder element.
- Electric hot water cylinder or the electrical connections to a gas hot water cylinder, thermostat or over temperature cut-out.
- An electric motor that is directly connected to the impeller of a pump (on same shaft).
- Circulation pump indirectly connected to the impeller via a magnetic or inductive drive.
- Igniters on gas fired equipment.
- Water or gas line solenoids.
- Minor faultfinding to determine failure of the component.

The replacement of a low-pressure hot water cylinder with a mains pressure cylinder is not permitted under the licence however the replacement of one brand of mains pressure cylinder with a similar type of another brand, in the same location, would be permitted.

Note: not all persons issued with this category of licence are permitted to work on both water plumbing and gas installations. REL holders in this category must only work on equipment for which they are trained and licensed under other relevant legislation.

Commercial equipment

- Disconnection and reconnection of commercial, dryers, washing machines, cooking equipment or their components such as contactors, elements, drive motors and fan motors.
- Minor fault finding to determine failure of the component.

Refrigeration and air-conditioning equipment

- Disconnection and reconnection of heat pumps, refrigeration and air-conditioning systems or their components such as contactors, fans, relays, thermostats, compressors or electronic cards but not the installation of, or alterations to interconnecting wiring between units.
- Minor fault finding to determine failure of the component.

Industrial equipment (mechanical fitters and the like, no fault finding)

- Disconnection and reconnection of motors, pumps and electrical equipment that forms part of a commercial or industrial installation that is preventing a mechanical fitter from performing what is their primary task.
- Generally there should be no need to fault find on the electrical circuitry to determine the failure of this type of equipment. Checking for supply voltage on a failed unit is not generally considered fault finding.

2.4 PROVISIONAL LICENCE TO PERFORM ELECTRICAL WIRING WORK FOR OTHERS

This licence entitles the holder of an Electrical Technician's Licence to perform electrical wiring work without the need for an Electrical Contractor's Licence. It is issued to enable an electrician to carry out electrical work for others gratuitously or for members of the electrician's immediate family.

This licence is typically only issued for a particular project.

The Regulator has not asked for public liability insurance in this case as the risk is carried by the parties involved.

2.5 APPRENTICES

Electrical apprentices must be signed up in an approved (by the Regulator) contract of training to perform electrical work according to the requirements of the *Electricity Industry Safety and Administration Act 1997.*

2.6 ELECTRICAL CONTRACTOR'S LICENCE

An Electrical Contractor's Licence is issued to the business and entitles the holder to enter into contracts for electrical work.

Obligations of the business:

- Must engage a nominated manager (may be the owner of the business if suitably qualified)
- Must have public liability insurance in accordance with the *Electricity Industry Safety and Administration Regulations 1999.*

Criteria for Nominated Manager

The Nominated Manager **must**:

- hold a current Tasmanian electrician's licence **and**
- have held an electrician's licence for at least 12 months

plus at least one of the following:

- have completed the TAFE Electrical Contractor's course within 4 years of application

or

- be currently a Nominated Manger for another electrical contracting business in Tasmania

or

- have previously been a Nominated Manager for an electrical contractor's business within 3 years of application

or

- be currently the holder of an equivalent interstate licence (or qualification). Application required.

The nominated manager must complete an additional application form (No fee applies).

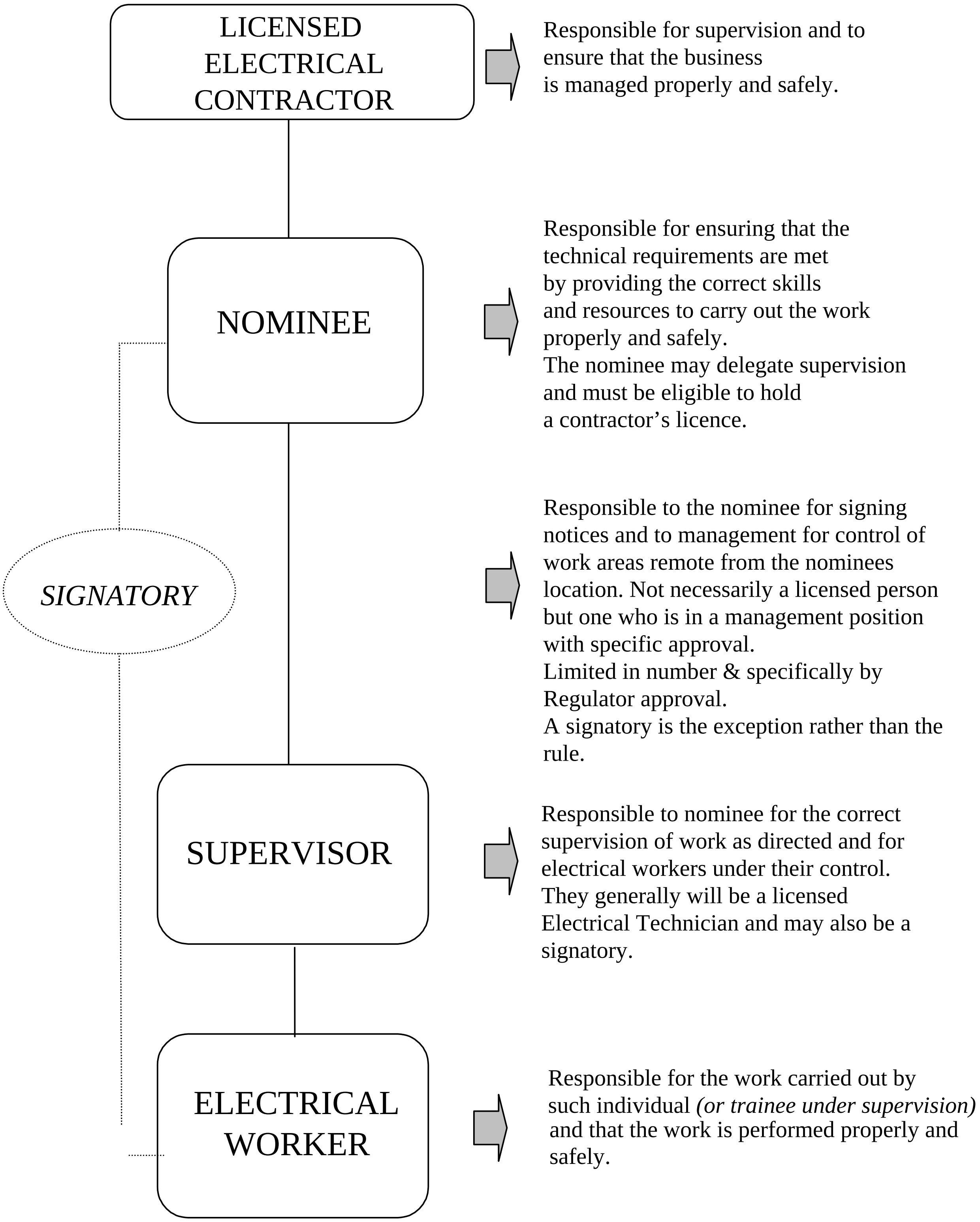
2.7 FEES

Fees are payable on all licences at the time of application and will be charged in accordance with the *Fee Units Act 1997.*

For additional information on electrical licensing contact the Licensing Administrator on (03) 6233 7831 or visit our web site at www.wst.tas.gov.au/electricity

For correspondence write to: Electricity Standards and Safety
The Licensing Administrator
PO Box 56
ROSNY PARK TAS 7018

2.8 ELECTRICAL CONTRACTOR'S LICENCE RESPONSIBILITES



This structure may vary in accordance with the size of the business and in some cases mean that a person assumes more than one role.

Section 3.0

Requirements for the Sale of Electrical Equipment in Tasmania

3.0 Requirements for the Sale of Electrical Equipment in Tasmania

In the interest of safety, the Electrical Regulatory Authority in each State and Territory of Australia administers regulations aimed at preventing the sale/hire of unsafe electrical equipment.

The *Electricity Industry Safety and Administration Act 1997* sets out the specific provisions for approval, sale and use of electrical equipment in Tasmania.

The Office of Electricity Standards *and* Safety undertakes the approval of electrical equipment in Tasmania.

Approval is valid for a period of up to five years and is recognised by all Regulatory Authorities throughout Australia, as well as New Zealand, if covering both 230 V and 240 V operating conditions.

3.1 SPECIFICATIONS FOR SAFETY

Standards Australia publishes a series of documents for the purpose of testing electrical equipment to verify compliance with safety requirements. These standards are listed in Australian/New Zealand Standard AS/NZS 4417.2.

A number of Australian Standards closely follow IEC (international) Standards with specific national variations for Australian conditions.

3.2 DECLARED ARTICLES

The electrical equipment declared by class definition, is published in AS/NZS 4417.2.

It is an offence under Part 4 of the *Electricity Industry Safety and Administration Act 1997* for this declared electrical equipment to be sold or hired, unless approved by the Regulator or an external authority (being an authority of another State or of New Zealand) and clearly marked as required.

Definitions of declared articles are listed in Australian/New Zealand Standard AS/NZS 4417.2 or may be obtained from the Office of Electricity Standards *and* Safety on request.

Additional classes of equipment may become declared from time to time by agreement between all the State Regulatory Authorities.

3.3 NON-DECLARED ARTICLES

Electrical equipment that is not declared under legislation may be sold without first being approved, however, it is the responsibility of the vendor, and manufacturer or importer to ensure that the non-declared articles offered to the public meets essential electrical safety requirements.

One way of ensuring that the electrical equipment meets essential safety requirements is to submit the equipment on a voluntary basis for approval and issue of a Certificate of Suitability by the Office of Electricity Standards *and* Safety.

Guidance on other means of meeting essential electrical safety can be found in the Australian/New Zealand Standard AS/NZS 3820 *Essential safety requirements for low voltage electrical equipment.*

3.4 MODIFICATIONS TO EQUIPMENT

Where modifications are made to previously approved equipment and it is desired to maintain the approval, the applicant must apply to the Office of Electricity Standards *and* Safety to have such modifications approved.

Separate applications are required for those modifications sought at the time of original approval submission.

Modification is generally considered to be a result of:

(i) change of components, materials or equipment design
(ii) extension of the list of approved articles in the form of a new model or option
(iii) change of catalogue or model number, or
(iv) change of manufacturer.

Approval of a modification is valid only for the remaining duration of the original approval.

Where a modification is determined to constitute a new type of equipment, application should be made for its separate approval.

3.5 APPLICATION FOR APPROVAL OR MODIFICATION

Application for approval of equipment or modification should be lodged with the Office of Electricity Standards *and* Safety and comprise the following:

(i) a completed and signed application form, which for modifications includes an itemised list of deviations from the originally approved article and a declaration that the remainder of the article is unchanged
(ii) application fee
(iii) where practical, a complete compliant production sample of the equipment
(iv) a fully compliant acceptable test report, and
(v) supporting documentation including installation and operating instructions, circuit diagrams and materials and component lists.

3.6 RENEWAL AND REPLACEMENT OF APPROVAL CERTIFICATES

The procedure for applying for renewal of an approval is the same as for the original application. Applications should be made prior to expiry of the existing approval. **(An approval certificate has a five year life).**

Each modification sought should be listed in accordance with the application guidelines previously described.

Any request for a replacement certificate must be made in writing to the Office of Electricity Standards and Safety.

3.7 TEST REPORTS AND TESTING LABORATORIES

The applicant is responsible to ensure that test reports submitted in support of an application:

(i) relate to the submitted article,
(ii) are originals or certified copies,
(iii) show full compliance with relevant current Australian Standards including any amendments or,
(iv) comprise a CB test report and certificate issued under IECEE CB scheme, or comprises of a test report endorsed by an acceptable laboratory, (under the guidelines of Appendix A of AS/NZS 4417.2:1996)
(v) are in English, and
(vi) are less than five years old.

CB Test reports to IEC (International) standards are acceptable only when all published Australian national variations are included, or addressed in an addendum report from an acceptable test laboratory.

Where materials or components are the subject of separate testing, copies of reports should be provided to the test laboratory for reference and inclusion in their test report.

Test laboratory acceptance criteria is described in AS/NZS 4417.2 and includes laboratories accredited or recognised by NATA - the (Australian) National Association of Testing Authorities or TELARC (New Zealand).

The following are some acceptable test laboratories, which are accredited to test the range of electrical equipment covered by the AS 3100, and AS/NZS 3350 series, and information technology and household electronic equipment standards.

South Australia (ITACS)	1800 675 473
Victoria (SGS)	(03) 9875 9001
Queensland (Energex)	(07) 3407 5323
NSW (TCA)	(02) 9410 5171
New Zealand (Wakefield)	0011 649 415 3355

Registers of other acceptable laboratories including those specialising in specific equipment or measurement are maintained by NATA, telephone (03) 9329 1633, fax (03) 9326 5148.

3.8 CHANGE OF PARTICULARS

The Office of Electricity Standards *and* Safety must be advised in writing of any change of name or address of an applicant or manufacturer.

3.9 ASSISTANCE

Applicants who do not have access to appropriate technical expertise within their own organisation may benefit from:

(i) obtaining the services of an independent test laboratory or electrical approvals consultant to assist in preparation of equipment and technical information (A limited list of consultants is available from the Office of Electricity Standards *and* Safety on request),

(ii) an opinion in principle from the Office of Electricity Standards *and* Safety on specific matters of policy or interpretation on(03) 6233 7585.

3.10 SCHEDULE OF CHARGES

Fees are charged for the following,

DECLARED ARTICLES	
Approval of declared articles	$234
Approval of modified electrical equipment	$117
OTHER (NON-DECLARED) ARTICLES	
Approval (Certificate of Suitability)	$234
Approval of Modification	$117
OTHER SERVICES	
Replacement, Duplicate or Transfer of Certificate	$87.75

3.11 OTHER RELEVANT STANDARDS

AS/NZS 3820 *Essential Safety Requirements for Low Voltage Equipment*

Sets out requirements for low voltage electrical equipment, to ensure that electrical equipment is constructed in accordance with good engineering practice in regard to safety such that it does not endanger the safety of persons (particularly children, the elderly and people with disabilities), domestic animals or property, when properly installed and maintained and used in applications for which it was made.

Electrical Regulatory Authorities have included this standard in their relevant legislation.

The standard is basically in two parts covering general safety requirements and means of compliance.

3.12 THE REGULATORY COMPLIANCE MARK

The Regulatory Compliance Mark (RCM) was developed to eventually replace the allotted approval number that is required to be identified on all declared articles.

The proposal arose from discussions between the Electrical Regulatory Authorities Council (ERAC), the Australian Electrical and Electronic Manufacture's Association (AEEMA) and the Consumer Electronics Suppliers Association.

The aim was to develop a unique mark, with rules for its use that would be accepted by regulators in Australia and New Zealand.

Guidance on the use of the RCM can be obtained from the Australian Standard AS/NZS 4417.1 2001 and part 2 and 3 or from the Office of Electricity Standards *and* Safety.

3.13 SALE OF SECOND HAND ELECTRICAL ARTICLES

If in the course of your business if you sell second-hand electrical appliances/equipment there are requirements under the *Electricity Industry Safety and Administration Act 1997* that the articles must have a safety label attached.

The label must state one of the following requirements:

(a) warning that the article has not been tested to ensure that it can be safely operated; or

(b) certifying that the article has been tested by a competent person and has been found safe.

The label must be durable with markings indelible and legible.

3.14 ENERGY PERFORMANCE LABELLING

Electrical equipment energy efficiency regulations have been introduced to support the requirements under section 59 of the *Electricity Industry Safety and Administration Act 1997*.

The introduction of these regulations means that it is an offence to offer for sale new electrical appliances that do not meet the energy performance standards and display an appropriate energy performance label for those electrical articles declared under regulations.

The declared articles comprise of cloths washing machines and dryers, dishwashers, refrigerating appliances and room air conditioners.

Section 4.0

Electrical Safety in the Workplace

4.0 Electrical Safety in the Workplace

4.1 ELECTRICAL ACCIDENTS

4.1.1 REFERENCE STANDARD

AS/NZS 4836:2001: SAFE WORKING ON LOW-VOLTAGE ELECTRICAL INSTALLATIONS

This Standard outlines principles and procedures of safe work, organisation and performance on or near low-voltage electrical equipment. It provides a minimum set of procedures, safety requirements and recommendations for a safe working environment on or near electrical equipment, installations or systems. In the absence of an equivalent documented company policy, Electricity Standards *and* Safety will use this standard as a benchmark when assessing the safety measures put in place at a workplace.

Prevention of electrical accidents is the only option available as there is no cure. Electrical workers play a major role in reducing the likelihood of accidents by ensuring their work meets or exceeds minimum standards.

Electricity Standards *and* Safety and Aurora Energy, in association with other electrical trade organisations, have increased activities related to electrical safety with an on-going program of publicity, posters and press statements to involve the electrical trade and general public.

4.1.2 WORKING ON EXISTING INSTALLATIONS

DO NOT WORK ON LIVE PARTS INCLUDING SWITCHBOARDS UNLESS ABSOLUTELY NECESSARY.

4.1.3 SWITCHBOARD SAFETY

If it is necessary to work on live parts, particularly switchboards, firstly determine exactly what is live and remove the risk of an incident, eg. the 'glove and barrier' method is one way to protect against accidental contact with live parts. PPE is essential for this type of work (see 4.7).

4.1.4 NEUTRALS ARE 'LIVE' CONDUCTORS

All associated active conductors must be isolated before any neutral conductor is removed from a link or terminal. When a neutral conductor is disconnected from any terminal (switchboards or equipment) then it must be treated as live and not touched until proven safe with a suitable voltage tester. Any active corresponding to the disconnected neutral must be tagged and locked off if there is any chance of the neutral becoming alive.

4.2 REPORTING SERIOUS ELECTRICAL ACCIDENTS

A person is deemed to have complied with section 72 of the *Electricity Industry Safety and Administration Act 1997*, if the responsible person notifies this office (Electricity Standards *and* Safety, acting on behalf of the Regulator), of any serious electrical accident, as soon as possible. A written report must also be provided within 21 days of the event.

We strongly recommend a precautionary medical check up for all shock victims.

If medical treatment is necessary as a result of a shock, then it is considered to be a serious electrical accident as defined in the Act and must be reported. Examples of this would be burns, administering of medication or admission to hospital. A check up, tests (ECG) or monitoring by medical persons does not, by itself deem an accident serious.

Please ensure you read this section of the Act.

Phone: 1300 366 322 (all hours)
Fax: (03) 6233 8338 between the hours of 9:00am and 4:00pm
(Please address to Electricity Standards *and* Safety).

Call an Aurora Energy Inspector to assist with determination of the cause and the rectification. 132004 (all hours).

NOTE: The *Workplace Health and Safety Act 1995* has particular requirements for reporting accidents and incidents.

4.3 INVESTIGATION OF ELECTRIC SHOCKS

4.3.1 GENERAL

In many instances electrical accidents are not reported or information provided is incomplete. In some cases the failure to report has led to a fatality from a second incident.

The information derived from accident reports is important as it provides a comprehensive guide to the framing of rules, regulations and standards and the design of electrical equipment. It also serves to provide an on-going review of the performance of rules and regulations, which continue to ensure the safe use of electricity by workers and in the community. Most importantly, the purpose of the investigation of any accident or incident is to prevent a repeat occurrence.

An adult heart can go into fibrillation when 50mA of current passes through the human body. Children are considered more sensitive to electric shock. This is the reason that residual current devices providing personal protection are set at 30mA.

Shocks may be received from electrical equipment such as stoves or heaters or even an outside garden tap. All shocks should be taken seriously and reported immediately. Some shocks may be as a result of static electricity however do not dismiss them as static unless all avenues have been explored and all tests performed.

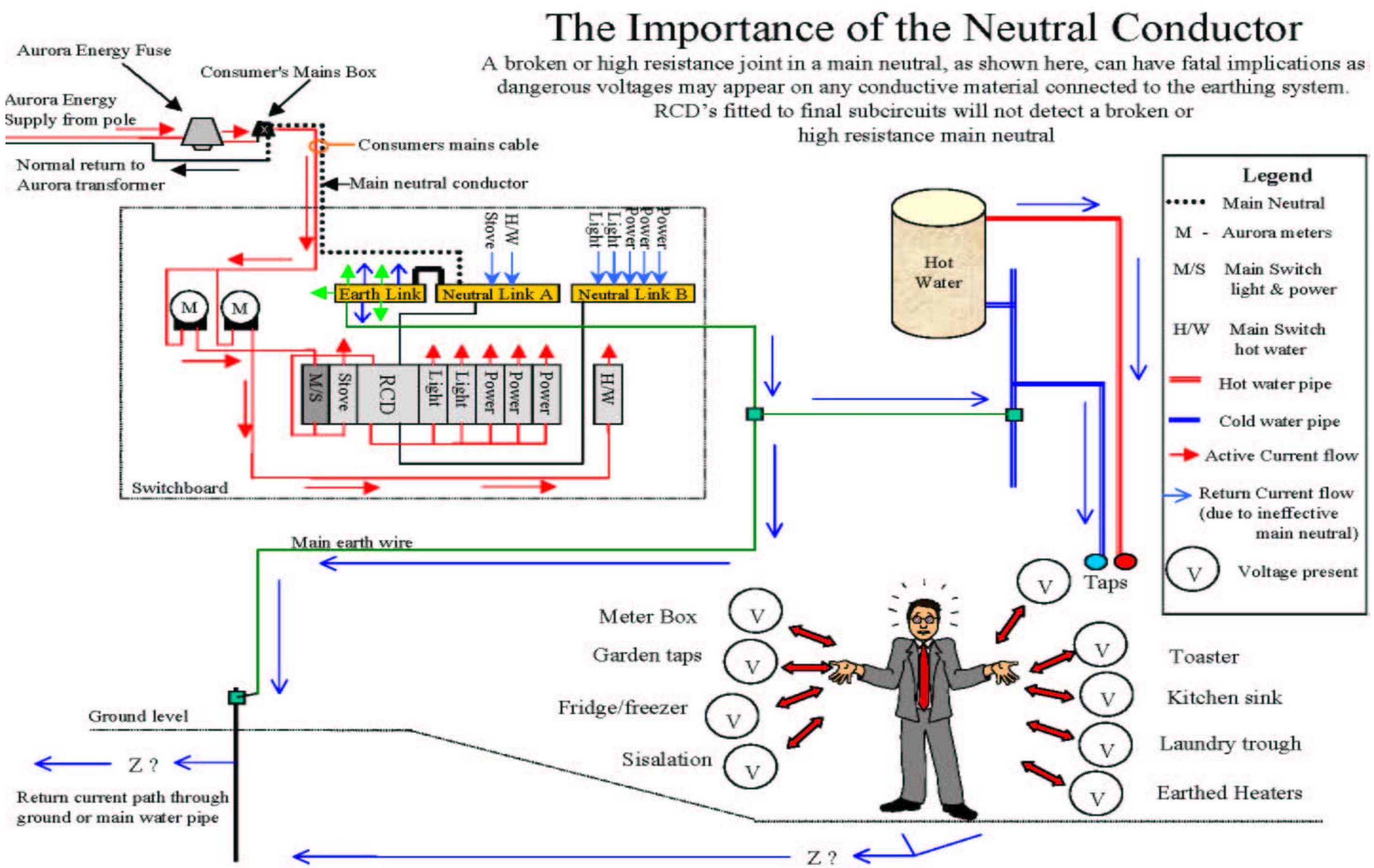
4.3.2 BROKEN OR HIGH RESISTANCE NEUTRALS

The most common electric shocks received are from water taps. In the first instance these shocks are often extra-low voltage and the recipient only feels a sharp needle type prick. Consequently they are often dismissed or tolerated for a period of time until the voltage increases causing more serious physiological effects. Unfortunately putting it off will not fix the cause and the second shock may be the last. A common cause is when a neutral begins to fail at the mains box connection resulting in an increase in the neutral circuit resistance. This creates more current to flow in the earthing system (dependent on the resistance of the passage of current to ground) via the MEN connection. The earthing system then becomes live in relation to the general mass of earth.

This is called *earth potential rise* and the voltage level is dependent on the circuit impedance and the circuit load at the time.

Because these shocks are often first felt when the recipient is in the bath or shower, there is an extremely high risk of death. Call Aurora Energy immediately on 132004.

On the next page, there is a diagram showing the current path when a main neutral becomes disconnected.


The Importance of the Neutral Conductor
A broken or high resistance joint in a main neutral, as shown here, can have fatal implications as dangerous voltages may appear on any conductive material connected to the earthing system.
RCD's fitted to final subcircuits will not detect a broken or high resistance main neutral
Aurora Energy Fuse
Consumer's Mains Box
Aurora Energy Supply from pole
Consumers mains cable
Normal return to Aurora transformer
Main neutral conductor
Stove
H/W
Light
Light
Power
Power
Power
Earth Link
Neutral Link A
Neutral Link B
M
M
M/S
Stove
RCD
Light
Light
Power
Power
Power
H/W
Switchboard
Hot Water
Main earth wire
Ground level
Z ?
Return current path through ground or main water pipe
Z ?
Taps
Meter Box
Garden taps
Fridge/freezer
Sisalation
Toaster
Kitchen sink
Laundry trough
Earthed Heaters
V
Legend
Main Neutral
M - Aurora meters
M/S Main Switch light & power
H/W Main Switch hot water
Hot water pipe
Cold water pipe
Active Current flow
Return Current flow (due to ineffective main neutral)
V Voltage present

4.3.3 INVESTIGATION KEY POINTS TO REMEMBER

1. When an electric shock has been reported to you call Aurora Energy on 132004 and ask for an Inspector to attend.
2. When you arrive on site assume anything conductive is ‘live’ until proven otherwise. Discuss the incident with the recipient or occupant if possible and if the Aurora Energy supply is overhead, visually check that the connections at the point of supply are satisfactory.
3. Create an independent earth as a reference point. This can be achieved by driving a metallic rod into moist grass away from any garden taps.
4. Commence testing by testing between the independent earth and all conductive parts. Include the switchboard enclosure and any outside taps. Do not assume that the electrical earthing system is safe, it may be “live” with reference to the general mass of earth. This is known as earth potential rise.
5. Turn off each circuit breaker or remove each fuse until the voltage has reduced. A progressive reduction in voltage would normally indicate that an individual circuit is not at fault.
6. If the voltage is still present turn off the customer’s main switch.
7. If there is immediate danger then you may remove the overhead service fuse on the house with an insulated tool, check that the voltage has reduced to 0V and wait for the Aurora Energy inspector. The service fuse must not be replaced without a direct instruction from the Inspector. Do not use a metallic ladder for electrical work where there may be a risk of shock eg. the gutter may be ‘live’.
8. If the supply is underground (and you are not authorised to access fuses) or removal of the overhead fuse does not eliminate the voltage - or it is not safe to remove the overhead fuse, then stand watch to prevent danger to others and wait for an Inspector or other authorised persons to arrive.

4.4 FIRST-AID FOR ELECTRICAL WORKERS

Maintaining competence in first-aid, particularly CPR is an essential part of being in the electrical trade.

Remember the rule, DRABC (in that order)

Danger
Remove the chance of further injury to yourself and the patient.
Be aware that the patient may be electrically ‘live’.
Response
Attempt to arouse the patient by shouting, pinching or squeezing their hand.
Airway
Roll the patient on their side and check the airway for any obstructions.
Breathing
While still on their side, look (rise and fall of their chest), listen (for a sound of breathing) and feel (rise and fall of their chest). If not breathing, give two full breaths.
Circulation
If still not breathing, check for a pulse at either the carotid artery (neck), inside the wrist or the femoral artery (inside thigh). If no pulse, commence CPR.

For up to date and detailed information refer to a recognised first-aid manual such as those produced by Red Cross or St John’s Ambulance Service.

4.5 ISOLATION AND SAFETY PROCEDURES

4.5.1 GENERAL

All electrical equipment and conductors shall be regarded as energised until isolated and proved de-energised. Work shall not be carried out on, or near, de-energised exposed conductors until an electrical worker has:

(a) Positively identified the electrical equipment, all of its energy sources and their isolation points
(b) Isolated and discharged where necessary the electrical equipment from all sources of supply
(c) Secured the isolation
(d) Proved de-energisation of all electrical equipment and conductors
(e) Identified the safe area of work.

4.5.2 IDENTIFICATION OF EQUIPMENT AND ISOLATION POINTS

The electrical equipment to be worked on and the appropriate points of isolation and all of its energy sources shall be positively identified.

4.5.3 ISOLATION OF ELECTRICAL EQUIPMENT

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

Control circuits or control systems (PLCs, emergency stops, etc.) shall not be used as a means of isolation, e.g. by operation of a stop button.

All other non-electrical sources of energy (e.g. counterweights on machines and stored hydraulic and pneumatic energy) shall be made safe. AS 4024.1 provides guidance on the safeguarding of machinery.

Consideration shall be given to the possibility of circuit wiring of electrical equipment or conductors becoming energised due to any operation of automatic control devices, e.g. thermostats, float switches, PLCs and other interface devices.

NOTES:

1. AS/NZS 2381.1 specifies requirements for the isolation of equipment in hazardous areas.
2. It is recommended that the active conductor be disconnected first followed by the neutral conductor. The earth conductor should be disconnected last.

4.5.4 PROVING DE-ENERGISATION

All electrical conductors, unless proven to be de-energised, shall be treated as energised.

Any voltage tests used to prove de-energisation shall be conducted between all conductors and between all conductors and a proven earth or shall be conducted to another approved procedure.

Voltage detectors used to prove de-energisation, shall be tested for correct operation immediately before use and again immediately after use to confirm that the detector is still working.

Persons required to work in association with electrical equipment shall be competent in procedures proving de-energisation and in the use of detectors.

WARNING: THE USE OF TESTERS THAT DETECT AN ELECTRIC FIELD SURROUNDING AN ENERGISED CONDUCTOR MAY NOT BE SUITABLE FOR CABLES THAT ARE SURROUNDED BY A METALLIC SCREEN, CABLES CARRYING DIRECT CURRENT AND IN SOME OTHER CIRCUMSTANCES.

4.5.5 IDENTIFY THE SAFE AREA OF WORK

The safe area of work should be identified by erecting obstacles or warning signs or by other approved means if necessary. All personnel who are to work in the safe area shall be advised of its limits.

4.6 THE TAG AND LOCKOUT SYSTEM

4.6.1 SECURE THE ISOLATION

All points of isolation should be locked off where possible. Switches remote from equipment and used for isolation should be provided with a device for securing the switch in the open position that requires a deliberate action to engage or disengage it. The securing device need not be an integral part of the switch and may be either:

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

Isolation may be secured by removing and tying back connections if this can be achieved safely.

4.6.2 TAGS - GENERAL

Tags should be legible and, where appropriate, dated and signed by all personnel involved in the work or by the supervisor in charge of the work party. If a formal permit system is used, the designated sign-on and tagging procedure shall be used.

Figure 4.6 shows typical tags.

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

4.6.3 DANGER TAGS

Appropriate danger tags shall be placed at all points of switching, isolation or disconnection.

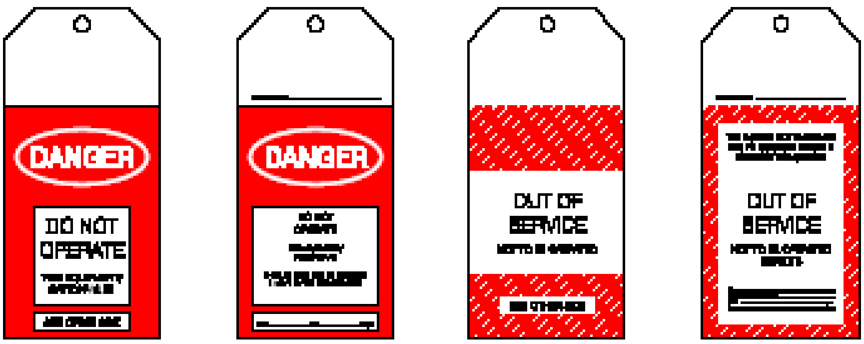
4.6.4 WARNING TAGS

If used, warning tags shall be affixed as a warning that the device or equipment is not to be operated, except as indicated on the tag.

4.6.5 REMOVAL OF TAGS

Tags shall only be removed with the permission of all signatories to the tags or in accordance with approved procedures.

Figure 4.6 Typical Tags



(a) Danger tags **(b) Warning tags**

4.7 PERSONAL PROTECTION EQUIPMENT (PPE)

Further guidance in PPE, safety equipment and performing risk assessments, can be obtained from AS/NZS 4836 – Safe working on low voltage electrical installations.

Electrical workers should consider the appropriateness of PPE required for each task undertaken. A risk assessment should be undertaken where there is a possibility of physical injury or electric shock.

The following is a checklist that can be used as a starting point covering most of the PPE often identified in a risk assessment for an electrical work site.

Safety glasses	Insulated sole boots
Close fitting clothing	Insulated tools
Gloves (voltage rated)	Non-metallic ladders
Safety harnesses	Hard hats
Ear protection	Insulated mats

4.8 SUPERVISION OF ELECTRICAL WORKERS

Whether you are an employer, supervising tradesman or an employee electrical worker requiring supervision, make sure you understand your obligations under the *Electricity Industry Safety and Administration Act 1997* and the *Workplace Health and Safety Act 1995.*

Electricity Standards *and* Safety recommends that all employers and workers follow the guidelines in this section.

You may be asked at any time to provide evidence of supervision levels applied in the course of your business. The levels indicated in this section are similar to those used in other jurisdictions and will be used as a benchmark for investigations.

In the interests of on-the-job safety we draw your attention to the following specific areas related to supervision.

4.8.1 ELECTRICAL WORKERS

Certain types of electrical workers must be supervised. They are:

- Apprentices
- Restricted Electrical Licence workers (in training)
- Provisional Licence holders (in training)
- Licensed workers who are inexperienced at specific tasks.

NOTE:

Apprentice electrical workers and provisional licence holders (undergoing training) are not permitted to supervise other electrical workers.

The primary duty of care rests with the employer, (if an Electrical Contractor, also the nominated manager) and the supervising electrician to determine the level of supervision required to maintain safety at all times. Consideration should be given to the type of work to be undertaken, the knowledge and skill level of the electrical worker being supervised together with the safety equipment required.

4.8.2 TYPE OF WORK

Variations in work environments, together with the scope of the work and whether connected to electricity supply or not, present many combinations which the supervising electrician must assess as part of determining safety requirements for the job at hand.

4.8.3 KNOWLEDGE/SKILLS OF ELECTRICAL WORKERS

The supervising electrical worker must make a conscious appraisal of the technical knowledge and practical skills of the apprentice, or REL holder. Where relevant, use should be made of the information available from the apprentice training assessment system, e.g. has the apprentice been deemed competent at TAFE in the module relevant to the task? Refer to progress reports provided by TAFE.

The type of work to be carried out must be measured against this overall appraisal, to determine the level of supervision needed for safe working.

4.8.4 SAFETY EQUIPMENT

The use of personal protective equipment (PPE) and other safety equipment is an essential part of accident prevention, which the supervising electrician needs to build into each project. Workers should have proper work clothing, insulated work footwear, safety glasses and the like. Insulating gloves, mats, covers and similar safety equipment should be used where appropriate. Portable residual current devices should be provided for fitting to all power supplies, extension leads and power tools. (refer to AS/NZS 4836 and section 4.7 in this document for more information on PPE).

4.8.5 WORK EXPERIENCE

The assessment of the electrical worker should be recorded by the employer (or host employer), showing dates, successful performance of key working practices and other important stages.

Where assessment of knowledge and/or skills proves difficult, assistance should be sought from the apprenticeship training authority or TAFE.

4.8.6 LEVELS OF SUPERVISION

Two levels of supervision may be applied:

Direct Supervision: The personal supervision of a worker, at all times, on a direct and constant basis, by a person licensed to carry out the work without supervision.

General Supervision: General supervision does not require constant attendance by the supervisor. General supervision must be given by a person licensed to carry out the work without supervision. The nature of the work and the competence of the person undertaking the work needs to be considered, to ensure safe and satisfactory work practices and that work standards are maintained.

Under the principle of general supervision, the supervising electrician should attend the work place, explain the task, ensure the worker understands the task and carry out any isolation that may be required. **The supervising electrician must ensure that the portion of the installation is de-energised before leaving the site.** The supervising electrician should return to the work place as often as considered necessary to ensure effective supervision is maintained and to test and re-energise if applicable.

4.8.7 APPRENTICES

Electrical apprentices must be signed up in an approved (by the Regulator) contract of training to perform electrical work according to the requirements of the *Electricity Industry Safety and Administration Act 1997*.

Apprentices require supervision for their safety, training and the safety of others. The amount of supervision (direct or general) requires continual assessment of an apprentice's experience, competence and the nature of the task being undertaken. It may vary from direct to general supervision depending on the type of work.

Progress reports from TAFE should be considered when determining the level of supervision required for apprentices, e.g. have they completed a module related to Installation Testing?

A gradual relaxation of supervision is logical as an apprentice develops the skills, knowledge and experience leading to a trade qualification.

As a guide to industry, Table 4.1 on page 14 sets out some basic criteria for a typical apprentice of average competence. This table should be referred to when determining the amount of supervision required. Some apprentices will require more or less supervision than shown.

It is not recommended that apprentices or trainees work on live parts and in case, shall the supervision of live work be any less than that stated in table 4.1.

4.8.8 RESTRICTED LICENCE HOLDERS (REL)

REL holders do not generally require supervision.

For those undergoing training to obtain an REL, an assessment of the individual's ability is required to ensure supervision is sufficient for safe and satisfactory workmanship. Depending on the complexity of the task, eg. ‘live work’ would require constant supervision.

All trainees’ work must be tested and checked by a person licensed to carry out the work without supervision in the same category of REL.

4.8.9 PROVISIONAL LICENCE HOLDERS

Those who hold a Provisional Licence for the purpose of training with the view to obtaining an Electrician’s Licence, shall be supervised in a similar way to that indicated in Table 4.1 for ‘4th and final’ year apprentices. An assessment by the supervisor is necessary to determine the experience of the Provisional Licence holder, particularly if they are unfamiliar with AS/NZS 3000 having undergone training in another country.

4.8.10 LICENSED WORKERS WHO ARE GAINING COMPETENCE AT SPECIFIC TASKS

Workers in the electrical industry are required to undertake a diverse range of tasks, however most workers are not experienced in all the tasks possible from hazardous and high voltage to domestic repairs. Employers, nominated managers and supervisors must assess the experience and competence when assigning tasks to a worker, regardless of whether they are licensed or not. Appropriate supervision should then be applied as necessary.

4.8.11 STANDARD OF WORK

The supervising electrician is responsible for checking and testing all work carried out to personally ensure compliance with AS/NZS 3000 - the Wiring Rules.

Queries: Should you have any queries in regard to installation compliance, please contact an Aurora Energy Electrical Compliance Inspector by telephoning **1300 132 007**.

Table 4.1
A guide to the minimum level of Supervision typically required

Type of Work	Apprentice (year)	Supervision Required
New Installation (not connected to electricity supply)	1st	Direct
	2nd	Direct/General
	3rd	General
	4th or Final	General
Alterations and Additions (existing installations)	1st	Direct
	2nd	Direct
	3rd	Direct
	4th or Final	General
Maintenance of Installations and Equipment	1st	Direct
	2nd	Direct
	3rd	General
	4th or Final	General
Workshop Tasks	1st	Direct
	2nd	General
	3rd	General
	4th or Final	General
Live Work (including live testing and fault finding)	1st	Not Permitted
	2nd	Not Permitted
	3rd	Not Permitted
	4th or Final	Direct
Isolation of Installations and Equipment	1st	Not Permitted
	2nd	Not Permitted
	3rd	Direct
	4th or Final	Direct (General if deemed competent at Installation Testing)

4.9 RESIDUAL CURRENT DEVICE'S (RCD) IN THE WORKPLACE

4.9.1 GENERAL

Employers and persons having control of a workplace are required to provide and maintain a safe system of work and a safe working environment (s.9 of the *Workplace Health and Safety Act 1995*). A person who has management or control of a workplace ('the accountable person') must ensure that any electrical installations associated with any installed plant at a workplace complies with the requirements of AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand Wiring Rules)* (r.80 of the Workplace Health and Safety Regulations 1998).

Persons having management or control at the workplace should install non-portable type RCD protection at the switchboard or at a fixed socket outlet (power point). Workers using hand held and portable electrical equipment must be able to tell if and where non-portable RCDs have been installed. Otherwise a portable RCD should be provided by the employer and must be used by the employee where provided.

An RCD is a device intended to isolate the circuit/s connected to it in the event of a predetermined current flow to earth. RCDs are also known by other names:

- earth leakage circuit breakers (ELCB) and
- safety switches.

RCDs offer a high level of personal protection from electric shock by immediately switching the electricity off when it flows to earth. They also reduce the risk of fire by often detecting electrical leakage to earth in electrical wiring and accessories.

There are many causes of electric shock and electrocution in workplaces. For example, contact with faulty electrical equipment or worn and damaged wiring and switches.

RCDs significantly reduce the risk of electric shock, but will not protect against all instances of electric shock. If contact is made with both the active and neutral conductors then the electric current will flow through the body, and will not be detected by the RCD unless there is also a current flow to earth. RCDs only provide protection from the point of installation i.e. ‘down stream’ in the electrical circuit.

4.9.2 INSTALLING AN RCD FOR WORKPLACE PROTECTION

Hand-held and portable electrical equipment operated from socket outlets should be protected by an RCD. This can be achieved by:

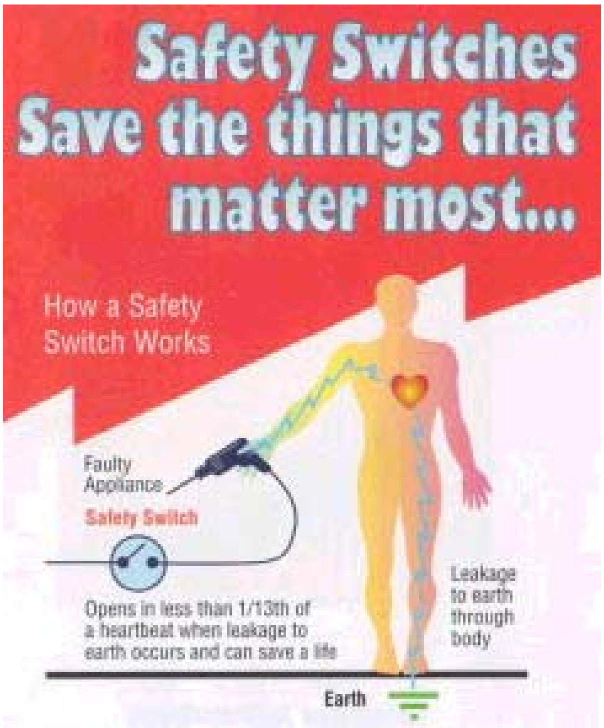
- a permanent RCD installed either in the workplace switchboard that supplies the socket outlets or in the socket outlet, or
- a portable RCD connected directly to the output side of a socket outlet.

It is preferable to install the RCD at the source of supply i.e. at the start of an extension lead. The extension lead and anything plugged into it is then covered by the protection

‘Portable Electrical Equipment’ - means electrical equipment [including cord extension leads] that is intended to be carried or moved while connected to an electrical supply.

‘Hand-held Electrical Equipment’ - means a portable appliance intended to be held in the hand during normal use, the motor, if any, forming an integral part of the appliance.

Consideration should be given to installing permanent RCDs in new workplaces, or when installing new electrical circuits. The most cost effective means of installing RCD protection in a new workplace or in a new electrical installation is to design the workplace circuits, based on their likely future use.



4.9.3 TESTING AND MAINTENANCE OF RCDs

An RCD installed at a workplace must be kept in good working condition and tested on a regular basis by a competent person to ensure its continued effective operation. A record should be kept of these tests.

Note: Australian Standard AS/NZS 3760:2000 In-service inspection and testing of electrical equipment, specifies safety procedures and frequency for the safety inspection and testing of portable electrical equipment, including portable RCDs.

CAUTION

RCDs will not protect against all electrical incidents; for example RCDs will not protect against the serious shock situation where a person contacts both active and neutral conductors without current flowing to earth.

RCDs are an addition to safety measures not a substitute for them.

4.10 TESTING AND TAGGING OF EQUIPMENT

In-service testing of electrical equipment is necessary for the safety of persons in the workplace.

The Workplace Health and Safety Act 1995 places a legal responsibility on every person at the workplace to ensure health and safety. These responsibilities are more fully outlined under Part 3 - Duties and Obligations Relating To Workplace Health and Safety.

Australian Standard ***AS/NZS 3760:2001, In-Service Safety Inspection and Testing of Electrical Equipment*** specifies in-service safety inspection and testing protocols and criteria that satisfy these obligations.

It should be noted that a separate standard exists for electrical safety for work performed within the Construction and Demolition Industry. The standard to be referred to for persons working in these areas, is ***AS/NZS 3012, Electrical Installations – Construction and Demolition Sites.***

For further information on Testing and Tagging contact Workplace Standards Tasmania on 1300 366 322.

Section 5.0

Technical Requirements

5.0 Technical Requirements

5.1 EARTHING - GENERAL

5.1.2 TYPE OF EARTHING

All electrical Installations shall use the MEN system of earthing unless otherwise approved.

5.1.3 EQUIPOTENTIAL BONDING

Involves the bonding of metallic water piping, metallic waste pipes and other extraneous metal in contact with the ground and accessible to personal contact to the earthing system at the outbuilding.

5.1.4 EARTHED FROM THE MAIN SWITCHBOARD

The most effective method of reducing the problem is for the system of earthing to be in accordance with AS/NZS 3000, as follows:

With this method, the earthing system in the outbuilding is connected directly to an earthing bar, link or terminal at the main switchboard. This is sometimes referred to as "laid up earth" in the submain. When the installation uses a laid up earth to supply an outbuilding then no MEN is to be installed at the outbuilding switchboard.

The two diagrams on the next page explain the situation with possible solutions as detailed in the preceding paragraphs.

5.1.5 LOAD BALANCE CHECK

In any case, the load connected to each phase of a multi-phase installation should be balanced as closely as possible to minimise neutral current.

As can be seen in first diagram, a potential difference up to approximately 6 volts may exist between A and B (the voltage could be greater, depending upon the distance from the supply transformer).

The voltage is also impressed on the metallic earthing system at the remote point.

Points C and D could be at different potentials (due to varying resistive levels of mass of earth), thus a person standing in the shower and touching the taps or water pipes, could receive a minor shock.

Effective equipotential bonding between points C and D will eliminate these shocks, alternatively the laid up earth method may be used.

As no current normally flows in the earthing conductor, earthing of the remote portion from the installations earthing system has eliminated the dependence upon a good earth contact at the remote position - points C and D are at the same potential.

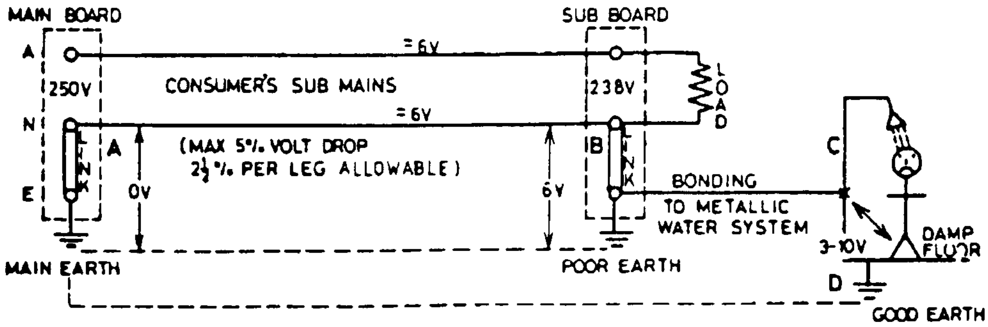


Figure 5.1 Separate MEN and Equipotential Bonding.

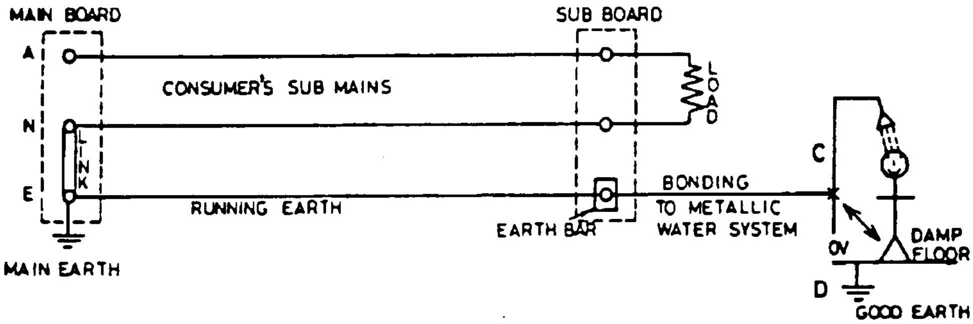


Figure 5.2 Earthed from the Main Switchboard and Equipotential Bonding

5.2 THERMAL INSULATION

5.2.1 EFFECT ON ELECTRICAL WIRING AND ACCESSORIES

Standards Australia (SA) has provided the following information on types of thermal insulation used in the building industry and the likely effect on the electrical installation. It is reproduced here with acknowledgment to SA for the information and guidance of the electrical trade and any others in the building industry for whom it is relevant.

5.2.2 TYPES OF THERMAL INSULATING MATERIALS

The range and form of thermal insulating materials include:

- Wool, polyester, fibreglass and rockwool which are normally formed into batts;
- cellulosic fibres such as wood, paper, cork and seagrass, which are normally installed in loose fill form; and
- expanded plastics such as polystyrene and unreaformaldehyde, which may be installed in a bead form, in slabs or batts.

The purpose of these materials is to provide resistance to heat flow and the effectiveness of each material is quite often in terms of overall thermal resistance or R-value. The higher the R-value, the better the material is at reducing heat losses from buildings. These materials generally exhibit favourable characteristics under fire conditions in that they have flame retardant properties and do not represent fire hazards.

5.2.3 OVERHEATING OF ELECTRICAL CABLES

When unenclosed electrical cables are installed in buildings, they are usually given ratings associated with free air circulation. The introduction of thermal insulation around these cables in wall cavities, floors and ceilings decreases the rate of heat dissipation from the cable to air because of the resistance to heat of the insulation material. This has resulted in cable failures, particularly on circuits in the vicinity of the maximum rating of free air conditions. Tests have verified that temperatures in excess of 100 °C can be achieved by V-75-PVC insulated cables at currents in the vicinity of 70% of unenclosed cable ratings.

It is worth noting, because of the thermal insulation material's burning characteristics, the incidence of fires arising from cable failures has not been significant.

5.2.4 POLYSTYRENE FOAM INSULATION IN CONTACT WITH PVC CABLE INSULANTS

A chemical reaction occurs between polystyrene and PVC whereby the plasticiser present in the PVC cable is taken up by the polystyrene. This process, known as marring, results in loss of cable flexibility, surface spoiling and cracking and can be avoided by the introduction of barriers or the use of nylon, polyethylene or thermosetting plastic Ion, polyethylene or thermosetting plastic sheaths.

SA Committee EL/I have considered this problem and have agreed that no immediate action is required because of the relatively low usage of polystyrene foam insulation and low incidence of cables subject to flexing. It is a matter for future developments.

5.2.5 UREA-FORMALDEHYDE (UF) FOAM AND ELECTRICAL ACCESSORIES

Urea-formaldehyde (UF) foam is dispensed on-site as a fluid mixture which foams and sets as a cellular or expanded plastic material.

The foam is pumped or injected into walls, floors and ceilings and is particularly suited to dwellings where the thermal insulation is added as an after-thought and the use of alternative materials would require significant structural work.

The particular problem associated with UF foam is the contact of the wet foam in its installation phase with the exposed electrical parts behind socket outlet's, light switches, lamp holders and the like. Tests have been conducted which indicate that the normal high resistance between terminals on a single socket outlet is reduced to the order or 10kΩ when UF foam is introduced. After the drying out or setting period, which depending on the foam mix and temperature conditions may take several days, the high resistance is restored. During this setting time the proper and safe use of electrical equipment is impaired and Committee EL/1 has examined many examples of burnt plug sockets. ESAA have been informed of this problem in an earlier correspondence from SA but consideration might be given to the following proposal from Committee EL/1 for inclusion in a Standard being prepared by the Association's Committee BD/58 under the title of 'The In-situ Installation of UF Foam for the Thermal Insulation of Cavity Walls, Ceilings and Floors'. The damp nature of the foam in its installation phase greatly reduces the electrical resistance between the terminals of the immersed equipment and it is not until the foam has completely dried out after a period of days that this resistance returns to an acceptable level. It is therefore recommended that one of the following actions is to be taken:

- The electrical circuits connected to equipment installed in the areas of foam installation are to be disconnected at the switchboard for a period of approximately two days; or
- Suitable means shall be employed to prevent the foam from coming into contact with the exposed parts of the equipment; this may take the form of shrouding or even removal of the equipment and packing of the cavity space.

In some situations the services of an electrical contractor may be required.

5.2.6 METALLISED FOIL

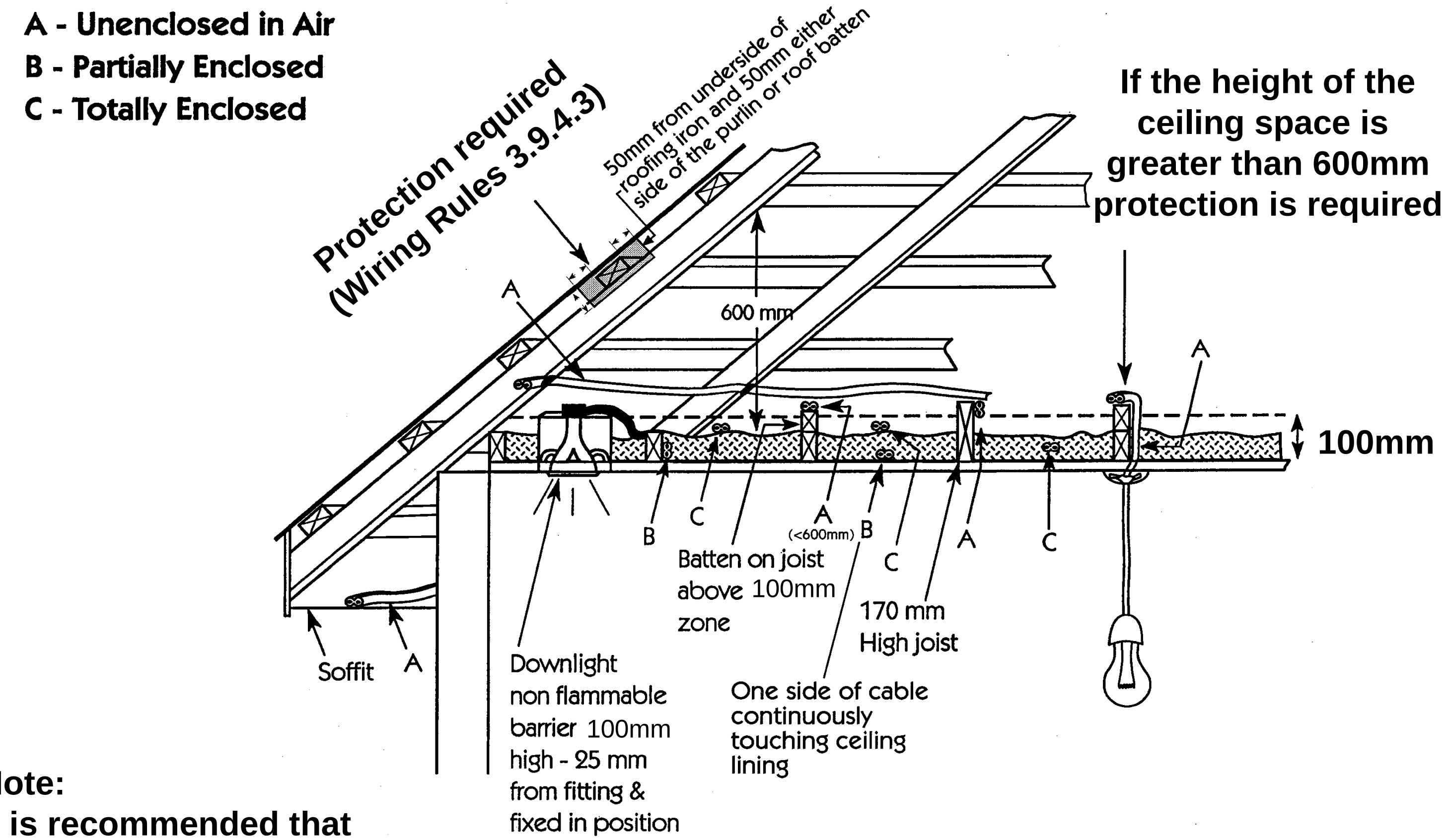
Several types of thermal insulation incorporating various forms of metallised foils have been used in roof spaces containing electrical wiring.

Recently our attention was drawn to a possible hazard of the metallised foil coming into wiring, exposed conductors or live terminals.

In the interests of safety, the Aurora recommends that the following warning notice be attached to these products to alert the users:

‘The installation of thermal insulating materials incorporating metal foil in roof spaces containing unenclosed electrical wiring and/or joints in electrical wiring may cause a hazard’.

Protection Required and Derating Zones for Ceiling Wiring



Note:
It is recommended that insulation be considered to be at least 100mm deep in all domestic ceilings, including those ceilings that have none installed at the time of wiring

5.2.7 INSTALLATION OF RECESSED DOWNLIGHTS

Downlight fittings are designed for the dissipation of hot air through slots or perforations in the top of the units into the ceiling space.

Thermal insulation materials around and over these luminaires leads to significant temperature rises of the fitting:

During installation of thermal insulation care must be taken to avoid contact with the parts of electrical appliances and luminaires that depend on free air circulation to limit temperature rise. Downlights shall be provided with suitable barriers to prevent loose fill insulation from coming into contact with the fitting (refer AS/NZS 3000).

5.3 NEUTRALS

5.3.1 IDENTIFICATION OF CONNECTIONS

AS/NZS 3000 requires the terminals of equipment mounted on a switchboard to be marked or arranged to identify the corresponding active and neutral conductors for each circuit. Apart from the safety aspect, there are obvious advantages where large numbers of circuits emanate from the main switchboards or distribution boards and circuit isolation is required.

Identification of corresponding active and neutral conductors must be carried out in an approved manner. Such methods would include the use of IPA studs, cable markers or appropriate marking of the number of the neutral bar terminal on a circuit schedule or adjacent to the relevant circuit breaker or fuse.

5.3.2 LOAD CURRENT DISTORTION AND EXCESSIVE NEUTRAL CURRENT

Our attention was drawn recently to several cases of excessive neutral current in three phase installations on large poultry farms. The main load was due to ventilating fans with thyristor (or "chopper" type) speed con-trollers. As the use of these simple and sometimes cheap controllers is growing rapidly and as their effect can be quite dramatic, an outline of what is happening should be of general interest.

With any type of load supplied through a chopper circuit, the current is distorted and the percentage distortion increases with the delay in firing. The power taken by the load is reduced by this delayed firing. With a resistive load (e.g. heating or incandescent lighting), the third harmonic in the load current reaches a maximum equivalent to over 30% of the original unchopped current. With an induction motor load (e.g. a fan) where the object is to vary the motor speed, the value of current at low speed is not much less than that at full speed. Consequently, the third harmonic current reaches higher values, e.g. equivalent to 40% of the full load phase current.

In installations supplied from three phase transformers the third harmonic is additive in the neutral just as with Fluorescent lighting. Thus the neutral current at low fan speed will probably exceed l20% of the maximum phase current even if there are equal loads on all three phases. As many neutral conductors including transformer neutrals are of reduced cross section, some cases of excessive heating and other problems may be encountered.

We are also concerned that with the excessive distortion there could be a significant effect on metering accuracy, although early tests show this to be less than 2%. The problem would not exist if the three phase fan motors were disconnected from the neutral but the suppliers seem to require the neutral connection to ensure fan speed stability.

In installations supplied from single phase transformers the third harmonic is not additive but appears with all other harmonics in the HV where it may have little effect. However, the query on metering accuracy is still valid.

When distorted currents are being measured, it should be realised that the normal clip-on-on ammeters are suspect. An instrument which is correct on an unchopped wave reads low on a chopped wave, and the correction increases up to 30% or more as the fan speed is reduced. Some allowance for inaccuracy should also be made with neutral current measurement. It is safer to use a clamp type CT and moving iron instrument (indicating or recording).

5.3.3 NEUTRAL VOLTAGE RISE

In outbuildings and detached portions of an installation, situations have arisen resulting in customers receiving minor shocks from metal water pipes. This is sometimes referred to as "stray voltage" or "MEN shocks".

In normal electric wiring installations under the MEN system, it is possible for the potential of the neutral conductor to rise above earth potential, even though the neutral conductor is earthed at various points. e.g. this may be due to:

- voltage drop in the neutral conductor
- heavy current in the neutral due to unbalanced multiphase loads
- high resistance contact of an earth electrode to the surrounding ground
- a high resistance contact in a neutral connection in a neutral conductor used as an earth bonding conductor.

Such situations can cause nuisance problems that warrant action but are unlikely to be dangerous under normal working conditions.

From experience and tests carried out in the field, this voltage can range from 3 to 10 volts.

As the problem discussed here is within the customer's installation, the responsibility lies with the customer to have the problem rectified by engaging the services of a licensed electrical contractor.

5.4 SWITCHBOARDS

5.4.1 LIMITING EDDY CURRENTS

When a current flows in a conductor which passes through a ferrous magnetic plate, (eg. steel plate), the resultant magnetic field induces a voltage which in turn produces eddy currents in the magnetic material enclosure. The magnitude of these eddy currents is dependent on the electrical properties of the enclosure, the magnitude of the current flowing in the conductor and the reluctance of the associated air gaps.

Excess eddy currents are undesirable as they waste energy and heat the surrounding enclosure to unacceptable levels. This section outlines design and construction techniques, which will limit eddy currents to acceptable levels in ferrous magnetic material cubicles (enclosures) used for electrical switchboards. These requirements are specified in general terms in AS/NZS 3000.

By using a slot or slots of sufficient width an air gap is introduced which impedes the flow of eddy currents induced by the magnetic field and restricts them to acceptable levels.

Where more than one conductor passes through a ferrous magnetic enclosure the net resultant current, obtained by vectorial addition, must be considered.

It is important to note that eddy currents only occur where there is a net resultant current flowing in the cables through the same aperture. **When all the active's and the associated neutral conductors pass through the one aperture, there is no problem.**

5.4.2 SLOT DIMENSIONS

If the current magnitude necessitates slotting of the enclosure to limit eddy currents then it is suggested that rectangular slots be used, extending **from the conductor group** to the edge of the enclosure. The combined width of the slot or slots is to be 20% (20% is a general rule of thumb that can be applied without using complex calculations) of the shortest distance to the edge of the enclosure. The shortest distance is determined as the distance from the centre of the conductor or conductor group to the nearest edge (cross sectional view) of the ferrous magnetic enclosure through which the conductor pass, see Figure 5.3.

5.4.3 OTHER CONSIDERATIONS

Any number of slots may be used provided that their combined width presented to the magnetic field path is at least 20% of the shortest distance to the edge of the enclosure.

The slots must run from the conductor or conductor group to the extremity of the ferrous magnetic enclosure or between the conductor groups, figure 5.4 and figure 5.5. If the slot or slots do not extend to the end of the enclosure then most of the magnetic field will pass through the magnetic material beyond the end of the slot, thus defeating the purpose of the slot.

Figure 5.4 and figure 5.5, shows a typical case of conductors passing through a metal enclosure with the approximate flux distribution shown around the conductors and some recommended positions for slots (dotted lines).

Figure 5.6, shows a typical switchboard which would not require a slot or slots as there would be no eddy currents flowing in the enclosure.

This information has been provided to enable compliance with AS/NZS 3000, however, other designs may also be acceptable.

5.4.4 BUSBAR SUPPORTS

Busbar supports shall be of an approved design.

Further information on the construction of switchboards can be referred in AS/NZS 3439.

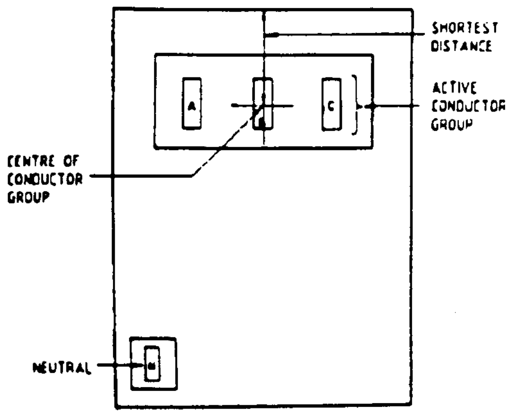


Figure 5.3 Calculation for Width of Slot

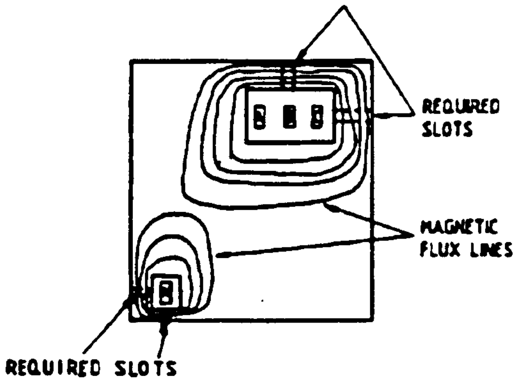


Figure 5.4 Typical Switchgear Assembly with Slotting of the Enclosure

Alternative:

Removing the section of the switchboard where the cables enter and replace it with a section of non-ferrous metal, eg. aluminium or brass

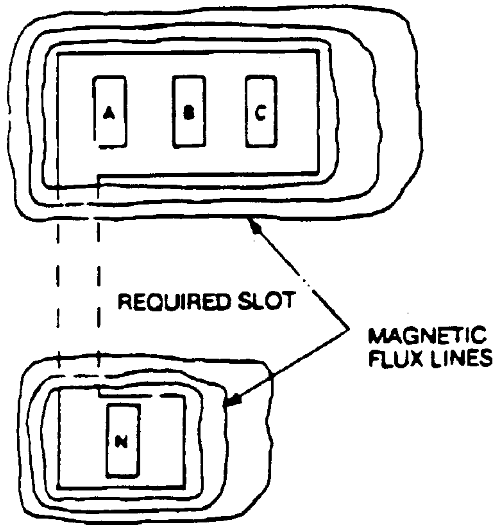
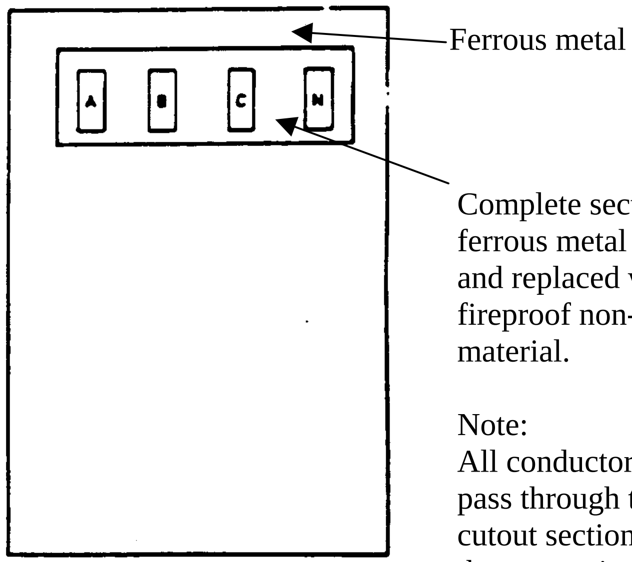


Figure 5.5 Typical Switchgear Assembly with Slotting of the Enclosure: Alternative Arrangement



Complete section of ferrous metal removed and replaced with a fireproof non-ferrous material.

Note:
All conductors must pass through the same cutout section so that the magnetic fields cancel out.

Figure 5.6 Typical Arrangement that Would Not Require Slotting

5.5 VOLTAGE DROP

5.5.1 GENERAL

ESS and Aurora inspectors will accept the values given for voltage drop in AS/NZS 3008.

5.5.2 UNBALANCED CIRCUITS

Calculation of volt drop for single phase and balanced three phase load conditions is adequately explained in AS/NZS 3008. Suitable worked examples are also provided to complement the explanation.

For unbalanced multi-phase circuits, some current will be flowing in the neutral conductor. Determination of volt drop in these situations is more complex and is dealt with in detail in AS/NZS 3008.

Two methods of calculation for unbalanced conditions are considered in AS/NZS 3008.

Method 1: Assume a balanced three phase load condition and calculate the voltage drop using the current flowing in the heaviest loaded phase. This is a conservative method and is useful if the out of balance conditions are intermittent (e.g. domestic installation).

Method 2: Using single phase values, calculate by vectorial summing of the voltage drop in each phase and the neutral conductor. This is a more accurate method where phase currents of different magnitudes are consistent over a period of time.

If neither of these two methods suits the particular installation (eg three phase mains but single phase metering) then the VD should be calculated by taking the MD of the highest rated phase and basing calculations on a single phase 230V supply.

This method should be used for installations where the-out-of-balance conditions are constant over a period of time, (typically larger non-domestic installations). This will involve other factors such as specific conductor material, temperatures and phase angles. Reference should be made to AS/NZS 3008 and the examples therein.

5.5.3 SUBMAINS

Single phase submains supplying single domestic installations (living units) must have a voltage drop not exceeding 5% of the nominal voltage. This voltage drop is to be calculated using either:

- the submains maximum demand; or
- the current rating of the circuit protective device.

5.6 LUMINAIRES

5.6.1 EXTRA LOW VOLTAGE

5.6.2 INSTALLATION

Extra low voltage (ELV) lighting is a specialised area of lighting that requires careful design and installation to reduce the risks associated with overheating of secondary conductors and use of thermal insulation in buildings.

Consideration should be given to the following installation requirements for an ELV lighting system.

Type: ELV transformers are a declared article and must be approved for use in Australia.

Location: ELV transformers must be located:

- in a readily available and well ventilated position where heat losses can be safely dissipated; and
- where the transformer will not be covered by thermal insulation; and
- where replacement of any internal fuse or resetting devices can be readily performed.

Enclosure: Open type transformers must be suitably rated to ensure that overheating does not occur when placed in an enclosure.

Transformer Rating: The transformer must be rated to suit the connected load.

In determining the connected load, the loading of each lampholder shall be taken as 50 watts or the maximum permissible lamp wattage that can be accommodated by the fitting, whichever is the greater.

***Exception**:* Where the light fittings are marked (in a position clearly visible) with the maximum lamp wattage, the loading of each lampholder may be determined by the marked wattage or 50 watts, whichever is the greater.

A common type of 12 volt ELV fitting can accommodate 50W or 75W lamps. If a circuit is designed, for example, to supply 4 x 50W lamps from a single 200VA transformer, the transformer can be overloaded if the 50W lamps are subsequently replaced with 75W lamps (i.e. total loading of 300VA).

5.6.3 ELV WIRING

Protection of Final Sub-circuit: Unless the transformer is short circuit protected (SCP), (and marked as such), all ELV final sub-circuits must be protected by a fuse or circuit breaker on the secondary side of the transformer.

This does not apply where a light fitting is supplied by an individual transformer mounted on the fitting.

Where more than one light fitting is supplied from the same transformer by individual sub circuit conductors, separate suitability rated fuses may be required for each circuit as the current rating of the fuses provided to suit the transformer's maximum rated output current may not provide protection for the individual conductors.

Where ELV transformers supply lighting tracks, circuit breakers MUST be used for the protection of the ELV conductors.

Rating of Cables: Cables must not be covered with thermal insulation, unless rated for such in accordance with AS/NZS 3008.

5.6.4. ELV LAMPS

The physical size of ELV lamps is smaller than the same wattage rating in normal low voltage (240V) lamps. For a given rating, the heat concentration is usually higher for ELV lamps.

Vertical Mounted: Recessed ELV lamps are normally only intended for mounting in a horizontal surface. If mounted in a vertical surface (e.g. wall mounted), consideration needs to be given to prevent the heat dissipated from the lamp damaging the wall above the fitting.

Dichroic: The "dichroic" feature of a lamp means that the lamp reflector is specially designed to reflect visible light downwards but reduce the downwards reflection of most of the heat from the lamp. The heat passes through the reflector to the space above. This feature has obvious advantages in the reduction of heat load for an illuminated room, but it means that ventilation through and above the fitting must be maintained by provision of a suitable guard designed to keep the thermal insulation at least 50 mm clear of the sides of the fitting and completely clear above the fitting. Dichroic lamps are generally of the metal halide type which may suffer a marked deterioration of life and performance if the voltage at the lamp is significantly above or below rated voltage. Special consideration must be given to voltage drop. This may require installing larger ELV conductors than required by current carrying capacity considerations.

Manufacturers recommend the installation of individual transformers for each fitting as this will ensure maximum lamp life and reduce excessive currents on ELV circuit cables.

5.7 SOCKET OUTLETS

5.7.1 ACCESSIBILITY

5.7.2 DISHWASHERS, REFRIGERATORS AND FREEZERS

Socket-outlets supplying the above must be located adjacent to or above the appliance (e.g. in the adjacent cupboard where it is readily accessible without having to move the dishwasher to gain access to the socket outlet).

5.8 ELECTRICAL EQUIPMENT

5.8.1 LOCATION OF ELECTRICAL EQUIPMENT NEAR ELECTRIC HOT PLATES OR GAS BURNERS

AS/NZS 3000 specifies that electrical equipment shall be adequately protected against damage which may result from exposure to such elements as high temperatures steam or any other circumstances that may occur.

To meet this requirement, unless specifically approved for the location, electrical accessories (e.g. socket-outlets, switches, lights) shall not be installed within the restricted zone as shown in Figure 5.8 (below).

5.8.2 RESTRICTED ZONE

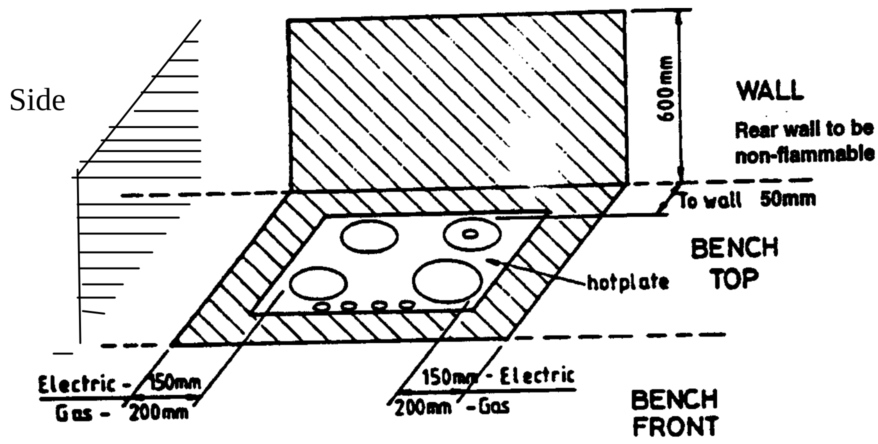
The restricted zone is contained by the vertical plane 150mm from the edge of the hot plates (gas - 200mm from the edge of the burners) extending to a height of 600mm above the hot plates/burners.

Note: Where a hot plate or burner is mounted on a bench, against a wall, the restricted zone shall extend to the wall behind the hot plates.

5.8.3

Protection provided by enclosures for electrical equipment is indicated by the International protection (IP) Code, basically by the two characteristic numerals as described in AS/NZS 1939.

Figure 5.7 Restricted area around cooktops



5.8.4 FUNCTIONAL SWITCHES

Functional switches as required by AS/NZS 3000, must not be installed within this restricted zone or on the wall immediately adjacent the cooktop (up to 600mm above the top of the cooktop). Functional switches are not permitted to be installed in a cupboard, as this is not considered sufficiently accessible for the purpose intended.

5.8.5 RANGES (STOVES), OVENS OR HOTPLATES

LOADING GENERAL

The final subcircuit maximum demand for these fixed stationary appliances is sometimes confused with that value required for calculation of consumers mains size.

Note: A combination oven and hotplate unit can be treated as one unit for the purpose of calculation of maximum demand on a final subcircuit or consumers mains. Regardless of whether the appliances are plugged in or not, the combined load can be assessed as an appliance.

MAXIMUM DEMAND OF RANGE FINAL SUBCIRCUITS

At first glance those items of equipment likely to draw less than full load current under normal operating conditions (ranges and the like) appear to have been overlooked in the new Wiring Rules, but have they?

Historically there has been very little trouble with the overloading of range circuits. Imperial 7/.036 and metric 7/0.85 or 7/1.04 cables have been widely used despite the fact that they were not rated for full load current of the range. This is due to the diversification factor based on typical usage (who turns all the elements on and if they do the elements will quickly cycle on the thermostat/simerstat).

Let us look at clause 2.4.3:

1.8.3.5 Limitation of maximum demand

The maximum demand may be determined by the current rating of a fixed setting circuit-breaker, or by the load setting of an adjustable circuit-breaker.

2.4.3 Protection against overload current

2.4.3.1 General

A protective device shall be provided to interrupt overload currents flowing in the circuit conductors before such currents cause a temperature rise detrimental to insulation, joints, terminations or surroundings of the conductors.

Although statements such as this were in the 1991 edition there was quite often additional more prescriptive information to define the parameters, such as the maximum demand of range final subcircuits. We now must take notice of these fundamental principal type clauses more often whereas in the past we were drawn to the prescriptive, ‘how to do it’ type information.

The answer for ranges is the cable size and protective device that will ‘do the job’ adequately (complying with all relevant clauses) protecting the installation without causing consistent nuisance tripping for the customer. Based on historical evidence and by using AS/NZS 3008.1.1 (selection of cables), AS/NZS 3018 (domestic installations) and the previous edition of the Wiring Rules it is unlikely that a 32A circuit breaker will have cause to trip when protecting a typical 11kW range.

If a circuit breaker is chosen to limit the maximum demand for a cooking appliance then the ‘functional switch’ required by clause 4.3.11 need only have a current rating greater than or equal to the rating of the protective device.

INSTALLATION

Manufacturers instructions are issued with each appliance particularly concerning methods of connection, fixing and clearances from combustible materials. Some upright ranges now require fixing brackets to be fitted to the rear wall or that the whole unit be fixed to the floor.

Generally these instructions form part of the approval of the particular appliance and must be complied with. Beware of clearances from combustible materials both above and below hotplates and ranges. Take particular care with wall oven venting and the clearances from the oven sides. (Note the two accompanying drawings of an oven and hotplates).

RE-WIRING

Some older ranges had as part of the unit, a socket-outlet installed on the hob splash back. If these ranges are re-wired they must comply with current installation standards. Therefore the socket-outlet must be RCD protected. As this is very hard to comply with it is our recommendation that these outlets be disconnected.

WALL OVEN FLUES

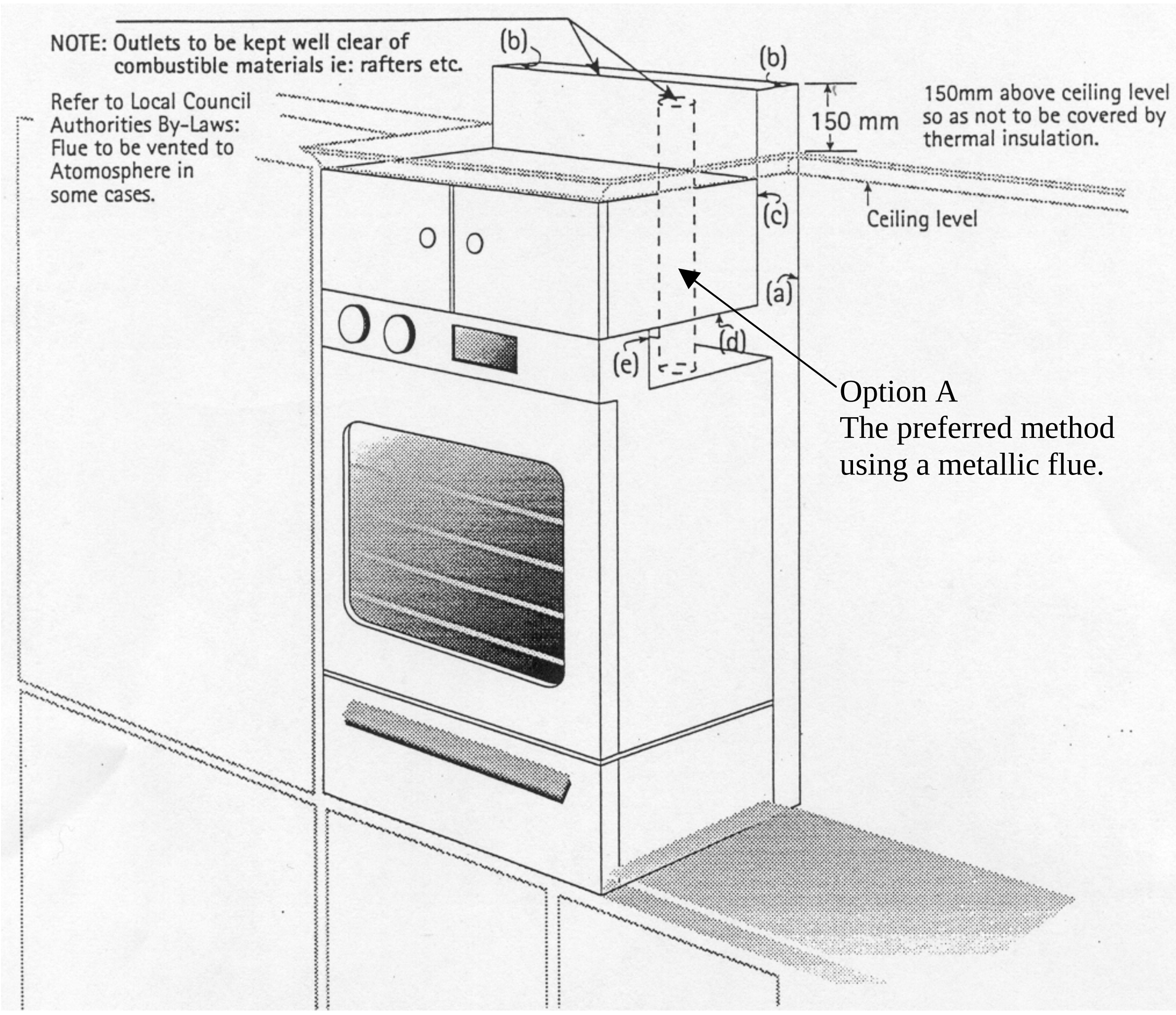
Option A

NOTE:

- The **preferred** alternative method to this fire rated duct is a vertical metallic flue installed in accordance with manufacturers instructions.
- Expelled waste air can be in excess of 250ºC.

Then if Option A (see Figure 5.8) is not achievable then option B would be an alternative method. This is achieved by lining the inside of the wall oven enclosure and the duct created behind the overhead cupboards.

Fig 5.8 Wall oven venting options



Option B (duct in the overhead cupboards)

The flue or duct created at the rear of any overhead cupboard, or similar boxed in section, shall be fire rated on all surfaces above the main body of the oven.

Fire rated materials shall be in accordance with AS/NZS 3000 (Melamine sheet and plaster sheet are not acceptable).

Protected surfaces shall include:

a) the rear wall extending vertically to the top of the duct
b) both sides extending vertically to the top of the duct
c) the rear of the cupboard extending vertically to the top of the duct
d) the underside of the cupboard shelf above the oven
e) the rear of the surround behind the control panel if exposed combustible material exists.

If overhead cupboards do not extend to the ceiling above, a small barrier-strip greater than 25mm in height should be installed around the top edge of the duct to prevent objects from accidentally falling down onto the oven vent.

5.9 CARAVANS AND CARAVAN PARKS

The electrical installation in caravan parks shall comply with AS/NZS 3001, AS/NZS 3000 and this publication.

The following information provides guidelines in the application of some of these requirements.

5.9.1 CALCULATION OF MAXIMUM DEMAND (MD)

The calculation of the maximum demand for plug sockets provided for the caravan site supply shall be as stated in AS/NZS 3001

Other facilities (e.g. ensuites) shall be calculated in accordance with AS/NZS 3000-2000.

Note: AS/NZS 3001, calculates the MD per phase by finding the total ampere loading and dividing by 3, whereas AS/NZS 3000 calculates the demand in amperes per phase.

5.9.2 VOLTAGE DROP

The voltage drop within the installation shall not exceed 5% of the nominal voltage.

Where a three phase sub-mains supplies a distribution board with outgoing single phase sub-mains the total voltage drop calculation is a little more complicated due to the different voltages. One method is to calculate the voltage drop by using the respective circuits maximum demand, as follows:

1. Calculate the voltage drop of the three phase consumers mains as a percentage of 415 volts.

2. Calculate the voltage drop of the three phase submains as a percentage of 415 volts.

3. Calculate the voltage drop of the single phase submains as a percentage of 240 volts.

4. Calculate the voltage drop of the single phase final subcircuit as a percentage of 240 volts.

The total percentages of 1, 2, 3 and 4 added together shall not exceed 5%.

5.9.3 EARTHING

The installations main switchboard must have a MEN connection.

Individual distribution boards may either be earthed via a conductor connected to the main switchboard or if detached or separate have a separate MEN connection in accordance with AS/NZS 3000 (refer to section 5.3.3 of this guide).

5.9.4 CONNECTION OF ANNEX

Where an Annex is wired as a permanent installation, e.g. not connected by a flexible cord, the electrical installation in the Annex shall comply with AS/NZS 3000

5.9.5 NUMBER OF OUTLETS PER BAY

It is recommended that at the design stage each caravan bay be provided with 2 outlets. This will enable the connection of additional caravan load if required, e.g. air conditioners.

5.10 GENERATING SETS

The basic requirements when installing a generating set for emergency use or as a standby to Aurora’s supply, is that these generating sets are:

- Installed in accordance with this publication, AS/NZS 3000, AS 3010.1 and where relevant AS 3009.
- Where relevant comply with the requirements of AS 2790.
- Mechanically and electrically isolated from Aurora’s supply unless special arrangements are made and confirmed by Aurora in writing; and
- Protected against weather, dampness, fire and overcurrent.

The following information is provided to assist in the application of the above requirements.

Note: All diagrams have the circuit protection (circuit breakers, fuses, etc.) omitted for simplicity.

5.10.1 CHANGEOVER SWITCH

This switch provides isolation between the generating set and the normal distribution supply. It is permanently wired and may or may not incorporate an intermediate "off" position.

If the changeover switch has an intermediate ‘off' position, it may be used in place of the main switch of the installation. Otherwise, a separate main switch (or switches) must be provided (see Figure 5.9 and Figure 5.10).

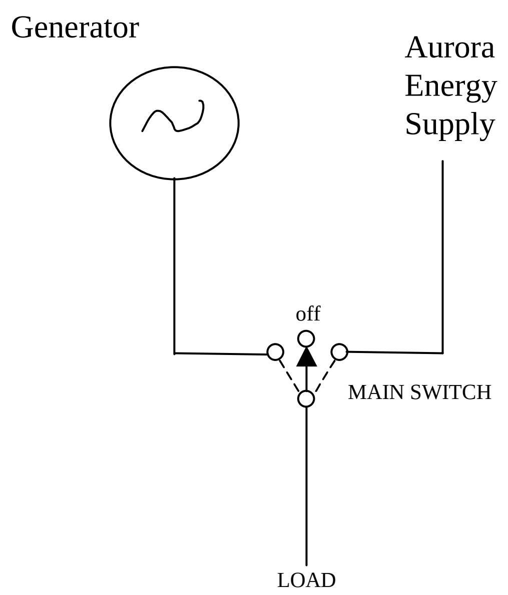


Figure 5.9 Changeover Switch With "Off" Position

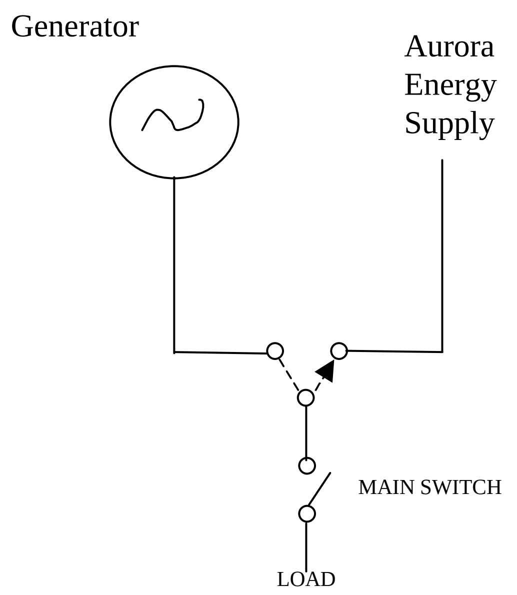


Figure 5.10 Changeover Switch Without "Off" Position.

5.10.2 SINGLE PHASE GENERATING SETS

5.10.3 WINDING TO FRAME CONNECTION

AS 2790-1989 specifies that single-phase generators may have one end of their winding connected to the generator frame provided that the generator output is protected by a, Residual Current Device (RCD).

It is important to ensure that the winding/frame connection is arranged so that it may be readily removed if the RCD is removed or the generating set is connected to an installation with an MEN connection.

Aurora will accept the following arrangements:

1. Where the RCD incorporates an integral socket outlet then the input neutral terminal of the RCD is to be connected to the earth terminal of the socket outlet. See Figure 5.11.

2. Where the socket outlet is not integral with the RCD then the input neutral terminal of the RCD must be connected to the generator frame. See Figure 5.12.

The earth terminals of all socket outlets supplied from generators, having winding to frame connections arranged via an RCD, must be effectively connected to the generator frame.

The schematic diagrams in figure 5.11 and figure 5.12, illustrate the principles involved; the heavy line shows the neutral/earth connection.

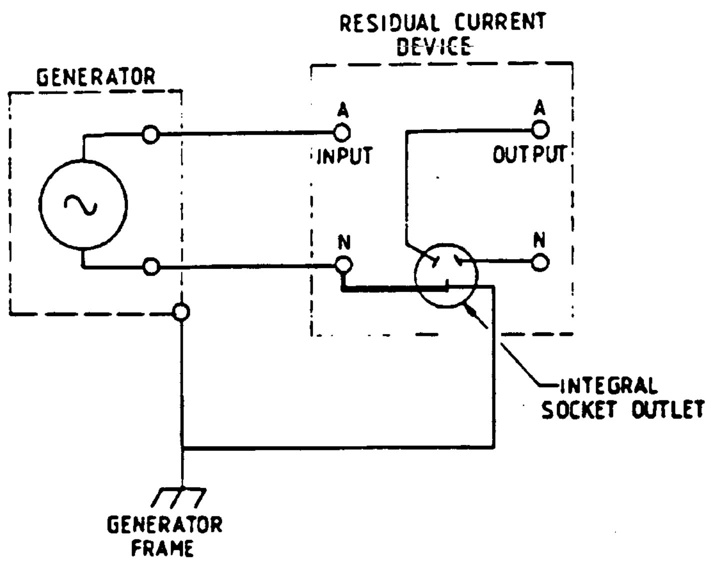


Figure 5.11 Single Phase Generator with Winding Frame Connection at the RCD/GPO

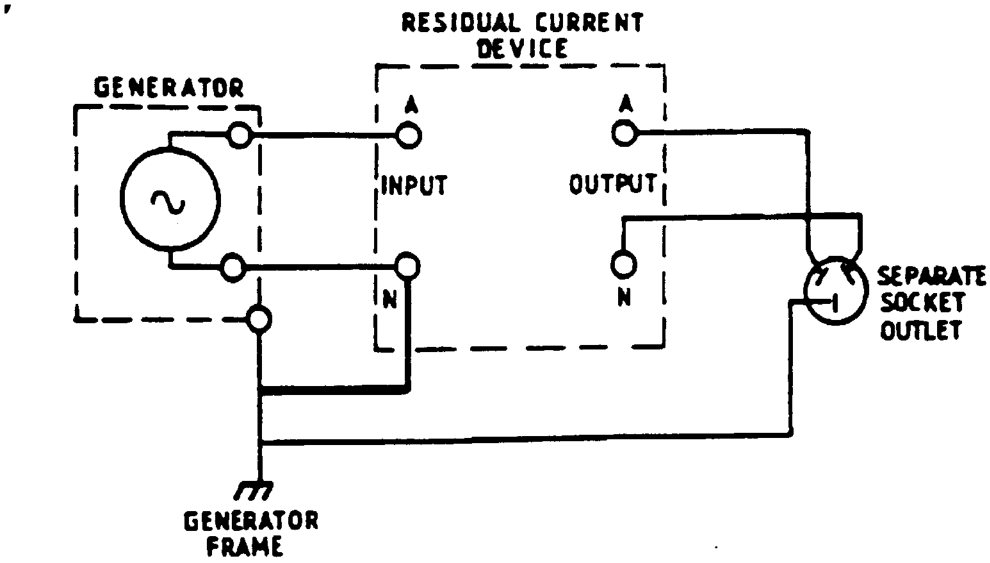
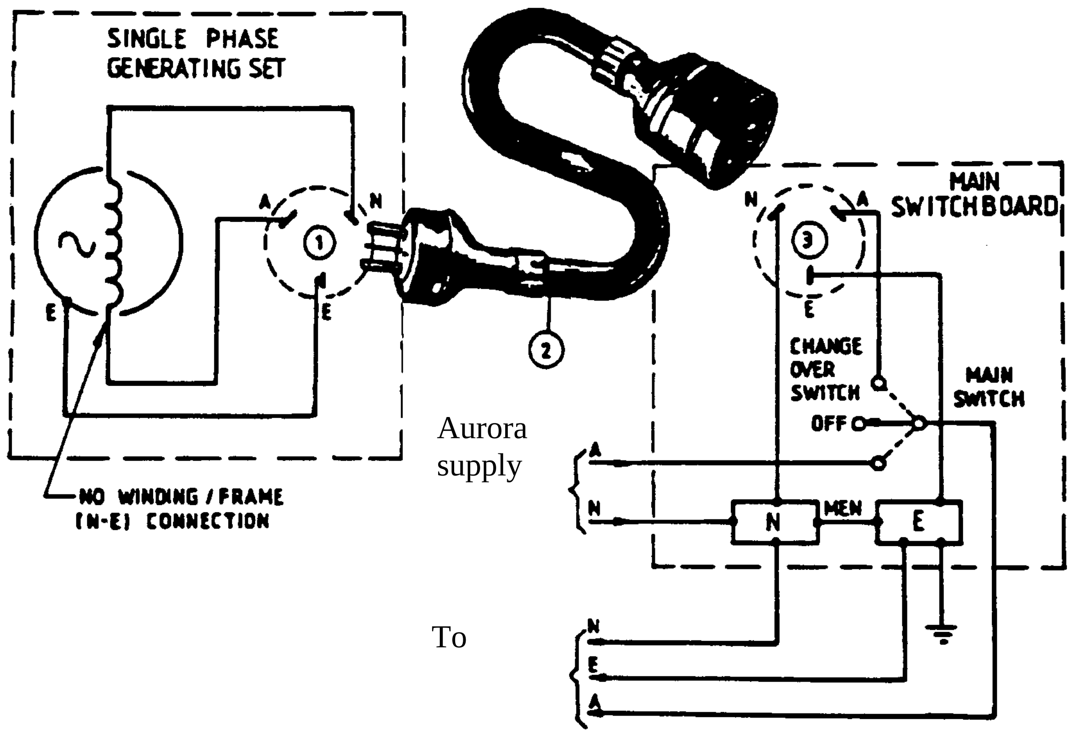


Figure 5.12 Single Phase Generator with Winding Frame Connection at the RCD: i.e. the RCD and the GPO are separate items



5.13 Single Phase Generating Set with plug and Socket - Outlet Connection Arrangement

Legend to Figure 5.13

1. Plug socket - (female) mounted on the portable generating set (front view).

2. Three conductor flexible cord capable of carrying the maximum output of the generating set outlet plug (i.e. 10 ampere socket-outlet and 10 ampere cable required).

3. Caravan type flush inlet socket (male pins).

5.10.4 GENERATOR SETS

There have been several fatal electrical accidents involving single phase portable generating sets in the past.

In all cases the victims were attempting to or had connected the generator to fixed wiring in a dwelling. One of the victims was an electrical contractor.

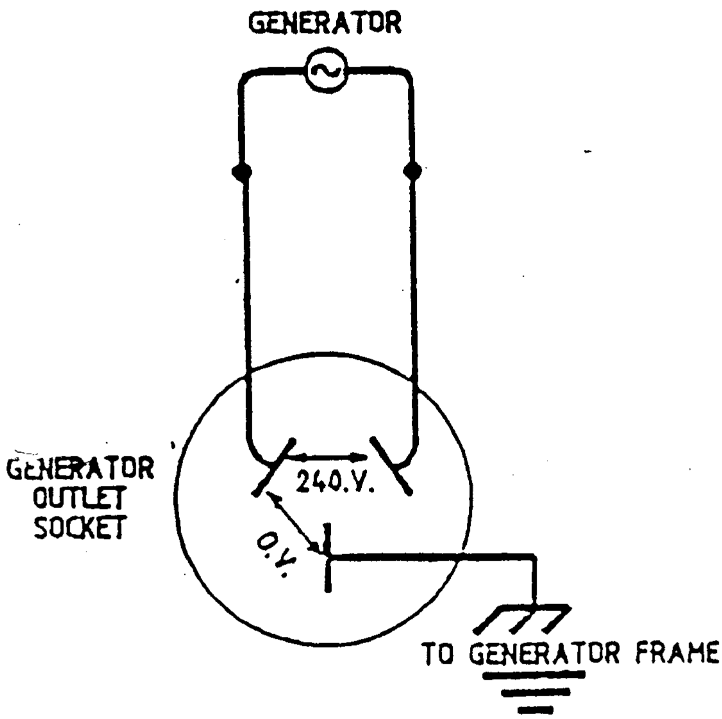
There is a concerned that electricians may not fully realise the problems which may arise if the generators are not connected correctly to a permanent installation.

5.10.5 SINGLE PHASE PORTABLE GENERATORS

1. FLOATING WINDINGS

The generated voltage is available only across the output terminals connected to the windings. There is no voltage between the windings and earth as there is no N-E connection at the generator.

Figure 5.14



FLOATING WINDINGS

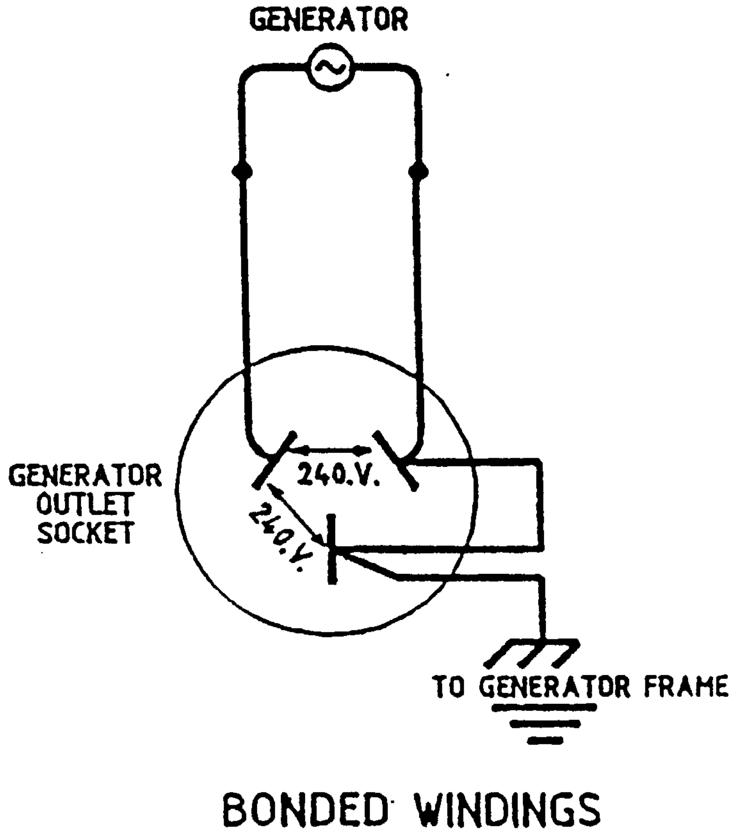
2. BONDED (POLARISED) WINDINGS

In some instances a bridge is connected between the neutral terminal and the earth terminal of the generator output socket as shown in Fig 5.15. Under this arrangement the generated voltage is available between:

- (1) the winding terminals

- (2) the Active winding terminal and the earth terminal
- (3) the Active winding terminal and the metal frame of the generator.

Figure 5.15

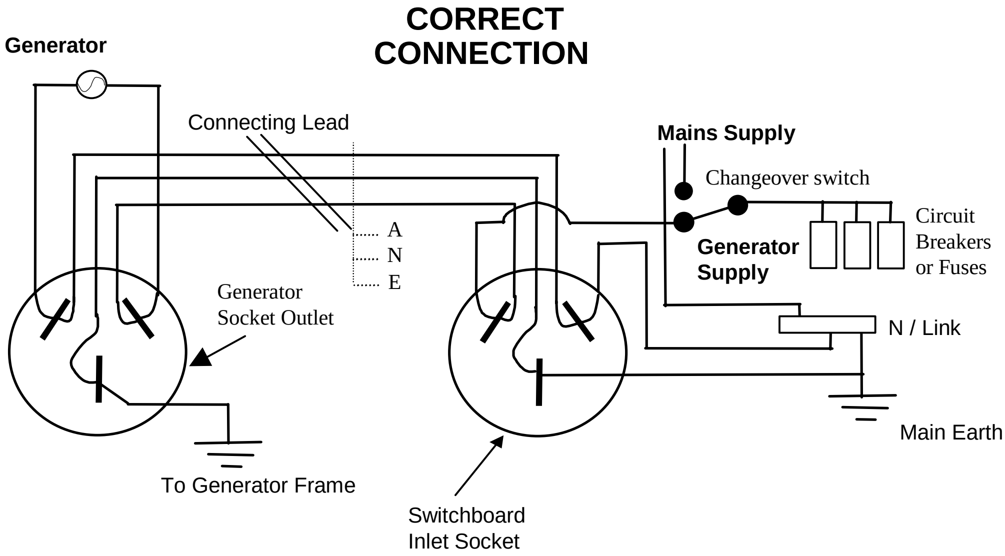


5.10.6 CONNECTION OF SINGLE PHASE PORTABLE GENERATOR TO FIXED INSTALLATIONS

1. FLOATING WINDINGS

Since the portable generator has no connection between the windings and earth it is immaterial which way it is connected to the fixed installation because it is not polarised.

Figure 5.16



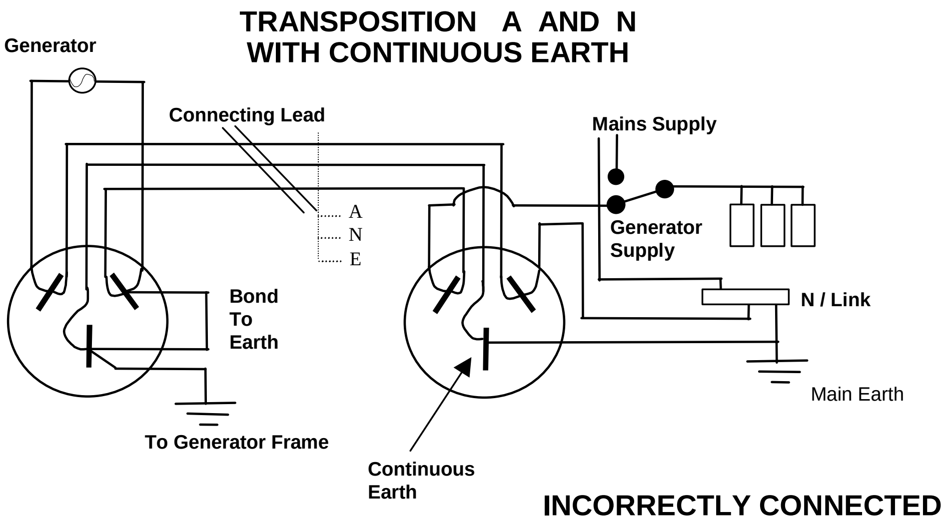
5.10.7 BONDED WINDINGS

The problem arises when a generator with bonded windings is connected to a fixed installation.

As previously pointed out one side of the windings is connected to the earth/frame terminal of the output socket. A flexible lead connecting the generator to a fixed installation MUST be correctly polarised and connected to the fixed installation with the active to the installation active, the neutral to the installation neutral link and earth to the main earth. Because of the MEN system, this effectively bonds the neutral and ea… …gether.

For instance, if a lead is used with a transposition of Active and Neutral but with a continuous Earth, a short circuit across the windings would occur. This short circuit would collapse the fields of the generator and no voltage would be generated.

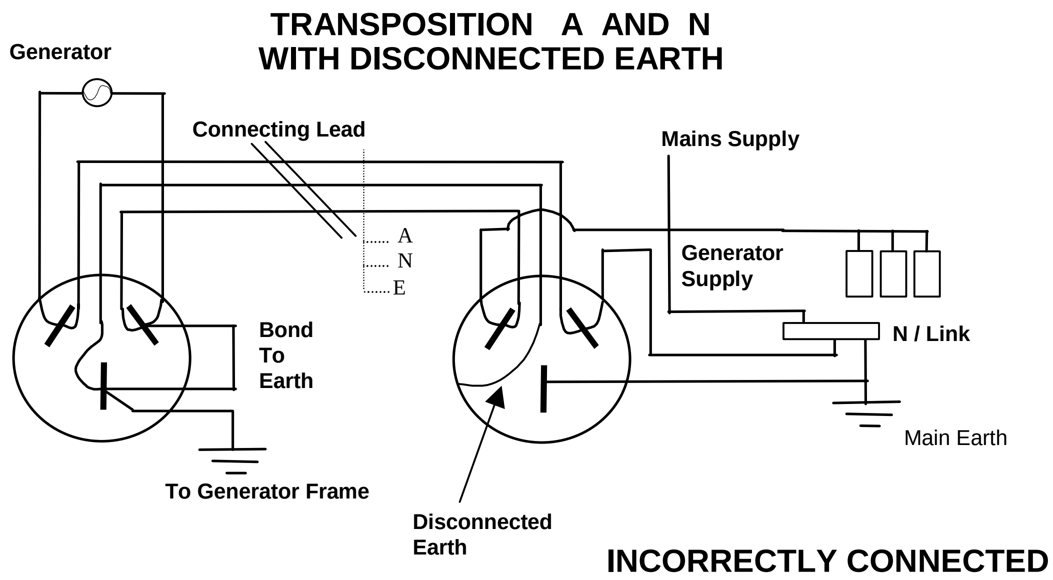
Figure 5.17



However, if the earthing conductor becomes disconnected (or if disconnected) see figure 5.18, the direct short circuit does not occur and the current will flow through the ground from the main earth stake back to the frame of the generator. The magnitude of this current now depends on the impedance of the ground between the installation earth and the generator.

Anyone bridging between the ground and the frame of the generator would receive an electrical shock of up to 240V especially if they lifted the generator from the ground as did occur in one fatal incident. Even if the generator was standing on the ground, when the victim contacted the frame there may be sufficient voltage difference for the shock to be fatal.

Figure 5.18



5.10.8 PLUG AND SOCKET-OUTLET CONNECTION

A typical application for this arrangement is at a farmhouse. The generating set is connected to the electrical installation via a flexible supply cord or cable.

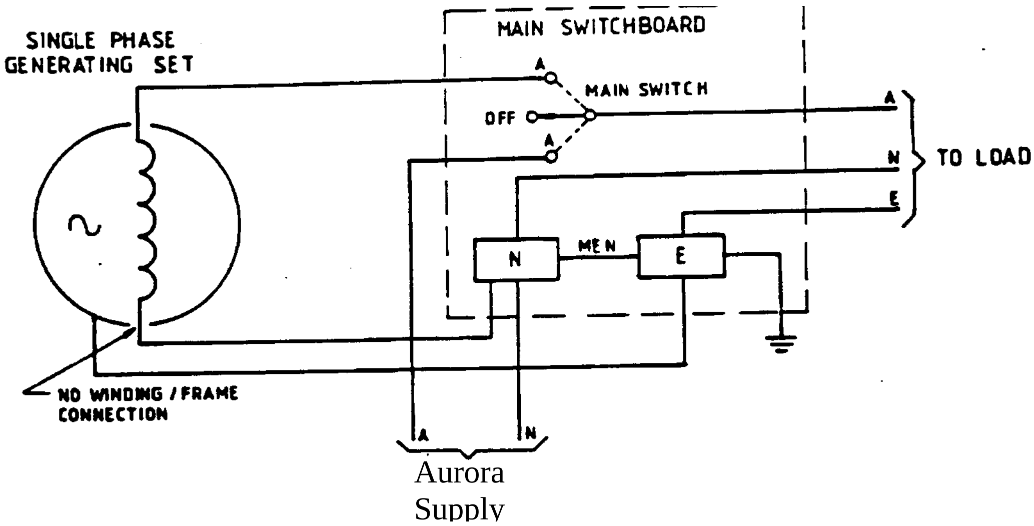
Note:

The generating set winding must not be connected to the frame, at the generator. If an RCD is fitted it must be installed on the load side of the MEN connection.

5.10.9 PERMANENT CONNECTION

A typical application of this is when the generating set is permanently installed as an alternative to Aurora's supply during outages.

Figure 5.19



Note:

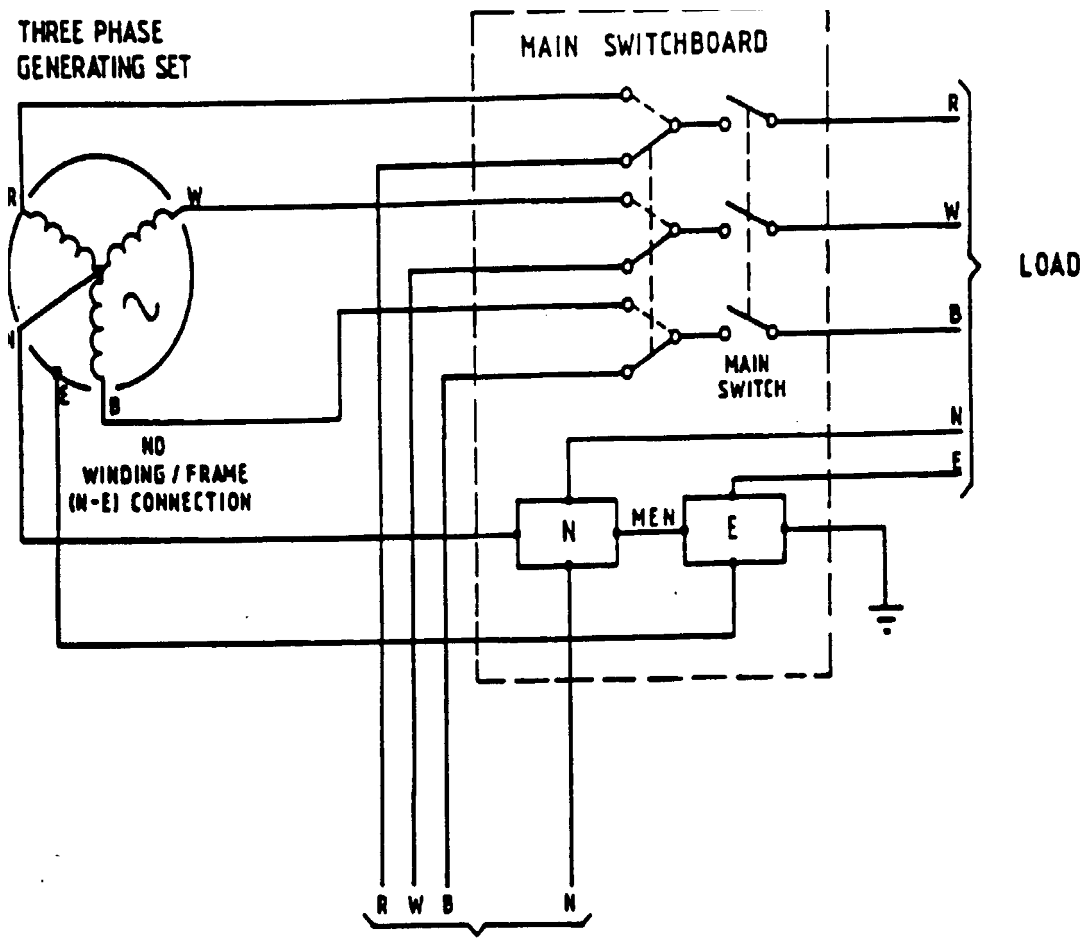
The generating set winding must not be connected to the frame, at the generator. If an RCD is fitted it must be installed on the load side of the MEN connection.

5.10.10 THREE PHASE GENERATING SET

5.10.11 CONNECTION TO A SWITCHBOARD WITH A MEN CONNECTION

When a generating set is connected to and utilises the MEN connection at the switchboard to solidly earth the neutral, no neutral earth connection is to be made at the generating set and the neutral conductor need not be switched (see Figure 5.20).

Figure 5.20



Aurora Supply

Three Phase Generating Set Connected to a Switchboard with a MEN Connection.

5.10.12 CONNECTION TO A SWITCHBOARD WITHOUT A MEN CONNECTION

When a three phase generating set is connected temporarily or permanently to a switchboard which does not have a MEN connection, i.e. to a distribution board which is located in the same building as the main switchboard, the neutral conductor must be switched and a neutral earth connection must be made at the generating set or alternatively at the distribution board (see Figure 5.21).

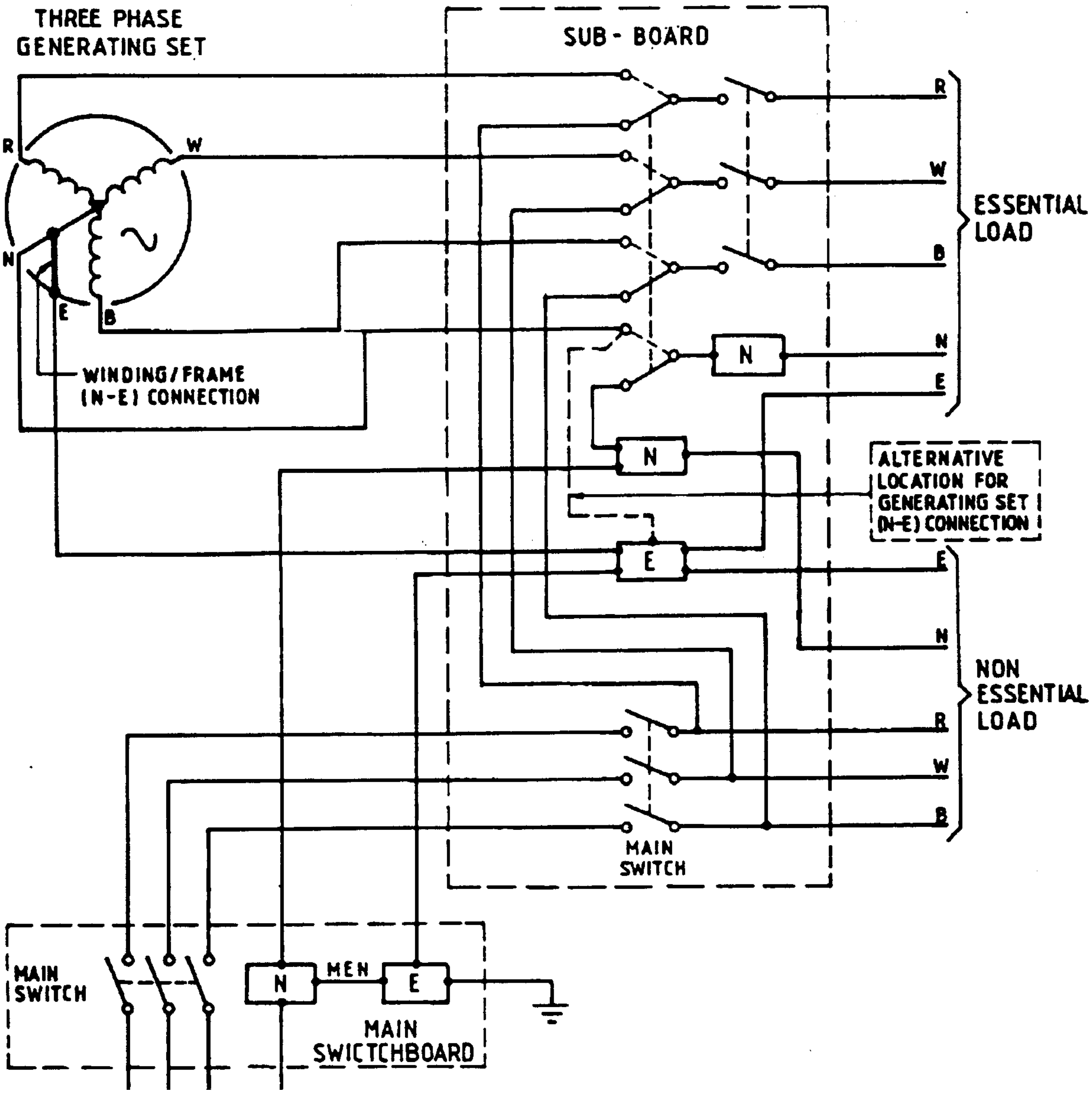
1. This arrangement has been submitted to SA for consideration. Until a ruling is issued this method of connection as shown in Figure 5.21 is to be adopted.

2. If a mineral insulated metal sheathed (MIMS), earth sheathed return (ESR) system is used to supply the distribution board, neutral switching and generating set N-E connection is not required.

3. A winding frame (neutral to earth) connection at the generating set need not apply if the installation is in accordance with AS/NZS 3000 (neutral not solidly earthed). This situation would rarely occur and should be discussed with Aurora Inspection section.

Three Phase Generating Set Connected to a Switchboard Without a MEN Connection.

Figure 5.21



5.11 ELECTRICAL SAFETY FOR OLDER HOMES/BUILDINGS

Just as people recognise the need to maintain their motor vehicle to ensure that it is safe, the electrical installation in your home should be checked to verify that it is safe. Generally, white and grey coloured plastic insulated electrical wiring should not cause any problems as it ages, but earlier cabling systems have a more limited lifespan and can become unsafe over time or with physical disturbance or structural change.

Older installations are a safety concern for electrical regulators. Electrical installations of the 1940s and 1950s consisted mainly of lead and rubber-sheathed, rubber insulated cables, or cotton-covered rubber-insulated wiring in split metal conduit. The electrical industry recently found installations with degraded rubber insulation, lead covered wiring deterioration and loose and unearthed split conduit assemblies. There is a risk of shock to tradespeople and occupants, and a risk of fire damage to buildings from aged wiring and switchboards.

A recommended method to improve the safety of all installation wiring is to install safety switches to minimise electrical shock hazard. Including safety switches in aged wiring installations can provide an additional monitoring measure against wiring failure in most circumstances. It is recommended that all light and power and other circuits have safety switches installed to provide increased protection against electrical shock and fire.

While a safety switch will not completely remove risk associated with an installation in relation to fire risk, it is the best available and most cost effective way to significantly increase the safety in your home. However, having a safety switch fitted should not be a substitute for treating electricity with the respect it deserves. Have your electrical contractor check your electrical installation if you have a pre-1950s home, experience problems with frequent tripping of circuit breakers or fuses blowing, or you think your switchboard, electrical wiring or equipment are suspect. Electricity Standards *and* Safety strongly recommend that home owners take every opportunity to have their electrical installation assessed for safety.

5.12 RELOCATABLE DWELLINGS ELECTRICAL STANDARDS AND IMPERIAL CABLES

Legislation in all Australian electrical licensing jurisdictions, including Tasmania, requires compliance with AS/NZS 3000-2000 (mandatory from 1 June 2000).

The standard sets down requirements for new electrical installations as well as alterations and additions to existing installations. Clause 1.5 Alterations, Additions and Repairs states:

‘Every alteration of, or addition to, an existing electrical installation shall be deemed to be a new installation, and all relevant provisions of this standard shall apply to such alteration or addition’.

When a dwelling is relocated and connected to a new electricity supply, it is expected that the electrical installation will serve the building for a considerable length of time. The same applies to an extension or additions to an existing dwelling. Councils have many similar requirements.

Imperial cables do not comply with the current requirements of AS/NZS 3000. In general, where imperial cables have been used in existing dwellings, they may continue to be used while no alterations or additions are made to the parts of the installation that use the imperial cables.

However, any change, such as an addition or relocation would mean the installation does not meet current requirements and therefore the relevant parts must be made to comply.

It is not only the cables but also the switchboard earthing and fittings that may need upgrading.

Imperial cables ceased to be used in electrical installations from the mid 1970’s. At the time of manufacture they were considered to have a life span of some 40 years. Earlier cables used lead, cotton and then rubber sheathing. These cables are beyond their life expectancy and now should be replaced immediately, regardless of the situation. Later imperial cables were PVC insulated and sheathed.

Insulation and/or sheathing of the PVC cables have been found to harden with resultant cracks, leaching of plasticiser, green exudate (a green substance that leaches out of some varieties of PVC) and general aging.

Imperial cables also:

- are smaller in cross sectional area and carry less current
- have unsheathed earth conductors.

Metric cables were generally increased in size to accommodate derating. eg. for domestic ceiling space insulation.