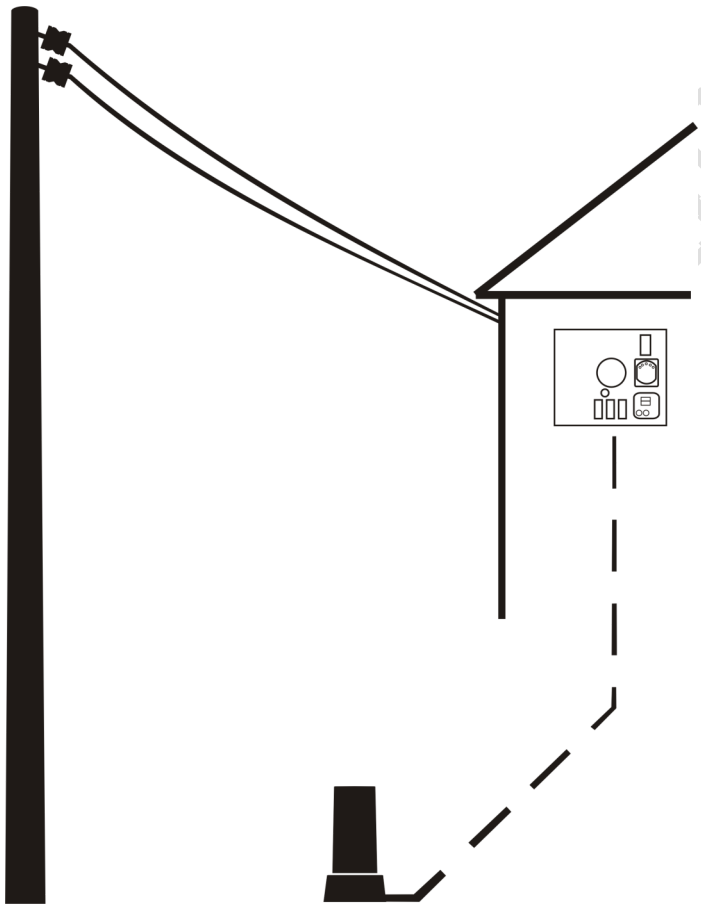
Service and Installation Rules of New South Wales

The electricity industry standard for customer connection services and installations

April 2025



Acknowledgements

The following organisations were members of the committees that have prepared and reviewed these Rules.

Department of Climate Change, Energy, the Environment and Water (DCCEEW)

Ausgrid

Endeavour Energy

Essential Energy

National Electrical & Communications Association (NSW chapter)

Electrical contractor and Accredited Service Provider (ASP) representatives

Comments and enquiries

To direct comments and enquiries on these Rules to electricity distributors:

Ausgrid	13 13 65 All areas of Ausgrid
Endeavour Energy	13 37 18 All areas of Endeavour Energy
Essential Energy	13 23 91 All areas of Essential Energy

Service and Installation Rules of New South Wales

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Foreword

The Service and Installation Rules of New South Wales (the Rules) is the recognised industry code outlining the requirements of electricity distributors when connecting a customer to the distribution systems of New South Wales. The Rules reflect the requirements outlined in the *Electricity Supply Act 1995* and Chapter 5A of the *National Electricity Rules*.

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) role in the preparation of the Rules is as convenor and secretary of the Service and Installation Rules of New South Wales Management Committee (the management committee) and is the notional holder of the copyright of the Rules.

This is the April 2025 edition of the Rules. The management committee identified in the acknowledgements has endorsed the changes.

The Rules set out the minimum standards for providing safe, reliable and efficient connection services to customer premises.

Neither the committee nor DCCEEW accepts any responsibility for:

- the design, operation or failure of any electrical installation or installation work
- any loss or damage occasioned to any person or property as a result of carrying out connection services.

Compliance with these Rules does not necessarily ensure satisfactory operation of electrical installations or installation work. The electrical contractor is responsible for carrying out any additional work to ensure satisfactory operation.

The management committee comprised representatives of government, electricity distributors, electrical contractors and other stakeholders. It consulted widely throughout the industry and a range of stakeholders while developing the Rules.

The management committee is responsible for resolving issues and monitoring the impact and further development of the Rules. Further editorial amendments will be considered at future meetings of the committee.

There may be situations the Rules do not cover. These may include unusual connection or situations that have been inadvertently omitted, and alterations to legislation and codes. The management committee does not accept responsibility where these situations occur.

Comments or enquiries on the provisions of these Rules should be directed to the electricity distributor.

Kathy Staggs
Convenor
Service and Installation Rules of New South Wales Management Committee

Contents

Figures

Tables

Amendment status schedule

Amendment number	Date issued	Sections affected
1	June 2015	All
2	September 2015	Minor Edit to Figure 1-2
3	August 2016	Major amendments to sections 1 and 4 as well as minor amendments to other sections of the document to support the NSW Electricity (Advanced Metering) Bill 2016
3a	September 2016	Clause 4.7.5 noted AS60269.3.0 & AS60269.3.1 withdrawn
3b	November 2016	Clause 4.7.2 and Notes to Table 4.1 amended to clarify rating of MPD fuse and use of CB in lieu of fuse Clause reference under meter protection device definition amended to 4.7.
4	August 2018	Revised to remove metering from electricity distributors responsibility due to introduction of Power of Choice legislation as from 1 Dec 2017 and introduction of separate Annexure for Metering and Installation Rules (therefore above clauses referenced may have been removed).
5	November 2018	Revised: clause 4.7.2 (c) about location of MPD to the MSB. Clause 4.10 making service neutral links obligatory. Clause 5.2.2 about special service length. Clause 8.6.13.1 updated worked example to meet current acceptable voltages.
6	January 2019	Fixed broken cross-references.
7	October 2019	Clauses 8.5 and 8.6.1 and 1.9 included new text to outline requirements relating to AEMO Distributed Energy Resource Register with a definition added. Clause 1.17.16 clarification that connection points shall remain separate. Amendments to correct page numbering, spelling errors, departmental change of name and heading error at clause 4.7.3 (resulting in renumbering thereafter and cross-referencing).
8	April 2025	Major revision to all sections within the Rules. Digitally remastered diagrams, hyperlinked definitions. Switched from two column to single column formatting.

Notes:

1 The management committee, may, at intervals of not more frequently than 6 months from the date of publication, make amendments to these Rules, including this amendment status schedule.

2 The management committee may publish amendments to these Rules on the DCCEEW website.

3 The user of these Rules is responsible for ensuring this amendment status schedule and the relevant sections are maintained up to date. No liability is accepted for errors or events arising from a failure or omission to update these Rules.

1 General requirements

1.1 Purpose of these Rules

Electricity distributors are obliged to connect customers to their distribution system under a customer connection contract. The contract stipulates terms and conditions that shall be satisfied by the electricity distributor and the customer.

To ensure the electrical installation of a customer can be connected to the distribution system, the electricity distributor can describe the requirements of the connection to its system (Service Rules) and compatible requirements of the electrical installation (Installation Rules).

These Rules – the *Service and Installation Rules of New South Wales* ('the Rules') – provide uniform requirements for electricity distributors, Accredited Service Providers (ASPs), electrical contractors and customers throughout NSW. This has been achieved by:

a) providing consistent requirements from electricity distributors

b) specifying electrical installation requirements as permitted by *AS/NZS 3000:2018 Electrical installations*

c) specifying service requirements to promote industry standardisation of equipment

d) specifying service requirements which comply with the provisions of the *Electricity Supply Act 1995*

e) including recommendations and advisory information which may indicate future requirements of AS/NZS 3000 and legislation

f) providing information to the electricity supply industry, metering providers, ASPs and the electrical contracting industry which enables them to work together to promote standardisation of systems and equipment.

These Rules should be read in conjunction with the *Gas and Electricity (Consumer Safety) Act 2017* and the Gas and Electricity (Consumer Safety) Regulation 2018, which provide a single legislative framework for the regulation of consumer safety in relation to gas and electrical products and services.

1.2 Application

Following the introduction of metering contestability arrangements (power of choice) under the *National Electricity Rules* (NER), changes to the NSW contestability framework were made to reflect the transfer of responsibility for new and replacement metering installations from the electricity distributor to the metering coordinator. Requirements for metering are no longer addressed by these Rules, other than for some aspects relating to the maintenance of existing Type 5 and 6 metering installations owned by electricity distributors. Controlled load functionality remains the distributor's responsibility. Requirements for new and replacement metering installations are specified by the Metering and Installation Requirements. Some references to metering and controlled load devices have been retained in the body of these Service and Installation Rules for completeness and information.

Electricity distributors have adopted these Rules through their customer connection contracts.

As set out in the note to clause 34(3) of the Gas and Electricity (Consumer Safety) Regulation 2018, persons carrying out electrical installation work should have regard to the Service and Installation Rules.

Where the word 'shall' appears, it indicates the electricity distributor cannot negotiate with the customer on that matter.

Where other less definite terminology is used, a degree of flexibility is indicated, and it may be feasible for the customer to negotiate with the electricity distributor. Where possible, the customer's preferences will be considered.

These Rules are designed to achieve safe, reliable and efficient outcomes for both the electricity distributor and the customer.

Consideration of safety to customers, electricity workers and the general public are paramount – as well as considerations of potential liability.

Should a contravention of these Rules (without an accepted alternative method) occur, the electricity distributor is entitled to refuse, suspend or discontinue supply, or require correction of the contravention subject to any resolution achieved by a dispute resolution process.

The Rules are presented in parts:

- Section 1 provides the fundamental legislative obligations, definitions, policy, conditions and informative statements.
- Sections 2 to 8 contain detailed design, material and construction information for services, service equipment and certain aspects of electricity-distributor-owned Type 5 and 6 metering installations that are not covered in the Metering Installation Requirements. These serve to clarify the electricity distributor requirements, and any alternatives for ASPs, electrical contractors and installation designers.

To avoid doubt, nothing in the Rules is intended to prevent or impede an electricity distributor exercising its rights under legislation in the management of its distribution system and equipment. The distributor for example, may repair, maintain, augment or renew service mains without reference to the Rules as it would be managing its system in accordance with jurisdictional regulatory requirements.

1.3 Alternative methods

(Note that alternatives to metering requirements are excluded from this clause.

Where the customer proposes an alternative method that is not specifically contained in these Rules, the proposal shall deliver the same or better level of safety, reliability and efficiency.

The electricity distributor shall deal with proposals for alternative methods using the following procedure:

a) Applications for alternative methods shall be made in writing to the relevant electricity distributor.

b) The electricity distributor shall acknowledge receipt of the application in writing, within 2 weeks.

c) The proposal shall be given due consideration and a formal response provided in writing, within 10 business days (or as otherwise advised). The electricity distributor shall outline the reasons for its decision.

d) Appeals (where necessary) should be made to the electricity distributor in writing. The electricity distributor shall review its decision and provide a written response, within one month (or as otherwise advised).

e) Further appeals (where necessary), should be made in writing to the Department of Climate Change, Energy, the Environment and Water for assistance.

Acceptance of any proposed alternative method does not imply automatic recognition as an industry standard.

1.4 Non-compliance

Where the customer does not comply with these Rules or an accepted alternative method, the electricity distributor may:

a) refuse, suspend or discontinue supply, or

b) require the customer to rectify the identified non-compliance or comply with the conditions of connection of supply, or

c) arrange rectification at cost to the customer, where safety issues are identified and a notice to rectify in line with the Rules is not actioned.

The electricity distributor may require the customer to pay for a re-inspection of the work in accordance with the Australian Energy Regulator pricing determinations.

1.5 Dispute resolution

If the electricity distributor and a customer are unable to resolve a dispute on matters related to these Rules using the electricity distributor's dispute resolution procedure, provided for in the customer connection contract, the customer may seek to have the matter resolved by the Energy and Water Ombudsman NSW (EWON) or by another process in accordance with the terms of the contract.

1.6 Safety and environmental risk management

These Rules specify the technical requirements for relevant work associated with electrical installations. Electrical contractors, and ASPs trained and qualified to carry out this work, shall do so in accordance with the conditions of their electrical contractor's licence, accreditation and authorisation as applicable. They shall abide by all applicable safety and environmental legislative requirements. This includes a requirement to assess the safety and environmental risks associated with the carrying out of work and taking appropriate action to mitigate those risks. The general process is summarised as follows:

a) Identify hazards associated with the work and the worksite.

b) Assess the risks associated with the identified hazards.

c) Implement appropriate control measures to mitigate the hazards.

An example of this process is the use of a hazard assessment checklist (HAC) at the work site before commencing work. The HAC includes a check of tools and equipment and worksite safety and environmental hazards.

Refer to *AS/NZS 4836:2023 Safe working on or near low-voltage electrical installations and equipment* as a guide.

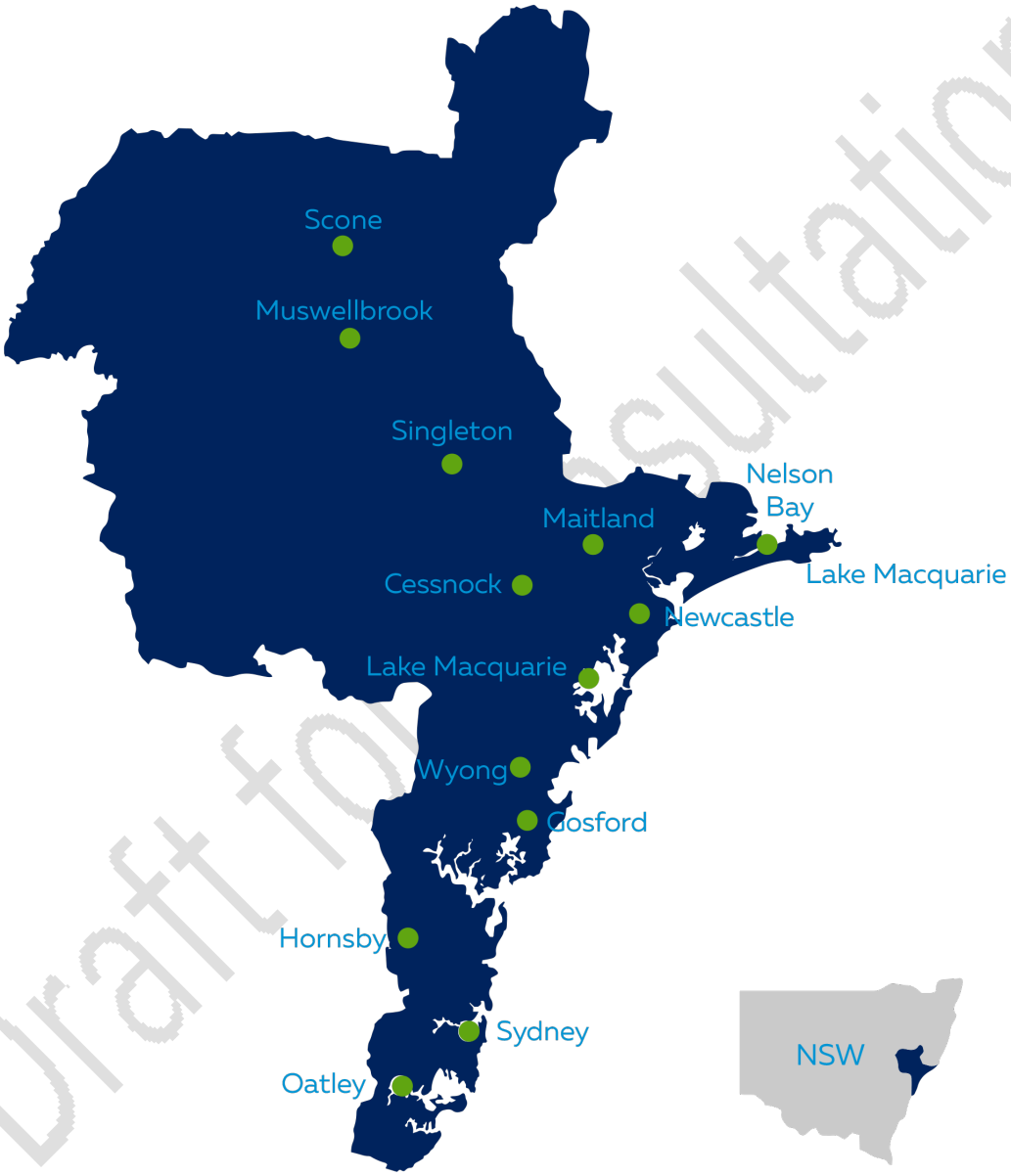
1.7 Legislation and standards

These Rules refer to a number of instruments of legislation, including codes, Acts and laws. All references are current at publication in April 2025. These should be used as a reference point, but where a more current instrument exists, it should override the older referenced instrument in this document. The same applies for Australian Standards.

1.8 NSW electricity distributor areas

1.8.1 Ausgrid

General enquiries	13 13 65
Emergencies	13 13 88
Street lighting	1800 044 808



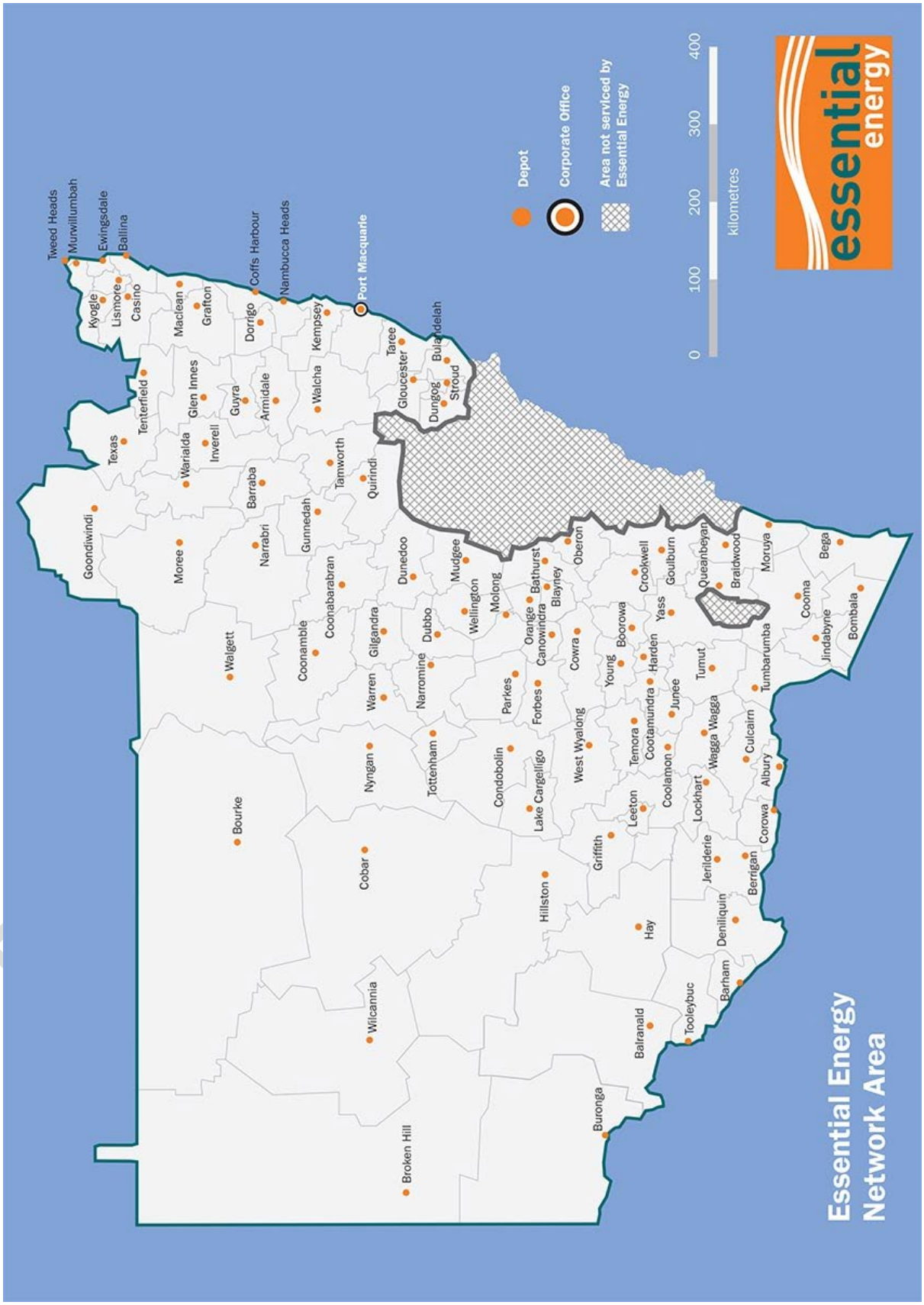
Ausgrid

1.8.2 Endeavour Energy

General enquiries 13 37 18
Emergencies 13 10 03

1.8.3 Essential Energy

General enquiries 13 23 91
Interruptions 13 20 80



1.9 Definitions

Meanings for the words used in these Rules are listed below. Refer also to the figures provided.

1.9.1 Accredited service provider (ASP)

An entity accredited to provide contestable network services in accordance with the *Electricity Supply Act 1995* and Regulations. This includes installation and removal of electricity-distributor-owned load control equipment (if any), and, in certain circumstances, reconnection of Type 5 and 6 meters where this is permitted by the electricity distributor and does not constitute a new or replacement metering installation under Chapter 7 of the *National Electricity Rules*.

1.9.2 Australian Energy Market Operator (AEMO)

Australia's independent energy markets and power systems operators, providing critical planning, forecasting and power systems information and security advice.

1.9.3 Authorised person

An individual granted permission in writing by an electricity distributor to work on or near an electricity distributor's distribution network.

1.9.4 Connection device

A fixture that forms the physical junction through which electricity is transmitted across a break in electrical conductors. Where the connection device forms part of the electrical installation as defined in clause 1.9.5 'Connection point' subclause (a), it is owned and maintained by the customer for connection to the distribution system.

1.9.5 Connection point

The definition of connection point in these Rules fulfils the requirements of defining the connection point in the *Electricity Supply Act 1995*.

'Connection point' means the junction where the distribution system is connected (by means of a connection device) to the customer's installation.

The connection point as defined in subclauses (a) and (b) shall be situated on relevant land.

The following situations describe the different types of connections at the connection point and also reference the relevant diagrams within these Rules:

a) Where electricity is supplied from the distribution system (that is not from a substation on relevant land) the connection point is on the distribution-system side of the connection device closest to the distribution system. Refer to Figure 1-1 (a), (b), (c) and (d), and Figure 1-2 (a), (b), (c) and (d).

b) Where the electricity is supplied from a distribution substation on relevant land, the connection point is at the electrical installation side of the distributor's protection device situated at the substation. Refer to Figure 1-1 (e) and Figure 1-2 (e). Where no LV protection exists consult with distributor.

c) The connection point for a high-voltage (HV) customer, a special small service or a customer who has entered into a relevant agreement with the electricity distributor concerned, is the connection point agreed in writing between the customer and the electricity distributor.

d) For rail network electricity systems not covered by (c) in this definition, the connection point with the railway direct current (DC) traction system is at the DC terminals of the rectifier in the railway traction substation.

For the purposes of applying this definition to electrical installations that were commissioned before the current version of the Rules, it is possible for a connection point to be notional.

For example, using a historic installation that is typically described in Figure 1-1 (d), this clause determines that the connection point is at the join in the pillar inside the boundary line. However, if historically this situation has existed without a physical connection to make and break conductors at the required location (i.e. contrary to current requirements, a continuous piece of wire enters and exits the pillar in this example), a notional connection point exists at this point as described in Figure 1-1 (d).

1.9.6 Consumers mains

Consumers mains are the conductors between the connection point and the main service equipment enclosure and form part of an electrical installation. Consumers mains may be overhead, underground or within a structure. Refer to Figure 1-1 (a), (b), (c), (d) and (e) and Figure 1-2 (b), (c) and (e).

1.9.7 Electrical Contractor

A licensed electrical contractor who is approved to carry out installation work or electrical tests on an electrical installation as defined by the Building Commission NSW.

1.9.8 Customer

An individual or entity who (either personally or through an agent) applies for or receives or makes use of a connection of an electrical installation to the electricity distributor's distribution system.

1.9.9 Customer connection contract

A contract between the network operator and a customer that contains the terms and conditions under which an electrical installation of a customer is connected to the electricity distributor's distribution system.

1.9.10 Distribution area

Distribution area in relation to the electricity distributor means the distribution districts described in clause 83 and listed in schedule 3 of the *Electricity Supply Act 1995*.

1.9.11 Distributed Energy Resource Register (DER Register)

The national register of generation sources under 30MW that are not registered generators with the Australian Energy Market Operator (AEMO), that will be operated by AEMO from 1 December 2019. From this date, distributor model standing offers will require customers to provide technical data on any generation sources installed under 30MW, including batteries, to this register. For further information see Distributed Energy Resource Register on the AEMO website.

1.9.12 Distribution main

The electricity powerlines that are used to convey electricity to the premise up to the point of common coupling (PCC) in relation to an electrical installation.

1.9.13 Distribution system

The electricity powerlines associated equipment and electricity structures that are used to convey and control the conveyance of electricity to or from the premises of customers or generators; or to, from and along the rail network electricity system. A distribution system does not include a transmission network.

The distribution system does not include any conduit, pole or other structure supporting protecting or enclosing electricity lines where those assets are part of an electrical installation.

1.9.14 Electrical installation

As defined by the *Gas and Electricity (Consumer Safety) Act 2017:* any fixed appliances, wires, fittings, meters, apparatus or other electrical equipment used for (or purposes incidental to) the conveyance, measuring, control and use of electricity in a particular place, but not including any of the following:

a) any electrical equipment (other than a meter) used, or intended for use, in the generation, transmission or distribution of electricity that is:
   i) owned or used by an electricity supply authority, or
   ii) located in a place that is owned or occupied by such an authority
b) any electrical article connected to, and extending or situated beyond, any electrical outlet socket
c) any electrical equipment in or about a mine
d) any electrical equipment operating at not more than 50V (volts) alternating current (AC) or 120V ripple-free direct current (DC)
e) any other electrical equipment, or class of electrical equipment, prescribed by the regulations.

An electrical installation may supply multiple customers, including for example:

f) strata title developments
g) embedded networks
h) shopping centres
i) buildings with separately metered subletting arrangements
j) previous arrangements of subtractive metering.

1.9.15 Electrically unprotected

Where the conductors (consumer mains) from the connection point are not protected by customer's protection.

1.9.16 Electricity distributor ('distributor')

The electricity distributor ('distributor') within whose distribution area any electrical installation or installation work is situated or where the installation work is carried out.

Note: Sydney Trains is the distributor for electrical installations on railway land and for a limited number of customers supplied from the rail network.

1.9.17 Electricity Supply Act

The *Electricity Supply Act 1995 No.94* (NSW).

1.9.18 High voltage (HV)

Voltages greater than 1,000V AC or 1500V DC.

1.9.19 High-voltage installation responsible person

The owner, controller or operator of a high-voltage (HV) installation i.e. taking supply at voltages greater than 1,000V AC.

1.9.20 Land parcel

An area of land with defined boundaries, under unique ownership for specific real property (land) rights or interests. The interests can involve physical aspects, such as the use of land, or conceptual rights, such as a right to use the land in the future.

1.9.21 Low voltage (LV)

Voltages greater than 50V AC or 120V DC but less than 1000V AC or 1500V DC.

1.9.22 Metering coordinator

An entity registered as a metering coordinator with AEMO.

1.9.23 Metering equipment

Equipment used to measure the electricity consumption at a metering installation as defined by the *National Electricity Rules*.

1.9.24 Metering Installation Requirements

Means the Metering Annexure to Service and Installation Rules July 2018

1.9.25 Network devices

Apparatus or equipment that:

a) enables a local network service provider to monitor, operate or control the network for the purposes of providing network services, which may include switching devices, measurement equipment and control equipment.
b) does not have the capability to generate electricity.
c) is owned and maintained by the distributor.

1.9.26 Non-urban classification

Areas classified as not urban.

1.9.27 NOSW

Notification of service work. Refer to clause 1.15.

1.9.28 Department of Climate Change, Energy, the Environment and Water (DCCEEW)

The Department of Climate Change, Energy, the Environment and Water, which is responsible for the preparation and publication of these Rules.

1.9.29 Overhead service

Overhead or aerial conductors, operating at LV, between the electricity distribution system and the connection point. Refer to Figure 1-1.

The overhead service comes under the ownership, control and maintenance of the electricity distributor as part of its network. The overhead service includes the strain clamp at the point of attachment but does not include the bracket or other form of anchor at which the overhead service is terminated or the connection device.

1.9.30 Point of attachment (POA)

The point, or points, at which the mechanical loads of overhead conductors of an overhead service or overhead consumer mains are terminated on a customer's building, pole or structure. Refer to Figure 1-1 (a), (b), (c), (e) and Figure 1-2 (c).

The POA forms part of an electrical installation.

1.9.31 Point of common coupling (PCC)

The point on a distribution system at which other customers or installations are, or could be, connected. Refer to Figure 1-1, Figure 1-2, Figure 2-1, Figure 2-2, Figure 2-8, Figure 2-9, and Figure 2-10.

The electrical assets on the installation side of the point of common coupling are dedicated for the use of that electrical installation. (It is possible for the point of common coupling to be within a high-voltage system.)

1.9.32 Relevant land

Land to which the customer concerned or the electrical installation owner has a legal right of access for the purpose of constructing or maintaining the electrical installation.

1.9.33 Repair

Restoration, to an acceptable operating or usable condition, of a broken, damaged or failed device or item of equipment or part thereof e.g. 'like for like' replacement.

1.9.34 Rules

The *Service and Installation Rules of New South Wales* as amended from time to time.

1.9.35 Service equipment

Equipment required by the distributor as set out in the NER and the Electricity Supply Act associated with the supply, control and non-revenue metering of electricity to a customer. It includes associated equipment that may or may not be provided by the distributor to control (e.g. non-revenue meters, current and voltage transformers, communication equipment and wiring), to protect (e.g. service protection fuses) and secure the service and control devices.

1.9.36 Service fuse

Refers to a service protection device. (This definition is obsolete but is retained to allow references from external documents to exist without ambiguity.)

1.9.37 Service main

Except on relevant land, means the electricity powerlines that are used to connect the electrical installation to the distribution mains between the connection point and the PCC.

1.9.38 Service protection device (SPD)

The first protection device which complies with clause 4.7, located on the installation side, or forming part of, the connection point.

1.9.39 Special Small services

Supplies located in public places, unmetered and of low-voltage (LV) single phase up to 10 amps (A) rating where an accurate assessment of energy usage can be made.

1.9.40 Sydney Trains (ST)

Sydney Trains is the electricity distributor for electrical installations on railway land within the railway 1500V DC electrified track area. It is also used to describe any other rail network that exists and is not specifically defined in these Rules.

1.9.41 Transmission system

Any electricity powerlines and associated equipment and electricity structures that are a transmission system operating at 220 kilovolts (kV) and above, plus parts of networks operating between 66kV and 220kV paralleling and supporting the transmission network (where deemed by the Australian Energy Regulator) to be a transmission network.

1.9.42 Type 5 and 6 meters

Metering equipment historically provided and installed by electricity distributors and/or electricity networks for small customers. These meters are characterised as interval (Type 5) or accumulation (Type 6) meters that are manually read.

1.9.43 Underground service

Underground cables, operating at LV, between the electricity distribution system and the connection point. Refer to Figure 1-2 .

The underground service comes under the ownership, control and maintenance of the electricity distributor as part of its network. The underground service does not include the conduit, structure or enclosure protecting or enclosing the cable that is situated on relevant land.

1.9.44 Underground supply from an overhead system (UGOH)

Underground supply from an overhead distribution system (UGOH) is a term used where a customer is supplied by an underground service from an overhead distribution system.

1.9.45 Urban classification

Areas where most of the land is zoned for residential and/or commercial and/or industrial use within a town or city type of area which is contiguous with other similar town or city areas with an aggregated population of at least 5,000 people.

Figure 1-1 Supply from overhead distribution mains

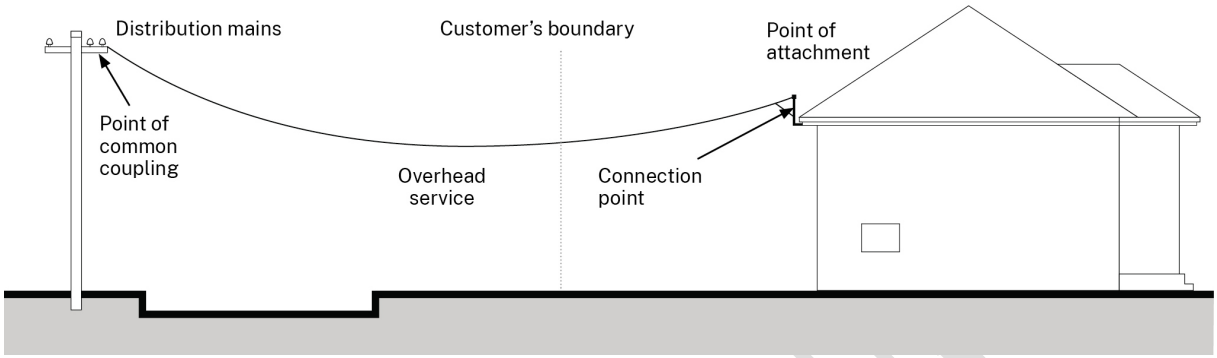


Figure 1-1(a) Overhead service

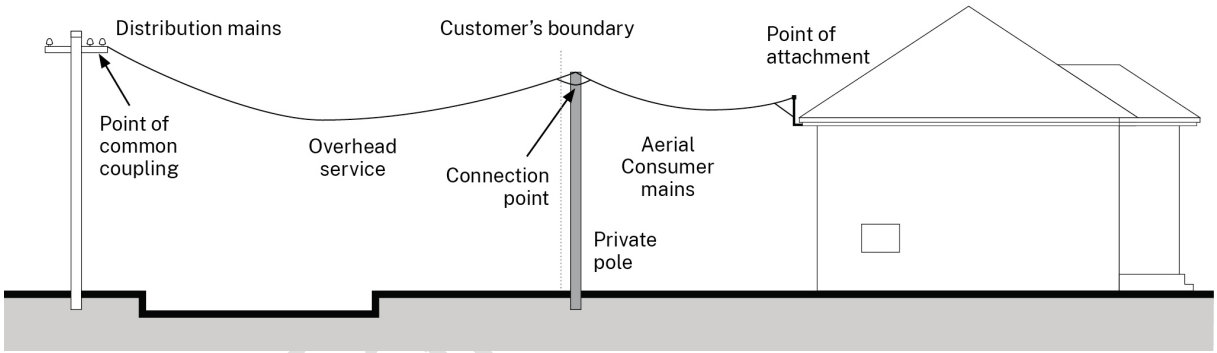


Figure 1-1(b) Overhead service and aerial consumers mains

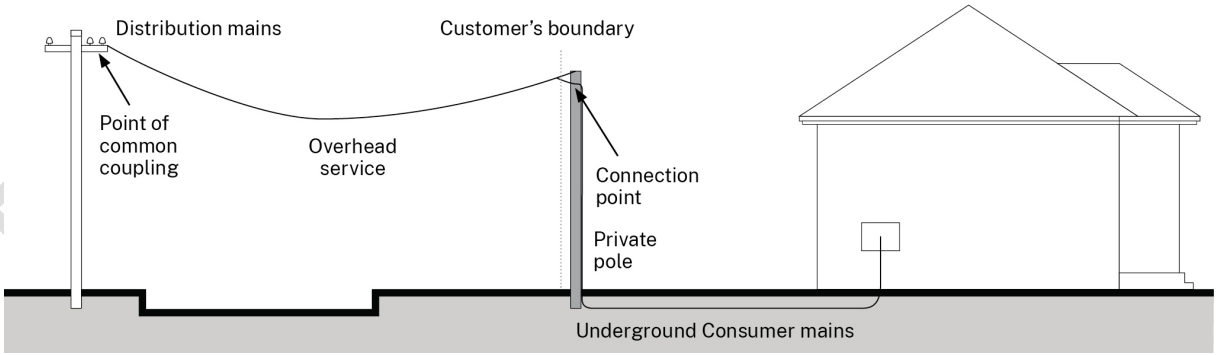


Figure 1-1(c) Overhead service and underground consumers mains

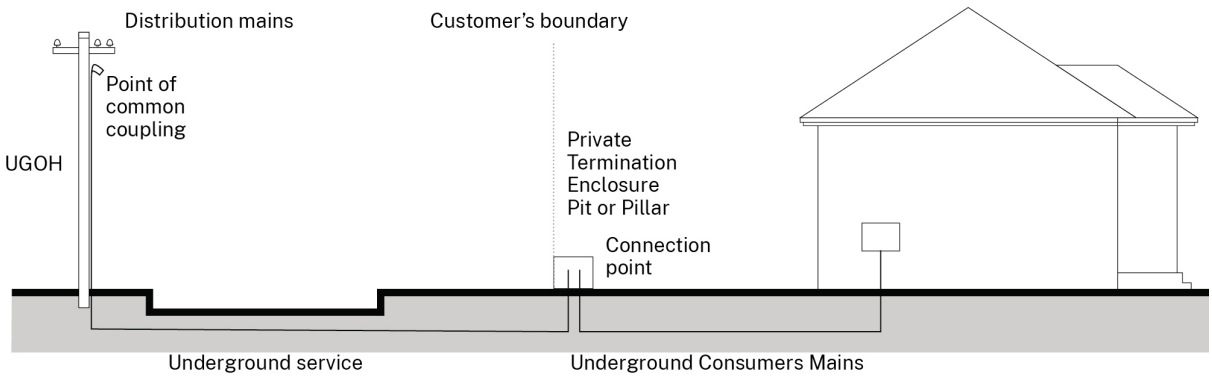


Figure 1-1(d) Underground service and consumers mains from overhead mains on electricity distributor's pole

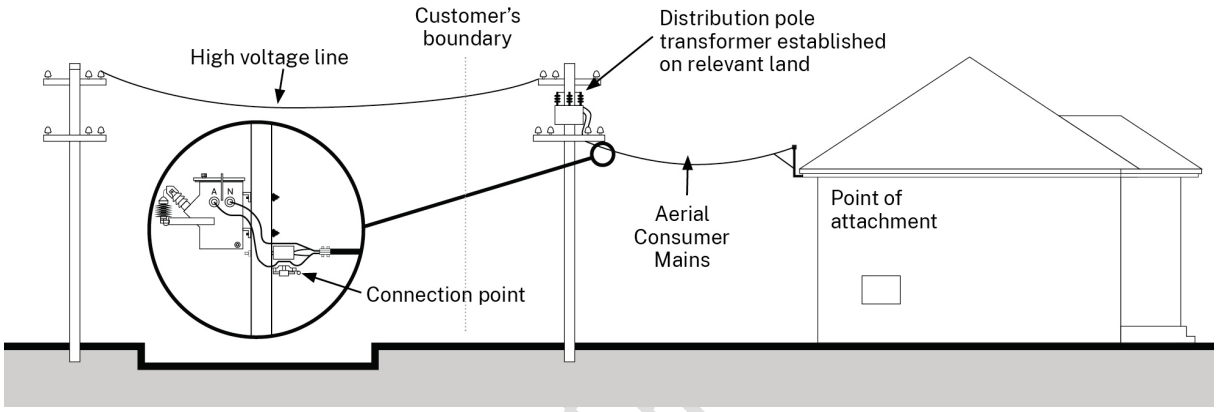


Figure 1-1(e) Overhead supply from substation on relevant land

Note that in this case, the connection point could be the:

- the point of common coupling – if other future LV customer connections are likely, or
- the high-voltage connections for the high-voltage tee line if assets are totally dedicated to the one installation, or
- any other point between the 2 options above depending on possible additional installation arrangements.

Figure 1-2 Supply from underground distribution mains

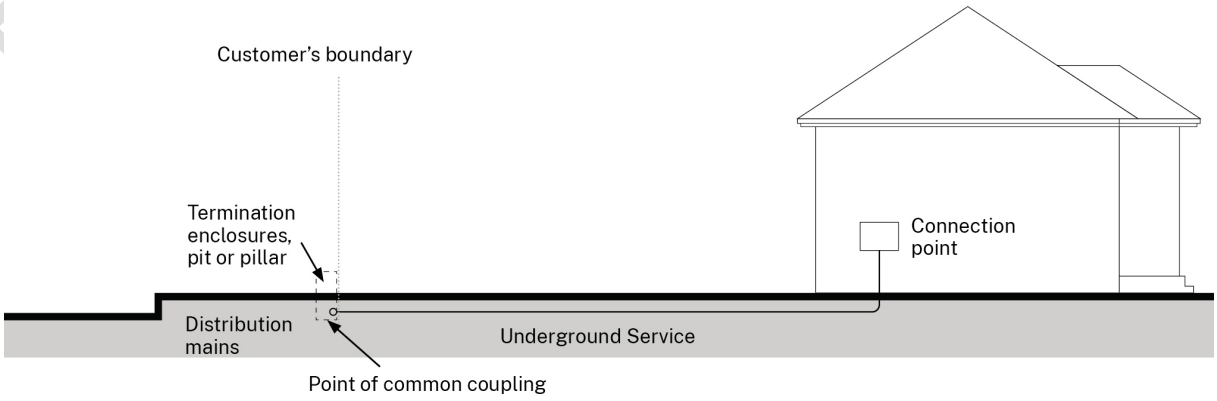


Figure 1-2(a) Underground service

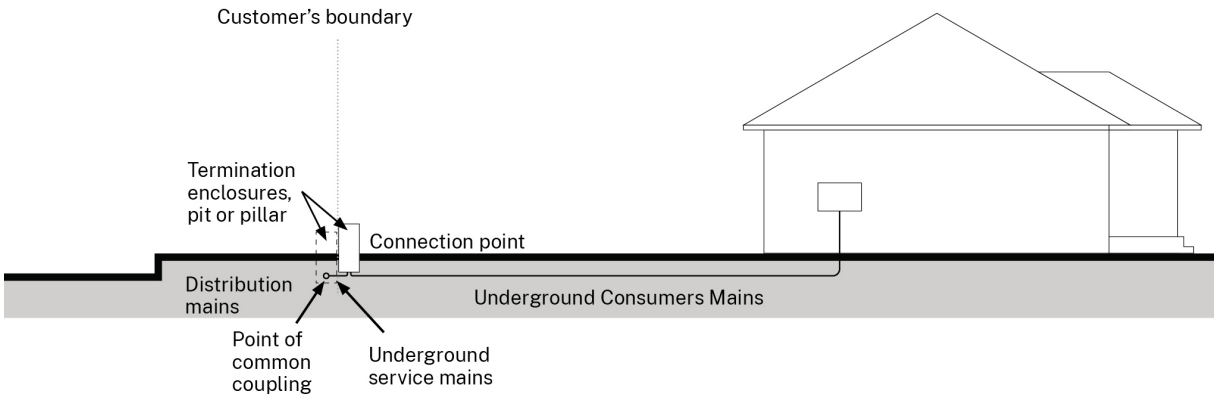


Figure 1-2(b) Underground service and underground consumers mains

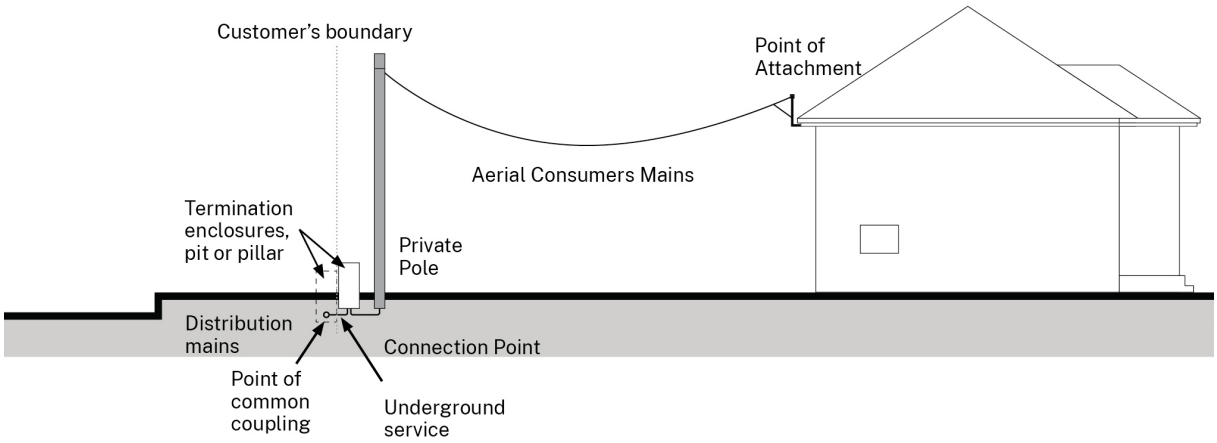


Figure 1-2(c) Underground service and consumers mains

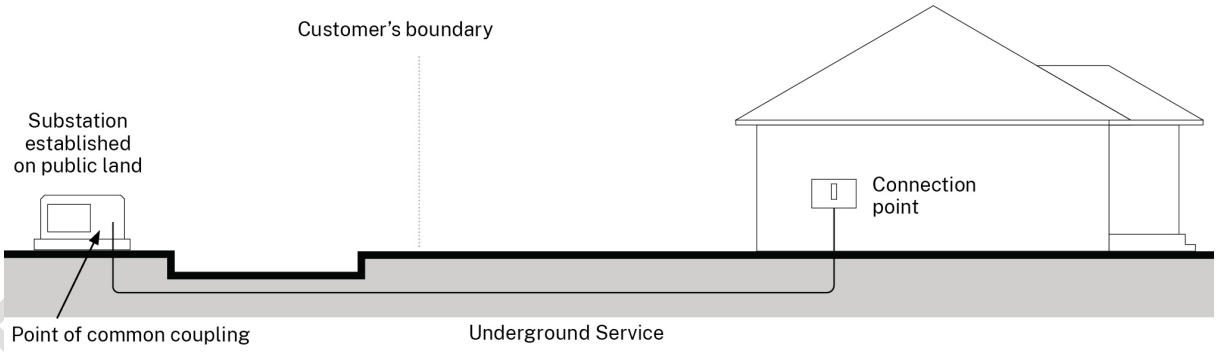


Figure 1-2(d) Underground services from substation on public land

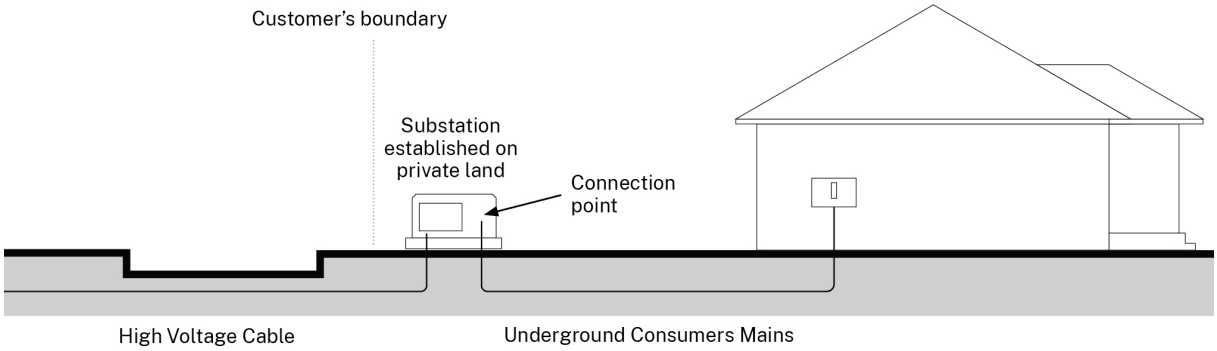


Figure 1-2(e) Underground supply from substation on relevant land

Note that in this case, the connection point could be the:

- the point of common coupling – if other future LV customer connections are likely, or
- the high-voltage connections for the high-voltage tee line if assets are totally dedicated to the one installation, or
- any other point between the 2 options above depending on possible additional installation arrangements.

Notes to Figure 1-1 and Figure 1-2:

A connection shall be able to be made at the connection point.

Access to substations for connection must be arranged with the distributor.

For Figure 1-1, a private pole is required if the service exceeds 50m if ≤100A or 30m if >100A. Refer to clause 3.5.1

For Figure 1-2, a terminal enclosure, pit or pillar is required if the service exceeds 50m. Refer to clause 2.6.2.

Additional drawings may be added in later editions of the Rules.

1.10 General

1.10.1 Introduction

1.10.1.1 These Rules

The objective of these Rules is to achieve the minimum standards for providing safe, reliable and efficient connection services to customers.

The Rules:

a) define the connection point as required by the *Electricity Supply Act 1995*
b) give guidance and minimum requirements for the provision of customer connection services
c) should be followed unless there is an agreed alternative course of action, which achieves the same or better result
d) can be used in support of enforcement provisions of the *Electricity Supply Act 1995*
e) can be used to support prosecution for failing to comply with or contravening provisions of the *Electricity Supply Act 1995* or associated regulations

f) are consistent with the NSW electricity distribution industry's requirements for preserving market integrity, security, reliability and safety of the system while minimising interference between and to its customers.

1.10.1.2 Complementary governance documents

The Rules establish conditions for connection of electrical installations to the electricity distribution system and are complementary to:

a) Gas and Electricity (Consumer Safety) Act 2017 covering:
   i) electrical installations (including meters)
   ii) electrical articles
   iii) electrical apparatus and appliances
   iv) accident reporting and investigation
b) *Electricity Supply Act 1995* which requires the electricity distributor to:
   i) connect customers under the provisions of a customer connection contract
   ii) develop and implement a plan setting out policies, practices and procedures with respect to the conduct of affairs
c) Gas and Electricity (Consumer Safety) Regulation 2018 covering among other things:
   i) safety of electrical installations
   ii) notification of installation work
   iii) testing of installation work
   iv) maintenance of existing electrical installations
d) National Energy Retail Law (NSW) 2012 covering:
   i) customer rights
   ii) standard form customer contracts
   iii) appeals
   iv) customer protection
e) Electricity Supply (Safety and Network Management) Regulation 2014 which requires electricity distributors to develop and implement safety management systems covering electrical installation of customers for the purposes of managing bushfire risk associated with aerial lines and equipment
f) AS/NZS 3000:2018 Electrical installations ('Wiring Rules')
g) Metering and Installation Requirements.

The electricity distributors recognise these Rules as the industry standard.

The customer connection contract specifies these Rules, which describe the electricity distributor's requirements for connecting electricity supply.

These Rules shall be read together with the terms and conditions of the electricity distributor's customer connection and customer supply contract.

1.10.2 Regulatory provisions

The Electricity Supply (Safety and Network Management) Regulation 2014 requires each distributor to prepare and implement a safety management system covering:

a) network safety and reliability

b) public electrical safety awareness

c) bushfire risk management (including for electrical installations of customers under certain circumstances).

The Regulation also provides that, in determining the content of its safety management system, a distributor shall consider codes, standards and guidelines specified by the Minister by notice in writing to the distributor. The safety management system shall specify where it departs from the requirements of any such code, standard or guideline and what arrangements are in place to ensure an equal or better outcome.

1.10.3 Working live information for electrical workers

The *Work Health and Safety Act 2011* and the Work Health and Safety Regulation 2017 Part 4.7, Division 4 stipulate strict restrictions on live electrical work.

Safe Work Australia has produced *Code of Practice: Managing Electrical Risks in the Workplace*. The code provides practical guidance for conducting a business or undertaking or managing electrical risks in the workplace. It applies to all workplaces where a person:

- has management or control of electrical equipment, including electrical installations, or
- carries out electrical work on or near energised electrical equipment, including electrical installations.

This code also applies to construction and demolition sites, except when a requirement of the code is dealt with in *AS/NZS 3012:2019 Amd1:2020 Electrical Installations – Construction and demolition sites*, in which case *AS/NZS 3012:2019 Amd1:2020* applies.

For further information contact a local SafeWork NSW office or call the SafeWork Assistance Service on 13 10 50 or visit the SafeWork NSW website.

1.10.4 Obligatory requirements

Legislation permits the electricity distributor to state its requirements in relation to a customer's electrical installation.

The electricity distributor may:

a) impose conditions on the installation and use of electrical appliances and equipment to prevent or minimise adverse effects on the supply to other customers

b) impose conditions on the loading, and the balancing of the load, over the phases of the customer's supply

c) require a minimum rupture rating or minimum breaking capacity of the customer's service protection device/s

d) require the customer to install relays, current transformers and other protection equipment having characteristics to suit the electricity distributor's protection system

e) require the customer to provide free of cost, for use of the electricity distributor, suitable accommodation for transformers, switchgear and other equipment.

The electricity distributor may also:

(f) make additional requirements where allowed by AS/NZS 3000.

(g) make interpretation of AS/NZS 3000

1.10.5 Damage

A customer may be held liable for the total cost of any damage caused by the customer to the electricity distributor's equipment.

1.10.6 Damage to other utilities

ASPs are liable for the total cost of any damage caused to other utilities during service work. They shall notify the relevant utility and the customer and arrange for the repair of damage caused.

1.10.7 Clearance to other utilities

The specified clearance should be maintained between the installed overhead/underground service and services of other utilities.

1.10.7.1 Navigable waterways and electricity assets

Under the NSW *Ports and Maritime Administration Act 1995*, obstructions and encroachments shall not be constructed in, on or over a navigable waterway without prior approval from Transport for NSW (TfNSW) and shall not constitute an obstruction to navigation. This applies to overhead (i.e. aerial), underground or submarine wiring systems including services, consumers mains, submains or final subcircuits.

It is the customer's responsibility to establish whether the waterway is navigable and to obtain all necessary approvals from TfNSW.

While formal advice should be sought from TfNSW, requirements are likely to include that design, construction, operation and maintenance complies with *AS 6947:2009 Crossing of Waterways by Electricity Infrastructure*.

1.11 Electricity supply

The supply of electricity to a customer's premises is subject to interruptions and fluctuations and other disturbances that affect supply quality.

Customers should consider the need for equipment to have sufficient protection to extreme voltage fluctuations to protect against:

a) storms and lightning

b) partial loss of supply, i.e. loss of 1 or 2 phases of a 3-phase supply.

1.11.1 Supply at 230/400V (low voltage)

Supply is an approximately sinusoidal AC wave form with a frequency of 50 hertz (Hz) and nominal voltage of 230/400V from a 3-phase 4-wire distribution system. In outlying areas, the supply may be from a 230/460V 2-phase 3-wire distribution system.

The normal 50Hz sinusoidal wave form may be modulated by signal frequencies for electricity distribution control and communication.

For details see *AS IEC 60038:2022 Standard voltages* and *AS 61000.3.100-2011 Amd 1:2016 Electromagnetic compatibility (EMC) limits – steady state voltage limits in public electricity systems*. If the 10-minute average voltage at the main switchboard (measured with reference to AS 61000.3.100-2011 *Amd 1:2016*) exceeds 253V with no load or generation connected, the electricity distributor should be contacted.

1.11.2 Supply at 230/460V (low voltage)

In areas limited to 230/460V supply, contact the electricity distributor for advice on special supply arrangements. These systems are 2 or 3-wire distribution systems with 180-degree phase displacement.

1.11.3 Supply at high voltage

Electricity supply may be provided at higher voltages if required. Contact the electricity distributor for advice on high-voltage supply arrangements. Refer also to section 7.

1.11.4 Supply from the railway distribution system

For electrical installations on railway land or supplied from the railway HV distribution system contact ST.

1.12 Provision for services and service equipment

1.12.1 Service specification

Access to the service and termination points shall be readily available.

The electricity distributor may determine the:

a) type, location and installation of service equipment, including network control devices
b) type and rating of service protection device
c) type, size and minimum rating of service conductors
d) construction and route of services
e) accommodation of any transformers, switchgear and other electricity distributor equipment on the customer's premises
f) point of common coupling
g) location of the connection point
h) position of the POA of an overhead service to any building, pole or structure (customers may negotiate the position with the electricity distributor if feasible)
i) property boundary entry of an underground service and the enclosure of the service cables.

Where alterations or additions are being carried out on an electrical installation, existing services, consumers mains and service equipment shall be replaced (by the customer) to comply with these Rules, where their current carrying capacity is exceeded by the maximum demand determined in accordance with AS/NZS 3000.

Information is provided on the electricity distributor requirements in the relevant sections of these Rules.

Non-distributor poles such as communications poles should not be used without prior consultation with and approval of both the pole owner and electricity distributor. See clause 2.10.5.

1.12.2 Advice to electrical contractors

The customer/electrical contractor is required to initiate and arrange for:

a) service equipment

b) point of common coupling

c) connection point

For electrical installations on railway land contact ST.

A service connected by an ASP shall not be connected until all payments from the connecting customer of any reimbursements due under any pioneer scheme arrangements have been made (refer to the *National Electricity Rules* and distributor customer connection contracts for details of the pioneer scheme).

A service may be disconnected by a distributor at its discretion where an unpaid pioneer scheme contribution exists.

Any disconnection and or reconnection costs incurred by a distributor resulting from a breach of this paragraph will be passed on to the customer in addition to unpaid pioneer scheme contributions. Further, any person who connects a service before ensuring pioneer payments have been completed may become liable in any legal proceedings, including recovery of unpaid pioneer scheme contributions, subsequent to their actions where a breach of this paragraph occurs.

1.12.3 Services

The electricity distributor may require the customer to do any of the following:

a) supply and install an overhead or underground service

b) provide for attachment of an overhead or installation of an underground service

c) provide for more than one connection point if the electricity distributor considers it necessary (e.g. to avoid interference with supply to any other customer).

The electricity distributor may, upon a customer's formal application, provide a service to an electrical installation.

The terms and conditions of the service arrangements may include the need and cost, if any, to extend or reinforce the existing distribution system and the coordination of these activities.

Customers are required to give adequate notice of electricity supply requirements so the electricity distributor can meet the customer's schedule.

1.12.3.1 Minimum insulation resistance

The insulation resistance between conductors and between conductors and earth of new services shall not be less than 50 megohms when tested using a 500V DC insulation resistance tester.

1.12.3.2 Number of services

Only one point of common coupling will normally be provided to each legal land parcel. A strata title development will normally be considered as one legal land parcel. The electricity distributor may vary these arrangements.

An electricity distributor may allow more than one electricity network connection per legal land parcel if the distributor considers that to do so would be sound engineering practice after considering any or all of the following:

a) the magnitude of the customer's load
b) the distance between 'sub installations' within a legal land parcel
c) the nature of the customer's activities
d) the site conditions
e) the ongoing segregation of the separate parts of the installation.

The customer may be required to pay the cost involved in providing an additional supply. Before starting work, the electricity distributor shall be consulted.

1.12.3.3 Number of phases

The number of phases required to supply an installation shall be determined by:

a) the maximum load permitted by the electricity distributor in accordance with Table 1-1
b) the load characteristics of customer's equipment, e.g. 3-phase motors, instantaneous water heaters, 400V welders, large heat / air conditioning loads.

Table 1-1 Allowable number of phases

Maximum demand	Number of phases
Not exceeding 100A per phase	1, 2 or 3 phase and neutral
Exceeding 100A per phase	3 phases and neutral
A motor exceeding 2 kilowatts (kW)	3 phases and neutral

Note: Determine the maximum demand in accordance with AS/NZS 3000 for consumers mains and submains.

1.12.3.4 Voltage drop/rise

The voltage drop in the overhead or underground service shall not exceed 3% of the nominal voltage at the PCC, unless approved by the electricity distributor. The voltage drop shall be calculated using the maximum demand of the consumers mains. Determine the maximum demand in accordance with AS/NZS 3000 for consumers mains and submains.

Where embedded generation is connected, the maximum permissible voltage rise on the underground or overhead service should not exceed 1% of the nominal voltage at the PCC, unless approved by the electricity distributor. The maximum permissible voltage rise for an installation shall not exceed 3%. See Figure 8-3, Table 8-2 and Table 8-3 for examples of voltage rise calculations.

1.12.4 Overhead service

The overhead service terminates at the connection point. However, the electricity distributor may nominate an alternative point on the customer's premises, e.g. if a service does not originate on a public road or future undergrounding of the street mains is planned.

Section 3 provides details of requirements for overhead services including:

a) determination of the route of the overhead service

b) means of support required to satisfy cable sag, tension and clearance requirements

c) termination and connection of the service to the electrical installation.

To ensure bushfire risk management is addressed, ASPs and electrical contractors shall obtain electricity distributor requirements before installing overhead services in rural areas.

The electricity distributor ensures maintenance of the overhead service, including service supports, is carried out on the customer's premises. The customer will be responsible for:

i) installation and maintenance of any support to the electricity distributor's requirements for the overhead service that is on the customer's premises

ii) the customer shall arrange with the electricity distributor or an authorised ASP for the maintenance of a private pole on the customer's premises that has a physical connection to the distribution system.

iii) installation and maintenance of any aerial consumer mains that are connected to the overhead service

iv) maintenance of required clearances between the overhead service and trees, vegetation on customer's premises (except in certain circumstances)

v) maintenance of required clearance between the overhead service and any building, structure or ground on the customer's premises

vi) installation and maintenance of the electrical installation which originates at and includes the connection point.

1.12.5 Underground service

The underground service terminates at the connection point. This is a termination pillar or facility, or the main switchboard located on the customer's premises. Refer to Figure 1-2.

Section 2 provides details of requirements for underground services including:

a) underground installation requirements

b) termination and connection of the service to the electrical installation.

The electricity distributor shall ensure maintenance of the underground service is carried out.

The customer is responsible for the installation and maintenance to the electricity distributor's requirements, of any conduit or structure and equipment which is required to be located on their premises for the installation and connection of an underground service.

In addition, the customer shall provide and maintain satisfactory access to the conduit or structure to avoid any unnecessary delay and inconvenience should work have to be carried out on the underground service.

The costs of excavation or reinstatement of finished surfaces (driveways, paths, etc) or demolition and reconstruction of civil works on the customer's premises to enable the electricity distributor to gain access to the underground service to affect any future repairs shall be borne by the customer.

1.12.6 Underground service connection to an overhead distribution system (UGOH)

1.12.6.1 Provision for future underground distribution system

In existing overhead distribution areas, the electricity distributor may require the provision of transition arrangements to provide for future undergrounding of street mains and services. In such cases, the arrangement will be deemed to be a combined overhead and underground service. Refer to Figure 1-1(c).

1.12.6.2 Underground supply from overhead distribution system (UGOH)

A customer-requested underground service may be provided from the overhead distribution system by an underground-to-overhead connection at a suitable existing electricity distributor pole. Refer to Figure 1-1 (d) and section 2 for further information.

1.12.7 Special situations

The following situations require special consideration. The electricity distributor should be consulted for advice.

Historic significance – Consult the owner or the gazetted authority if a building or an environment feature has, or appears to have, historic significance. Do this before carrying out any work.

Isolated or non-urban areas – Special conditions may apply to the provision of supply to these areas.

Old city districts – Alternative methods of supply may need to be considered for old buildings.

1.12.8 Installations on railway land

Special conditions apply to services, service and metering equipment (and electrical installations) on railway land due to:

a) ownership of the land by the railways

b) special railway operational requirements due to running trains

c) the overhead 1500V DC electrified track area (refer to clause 1.11.4).

ST is the contact point for all electrical installations on railway land in the railway 1500V DC electrified track area, due to special earthing, bonding and isolation requirements.

It is also the distributor for customers in other areas who are supplied from its high-voltage distribution system (refer to clause 1.11.4).

In the NSW railway 1500V DC electrified track area, electricity supply to the rail network is either from the rail high-voltage distribution system, or from the local electricity distributor where there is a requirement to establish a small low-voltage distribution system which includes a special isolation transformer to isolate the local electricity distributor's multiple earthed neutral (MEN) earthing system from the rail earthing system.

In certain cases, a changeover contactor is provided with the normal supply being provided from the rail HV distribution system and the back-up supply originating from the local electricity distributor but conveyed on railway land via the small LV distribution system as detailed above.

Due to the 1500V DC overhead wiring traction system, installations on railway land do not use the MEN earthing system. Instead, they use a modified direct earthing system, which incorporates a reticulated insulated earthing conductor.

All applications for electricity supply in the railway 1500V DC electrified track area are to be made in writing as detailed in ST publications.

In the non-electrified track area, while electricity supply will normally be from the local electricity distributor (and a special isolating transformer is not required), applications shall be made in writing, as detailed in ST publications, to obtain approval for the proposed route along with details of any special conditions that will apply for the service where it is on railway land.

Refer to clause 1.17.7 for special earthing requirements for electrical installations.

Refer to section 2 of these Rules regarding special requirements for underground services, and section 3 regarding special requirements for overhead services.

1.12.9 Alterations, additions and upgrades

These Rules, in their entirety provide the guidelines for all new service installations.

However, alterations, additions or upgrading of existing:

a) overhead service / underground service / consumer mains

b) service equipment

required by or for the customer shall comply with these Rules.

All alterations, additions and upgrades shall:

c) ensure the MEN connection is at the customer's main neutral link and not at the service neutral link

d) ensure the SPD meets with the requirements of clause 4.7

e) ensure, where a combined SPD/MPD is used, it meets with the requirements of clause 4.7

For the purposes of subclause (a), an electricity distributor may maintain, renew, upgrade or alter an existing service line without reference to the Rules where that service forms part of the distribution network.

For clarity, Type 5 or 6 metering equipment that is temporarily removed may, at the discretion of the electricity distributor, be re-fixed in the same or a very similar location provided the metering equipment:

i) is not faulty or physically impaired, and

ii) is not being relocated to a different connection point, and/or

iii) the physical location and nature of the connection does not change, and

iv) complies with the distributor's requirements (e.g. size, location) and is not classified as a new or replacement metering installation under Chapter 7 of the *National Electricity Rules*.

1.12.10 Accommodation of electricity distributor's substation equipment

The distributor may decide the supply of electricity required by a customer is too large to be provided by a service from its low-voltage street distribution mains. The electricity distributor may require transformers, switchgear and other distribution equipment to be installed on the customer's premises. This may also arise when the customer takes supply at high voltage.

The electricity distributor will, in such circumstances, require the customer to provide a place within the premises to accommodate the transformers, switchgear and other equipment free of cost.

The place provided shall be:

a) considered suitable by the electricity distributor

b) enclosed in a manner approved by and at no cost to the electricity distributor

c) provided with satisfactory arrangements for access and tenure.

The electricity distributor may want to use the equipment to supply other premises. It may install additional equipment within the enclosed place to supply other premises.

1.13 Payments for equipment and services

In accordance with the *Electricity Supply Act 1995* and customer connection contract, the electricity distributor may require a customer to pay:

a) for the supply, installation, connection and maintenance of overhead or underground services, and service equipment

b) for the alteration of supply arrangements due to a customer request or to rectify a contravention of the electricity distributor's requirements

c) a contribution towards the extension or alteration of the distribution system to accommodate the customer

d) a contribution for any reimbursement under applicable pioneer schemes.

Electricity distributors shall also comply with Australian Energy Regulator (AER) determinations on capital contributions (including associated miscellaneous charges) and recoverable works. Refer to the AER website for capital contribution determination. Subject to the requirements of the AER determinations, electricity distributors may establish and publish prices, terms and conditions, if any, for the above work.

1.13.1 Extension or alteration of distribution system

The distribution system at the intended PCC may not be capable of supplying the customer. Alterations may be necessary where the customer intends to install an electrical load that, because of its size or characteristics, may affect the quality of supply to other customers. Extensions generally apply where the electrical installation is a considerable distance from the existing distribution system.

Where the existing distribution systems are single phase, 3-phase loads would require an extension (and possible augmentation) of the distribution system and an upgrading of a transformer.

These conditions may necessitate work to alter, extend or upgrade the distribution system.

Customers therefore need to apply to electricity distributors so that arrangements can be determined.

1.13.2 Contestable work

Details of the competitive process are given in the *NSW Accredited Service Provider (ASP) Scheme Rules*. Clause 1.14 provides further information on the accreditation and authorisation for Level 2 ASPs.

1.13.3 Avoid premature expenditure

A person who wishes to connect an installation to the electricity distributor's distribution system or increase the capacity of an existing connection shall complete an application for connection (AFC).

Customers are advised not to make commitments or payments (e.g. contractual arrangements), for designs, materials or works until they receive written approval from the electricity distributor.

The customer should consider the possibility of the load exceeding the proposed arrangements and make allowances to avoid future upgrading costs.

1.13.4 Demand management

Charges may be minimised or avoided by carrying out an appropriate demand management review of the size and type of loads proposed to be connected.

1.14 Accreditation and authorisation for Level 2 ASPs

The *Electricity Supply Act 1995* specifies requirements relating to the provision of customer connection services and allows customers to choose the supplier of those services which the customer funds. These are contestable works. (Refer to the *NSW Accredited Service Provider (ASP) Scheme Rules*).

The work is subject to the electricity distributor's design, construction and installation standards and can be performed only by an ASP chosen by the customer.

1.14.1 Accreditation

Accreditation is intended to facilitate the outcomes outlined in the *NSW* Accredited Service Provider *(ASP) Scheme Rules* as follows:

a) The works comply with the electricity distributor's requirements.

b) Individuals undertaking the work are suitably trained and qualified.

c) Connections to the distribution system are performed only by individuals that are authorised by the electricity distributor.

d) The works comply with the electricity distributor's safety management system.

e) The safety, reliability and efficiency of customer connection services is ensured.

There are 3 levels of accreditation:

Level 1: permits work on the electricity distributor's distribution network that is contestable work associated with the connection of a customer's development.

Level 2: permits the installation and connection of contestable customer connection work between the PCC and the connection points and at the main switchboard. These Rules apply principally to Level 2 ASPs.

Level 3: related to associated design work.

Accreditation is granted by the Department of Climate Change, Energy, the Environment and Water in accordance with its accreditation scheme.

1.14.2 Authorised person

Individuals working for ASPs or subcontractors of ASPs shall be appropriately authorised in writing by the electricity distributor to undertake works on or near the electricity distributor's distribution system.

Authorisation is required for individuals performing the following work:

a) connecting an electrical installation to the electricity distributor's distribution system or service at the PCC or at the connection point

b) disconnecting or reconnecting an electrical installation at the PCC, connection point, service protection device, electricity-distributor-owned Type 5 or 6 meter, link or other equipment

c) installing, connecting, disconnecting or adjusting equipment which has been sealed by the electricity distributor or is required to be sealed

d) working on or near equipment such as: service and Type 5 and 6 metering equipment, service pillars, posts or structures, or lamp fittings that are the electricity distributor's property.

At the completion of the work performed, all tests, according to the electricity distributor requirements, shall have been performed to ensure safe connection to the network. These tests shall include polarity, phase rotation (before and after and where applicable), insulation resistance and earthing integrity. The tests will include both visual and instrument checks.

The main switch/es shall be sealed in the OFF position with suitable tags which only the customer's electrical contractor (who may also be the ASP) who tested the electrical installation may remove.

The ASP or meter provider shall not energise the installation past the main switch unless they are in possession of a copy of the relevant certificate of compliance of electrical work (CCEW) being carried out in accordance with requirements of the Gas and Electricity (Consumer Safety) Regulation 2018 or have completed such a document indicating all tests required have been performed.

Energising of the electrical installation past the main switch/es is the responsibility of the customer's electrical contractor.

1.15 Notification of service work (NOSW)

The ASP shall complete a NOSW notification, in the format required, that contestable service work has been carried out.

Contestable service works include but are not limited to:

a) install and connect new overhead or underground services

b) disconnect/reconnect overhead or underground services at the PCC

c) disconnect/reconnect an overhead service at the connection point

d) install, relocate or replace service equipment

e) relocate electricity-distributor-owned Type 5 or 6 meter installations

f) energising new installations.

The notice is to be forwarded so it will be received by the distributor within 2 working days of completion of the work.

The notice may include:

i) the customer details
ii) the scope of the work performed
iii) the test results
iv) the ASPs details
v) the installing and testing authorised person's details
vi) the service equipment information
vii) an accurate plan showing the details of the service route
viii) relocation of Type 5 or 6 meters
ix) the national metering identifier (NMI), where provided by the customer
x) the connection offer or job number
xi) a CCEW or reference number accompanying a NOSW where electrical installation work has occurred, in line with distributor's requirements and procedures.

1.16 Connection and disconnection of electrical installations

Legislation requires that electrical installations shall comply with relevant safety standards at the time of connection and remain safe while connected to supply.

Disconnection by the distributor is possible if the contract conditions are not satisfied, but only after reasonable notice is given under customer connection / supply contracts.

The distributor's electrical installation safety plan should be referred to for ensuring the provision of safe electrical installations.

1.16.1 Availability of supply capacity

Customers shall give notice as specified by the distributor of their supply requirements so appropriate arrangements can be made. This applies particularly where a customer intends to install items of equipment which:

a) place significant electrical loads on the electricity distribution system
b) may affect the quality of electricity supply to other customers
c) export to the network and may have adverse effects on the network or the customer's installation.

Failure to apply in writing to the electricity distributor may result in delays for connection.

It may be necessary to reinforce the electricity distribution system or impose special conditions or restrictions on the operation and use of the equipment before any upgrading work that may be necessary to ensure satisfactory operation of the equipment.

Application shall be made in writing to the electricity distributor by way of an application for connection form for the provision of customer connection services and supply of electricity to:

i) all new installations
ii) Where an alteration would increase the maximum demand above the existing connection agreement
iii) for all non-urban installations (refer to clause 2.6.3)

iv) where the premises are in isolated or undeveloped areas

v) for new or redeveloped multi-residential installations

vi) for special small services

vii) where alternate supplies and/or batteries are proposed; see section 8

viii) for installations containing air conditioning without assisted start

ix) on railway land in the railway 1500V DC track area; the application process is detailed in ST publications

x) or as directed by the electricity distributor.

A maximum demand determination in accordance with AS/NZS 3000 shall be provided as part of the application process. Once approved by the electricity distributor, the maximum demand shown on the application form defaults to the approved 'supply capacity' for the installation.

The approved 'supply capacity' is not related to:

(1) the service fuse or circuit breaker rating used to protect the installation

(2) any export capacity for the premises that may be approved by the electricity distributor or is being proposed by the customer.

Where the electricity distributor has no discoverable record of an approved 'supply capacity' for an installation, the supply capacity is deemed to be the 30-minute maximum phase demand recorded for a period equal or exceeding the previous 2 years determined from historical metering data or as otherwise determined by the electricity distributor.

To maintain acceptable distribution network operation, the electricity distributor may require special conditions, equipment, restrictions or agreements before granting approval for supply.

1.16.2 Connection to supply

Under the *Electricity Supply Act 1995* a person who owns or occupies premises shall apply to the electricity distributor to obtain approval for the provision of customer connection services to those premises. Refer to clause 1.13. Such services shall be provided under a relevant customer connection contract.

Connection services to customers' premises may only be provided by ASPs and their individual employees, as authorised by the electricity distributor.

1.16.3 Permanent disconnection and removal of supply

Only suitably accredited and authorised service providers are permitted to carry out the permanent disconnection and removal of overhead and underground services, electricity-distributor-owned meters and load control equipment from customers' premises.

The ASP shall consult with the electricity distributor for each proposed job for its procedural requirements and formal permission to proceed.

The ASP will need to forward to the electricity distributor a written request from the owner and written agreement from the occupier (customer) if not the owner. If the customer is non-franchise, then the written agreement of their retailer shall also be forwarded.

Following disconnection, the ASP shall return to the electricity distributor:

a) recovered overhead service / underground service unless other arrangements are made with the electricity distributor

b) recovered type 5 and 6 metering equipment, load control or network device belonging to the electricity distributor

c) a completed NOSW form.

The removal of metering equipment and network devices shall be done in accordance with AEMO's procedures.

1.16.4 Safe installation

The Gas and Electricity (Consumer Safety) Regulation 2018 requires that installation work on an electrical installation shall:

a) comply with AS/NZS 3000, the Wiring Rules

b) not be energised unless the electricity distributor has permitted the connection to its distribution system for:

   i) any new electrical installation that has not previously been energised

   ii) any alteration of, or addition to, an electrical installation that will require a change to the network connection.

c) Be maintained so as to ensure that:

   i) the safe and satisfactory operation of the installation is not impaired by interference or damage,

   ii) the live parts of the installation remain properly insulated, or protected against inadvertent contact with any person,

   iii) the installation is not used in a manner that exceeds the operating limit imposed by the design or installation.

d) After completion and before commissioning, a safety and compliance test on electrical installation work shall be carried out to verify safe operation and compliance with AS/NZS 3000 by a person authorised under the *Home Building Act 1989* to do electrical wiring work without supervision.

e) As soon as is reasonably practicable (but in any event no later than 7 days) after completion of any safety and compliance test on electrical installation work, the results of the test are to be notified by the person who conducted the test, as follows:

   i) to the person for whom the work is carried out for all electrical installation work

   ii) to the electricity distributor and Building Commission NSW if the installation work involves:

      (1) a new electrical installation, or

      (2) any alterations or additions to an existing electrical installation that will require additional work to be done by or on behalf of the electricity distributor in relation to the network connection for the installation, or

      (3) work on a switchboard or associated electrical equipment (other than work to repair or replace equipment that does not alter the electrical loading, method of electrical protection, system of earthing or physical location of the switchboard or equipment being repaired or replaced).

Note: Work on a switchboard or associated electrical equipment includes, for this purpose, the addition of new subcircuits or submains, any work that increases the rating of existing subcircuits or submains, and replacing existing circuit protection with residual current device (RCD) protection.

1.16.5 Bushfire management

The Electricity Supply (Safety and Network Management) Regulation 2014 requires NSW electricity distributors to have a safety management system in place covering the management of bushfire risk relating to electricity lines including electrical installations of customers connected to the network.

Further, in accordance with the *Electricity Supply Act 1995*, in bushfire prone areas, distributors may require customers to rectify defective installations including vegetation management. Where such work is not carried out, distributors may carry out this work at the customers cost or alternately may disconnect an unsafe installation.

1.16.6 Inspection

Where an officer of an electricity distributor performs an inspection, including any tests as part of the inspection, the assessment is limited to what can be observed or checked. This will depend upon the state of completion of the installation and does not guarantee the work complies with standards in every respect.

Note: An appropriately authorised Level 2 ASP shall complete a notification that contestable service work has been carried out as required under clause 1.15 (NOSW).

1.16.7 Disconnection

As a result of its inspection, the electricity distributor or an appropriately authorised Level 2 ASP may disconnect, refuse to connect, or plan to disconnect supply to the installation or parts thereof that contravene AS/NZS 3000 or relevant installation provisions of these Rules.

When this occurs, the electricity distributor, an appropriately authorised Level 2 ASP or a representative of NSW Building Commission will give written notice to the customer and/or the customer's electrical contractor advising of the contravention or defect.

If the defect creates dangerous situations, the electricity distributor or an appropriately authorised Level 2 ASP will take immediate disconnection action.

For defects of a minor nature, the electricity distributor may allow connection subject to rectification being completed within a period stated in the written notice.

The electricity distributor may also disconnect or discontinue supply with reasonable notice to a customer for a breach of these Rules or the customer connection or supply contract.

Note: An appropriately authorised Level 2 ASP should undertake immediate disconnection without prior discussion with the relevant distributor only in circumstances where there is an immediate duty of care consideration in regard to a dangerous situation. Notification to the Distributor is required immediately after disconnection.

1.17 Provision for customers installation

1.17.1 Advice to customers

Customers should obtain advice about the terms and conditions that will apply to the connection and supply of electricity before they incur any expenditure or enter into any contract. Refer to clause 1.12.

1.17.2 Limits on the connection and operation of equipment

1.17.2.1 General

The equipment in an electrical installation shall be arranged and operated so as to minimise or prevent adverse effects on the distribution system and other electrical installations connected to the distribution system.

The effects may be considered under the following categories:

a) **Excessive fluctuations** – equipment which would cause excessive voltage disturbances on the distribution system as a result of large or fluctuating load demands, e.g. arc furnaces, welding machines, X-ray units, frequently started motors including air conditioning equipment; shall comply with AS/NZS 61000.3.3:2012, SA/SNZ TS IEC 61000.3.5:2013 and AS/NZS 61000.3.11

b) **Excessive distortion** – equipment which would cause excessive distortion of the supply wave shape, e.g. rectifiers, frequency converters, electronic load control devices, saturable reactors shall comply with AS/NZS 61000.3.2, AS/NZS 61000.3.4 and AS/NZS 61000.3.12

c) **Interference with frequency load control system** – equipment which would adversely affect the electricity distributor's load control equipment: e.g. shunt capacitors used in power factor correction of fluorescent lighting

d) **Generating systems** which may have adverse effects on the network or the customer's installation.

The customer should take particular care to check that equipment in these categories complies with the limits and conditions imposed by the electricity distributor.

The electricity distributor may refuse to permit the connection of equipment if it considers that the electricity supply to other customers would be adversely affected.

Note: clauses 1.17.2.3 to 1.17.2.5 provide limitations and exceptions that are generally considered acceptable.

1.17.2.2 Corrective action

Where a customer's equipment creates undue interference and adversely affects the supply to other customers, the electricity distributor will require the customer to take corrective action. The customer shall comply with this clause even if the electricity distributor has approved the connection of the apparatus or equipment causing the interference. This may involve the imposition of requirements which are more stringent than the general limitations given under clauses 1.17.2.3 to 1.17.2.5.

In this situation, and others where there may be doubt as to the effects of equipment connected, or intended to be connected, to supply, the customer should seek professional assistance.

1.17.2.3 Limitations – general

The equipment may be restricted by the change in current that occurs when the equipment is switched on and off or between other operational settings. The magnitude and frequency of the current changes are important factors. Table 1-2 provides a guide to limits that may be applied to equipment other than motors, which are covered in clause 1.17.2.4.

Table 1--2 Guide to limits to current changes for equipment other than motors

Equipment voltage (V)	Connection of load	Switching arrangements	No. of supply phases	Limit applying to changes of line current (A)	
				Fluctuating or intermittent (4 or more changes per hour)	Continuous or steady (less than 4 changes per hour)
230	Line to neutral		1	15	25
230	Line to neutral	Phases not switched simultaneously	2 or 3	15	25
230	Line to neutral	Phases switched simultaneously	2 3	25 30	25 50
400	Line to line (no neutral connected)	Phases switched simultaneously	3 2	30 45	50 50

Notes to Table 1--2:

1 Equipment having 'fluctuating or intermittent' line current changes includes welders, heating units controlled by thermostats or energy regulators, and repetitively switched machines e.g. X-ray units.

2 A number of individual appliances which are likely to be controlled by one switching operation e.g. space heating installations, illuminated tennis courts etc shall be regarded as one appliance.

3 Some equipment may be exempted from Table 1--2. See clause 1.17.2.5.

1.17.2.4 Limitations – motors

The starting current of motors, which is significantly higher than running current, can cause a significant fluctuation of the supply voltage. Motor installations with associated starting/control devices shall be designed to ensure the starting current will not cause the reduction in voltage measured at the connection point to exceed 5% for more than 20 milliseconds.

Table 1-3 provides a general guide for different types and uses of motors.

In areas limited to 230/460V supply, contact the electricity distributor for advice on special supply arrangements.

Table 1-3 Limits of motor starting currents

Motor type	Starting current (A)
Single phase, 230V	45
3 phase, 400V domestic	53
3 phase, 400V non-domestic	3.3k + 53
3 phase, 400V lift motor	200
3 phase, 400V fire and smoke control equipment	1.5 (3.3k + 53)

Note: k = the continuous output rating in kW of the largest motor in the installation or group of motors that are started simultaneously.

1.17.2.5 Exemptions and special considerations

The distributor may agree to the connection of equipment which does not meet the general limitations provided in Table 1-2 and Table 1-3.

Equipment that may be exempted or be suitable for special consideration may include:

a) storage and instantaneous water heaters

b) controlled load tariff equipment, where supply is only available during certain off-peak hours

c) appliances incorporating motors which are switched with another load component, provided that:

   i) the total change in line current does not exceed the motor starting current limit of Table 13, and

   ii) the change in line current attributable to switching load other than the motor does not exceed the limit of Table 12

d) motors which are not frequently started and which the distributor has assessed as being able to be connected without creating undue interference.

An installation may be less susceptible to creating adverse effects where it:

a) is connected to a low impedance distribution system as may be found in urban areas, or

b) is in the proximity of, or directly connected to, an appropriate size substation, or

c) incorporates substantial power factor correction facilities.

Customers who consider their equipment and installation to merit special consideration should contact the distributor before implementing any changes.

1.17.3 Balancing of load

The loading of an installation, or a separately metered part of an installation, which is supplied by more than one phase, shall be arranged so the maximum demand in an active service conductor is not more than 25A above the current in any other active service conductor.

The total current in the service neutral conductor of a 3-phase supply shall not exceed the highest simultaneous current in any active conductor, including the effects of harmonic currents.

The electricity distributor may agree to other limits.

1.17.4 Protection from prospective short circuit currents

The electrical installation shall be designed and installed so it will perform satisfactorily under all fault conditions.

In determining the suitability of equipment for use at 230/400V, for services up to 400A and supplied from a distribution system, electrical installations up to and including the main switchboard shall be constructed to the nominal prospective short circuit current as specified below:

a) suburban residential areas: 10kA

b) commercial and industrial areas: 25kA

c) installations on railway land supplied by the rail HV network: 6kA.

For switchboards greater than 400A refer to clause 4.15.2.

In certain circumstances lower or higher values may apply e.g. non-urban areas and direct connection at a substation. In these cases, and in the case of supply at high voltage, the electricity distributor will advise the customer on the appropriate conditions in writing.

1.17.5 Coordination of protection devices

The protection devices forming part of an electrical installation should operate in such a manner that a fault in the installation is unlikely to activate protection devices installed in the distribution system. To achieve this, the electricity distributor will require all protection devices to be coordinated or graded with the service protection device(s).

Refer to section 4, which provides the requirements for low-voltage switchboards rated above 100A.

1.17.6 Sealing / locking

The customer shall provide for the fitting of seals or locks to service equipment or to parts of the electrical installation. The provision shall be approved by the electricity distributor. Seals or locks shall be affixed in circumstances where they are necessary in the opinion of the electricity distributor or required by law. These circumstances may include:

a) preventing obstruction or diversion of the supply of electricity

b) avoiding interference to other customers' supply

c) securing the control of the electricity supply

d) any other purposes relating to the agreement with the customer.

Refer to section 4 for details for sealing and locking methods for service equipment.

1.17.7 Earthing

New electrical installation, and alterations or additions to existing installations, shall be earthed using a multiple earthed neutral (MEN) system complying with the requirements of AS/NZS 3000.

a) The main earthing conductor or a bonding conductor shall not be connected to the service neutral link or bar.

b) The MEN connection shall be made at the first downstream consumer's neutral link. All subsequent customers' neutral links installed at the service position / main switchboard shall originate from the first downstream customer's neutral link (at which the MEN connection is established).

Exceptions may arise in high-resistivity soil, high-voltage installations, high neutral voltage, mining or similar large outdoor installations.

For specialist applications the electricity distributor shall approve proposals for alternative earthing methods.

1.17.7.1 Earthing installations on railway land

Electrical installations on railway land in the railway 1500V DC electrified track area shall be earthed (using a modified direct earthing system) by connection to a nominated terminal and in accordance with special isolation, earthing and bonding requirements, in particular:

a) provision of a service earth link when nominated

b) no earth to neutral connection to be made by the customer

c) no separate electrical installation earth electrode to be installed

d) special minimum size for earthing and bonding conductors

e) mechanical protection requirements.

Details will be provided on application by the party nominated in ST publications.

1.17.8 Main switchboards rated above 100A

Low-voltage customers' main switchboards with ratings of more than 100A per phase shall be constructed to AS/NZS 61439 series (Low-voltage switchgear and control gear assemblies) and subject to additional electricity distributor requirements. The customer shall not proceed with work until they know the:

a) requirements for service equipment

b) distributor's planning requirements.

The electricity distributors have developed *Compliance Statement for Main Switchboards Greater than 100 Amps* for switchboard manufacturers and electrical contractors. This statement is to be completed and signed by the relevant switchboard manufacturer, then submitted with main switchboard plans for all new and altered main switchboards that require the distributor to inspect before energising.

Refer to section 4, which provides additional requirements for low-voltage main switchboards rated above 100A.

1.17.8.1 Control of incoming supply

Facilities complying with the requirements of AS/NZS 3000 shall be provided on the customer's main switchboard to isolate all portions of the electrical installation from all possible sources of supply.

Apply to the electricity distributor for its requirements on the use of bus-couplers where multiple supplies are available.

1.17.8.2 Multiple supplies

Where the distributor agrees to provide an electrical installation with more than one connection point, the customer shall ensure the supplies from each connection point are not paralleled within the installation.

In general, where a single switchboard is supplied from more than one transformer, and the electricity distributor does not permit the paralleling of supply transformers, each transformer shall be connected to a separate section of the busbar.

The provision of bus section couplers to interconnect the separate sections of the busbar is optional provided such couplers are:

a) installed and connected on the line side of the metering equipment
b) installed at the customer's cost
c) under the electricity distributor's control
d) provided with facilities for locking in the 'off' position by the distributor's security lock. Locking facilities shall accept a 10mm diameter shank. The lock shall be provided at the customer's cost and will remain the property of the distributor.

Where a bus section coupler is provided, a warning notice with permanently engraved white letters, 6mm high on a red background, shall be fixed adjacent to the lock at the bus section coupler. The warning notice shall read:

WARNING – This coupler is connected on the line side of the installation main switches.

Where off-load isolators are used as the bus section couplers, an additional engraved label shall be fixed at the point of operation to indicate the isolator shall not be operated under load.

1.17.9 Identification

The electricity distributor requires marking on electrical installations to identify the purpose and relationship of equipment. The marking may be in addition to that required by AS/NZS 3000 where:

a) Premises are subdivided into multiple occupancies with separate electricity supplies: the marking is used to identify the occupancy and the switchboard that supplies it. This will involve corresponding legible and durable marking at both the main entrance of the occupancy and the corresponding distribution board, or switchboard.
b) Installations are supplied by more than one service: The marking is used at the main switchboards to identify the portion of the premises being supplied and the presence, location or operation of any alternative source of supply. In addition, a diagram showing the segregation arrangement shall be attached to each main switchboard. All distribution boards shall be labelled to indicate from which service they are supplied.
c) Installations are supplied from the rail network distribution system; the markings on the main switchboard shall indicate that the installation is supplied from the rail network distribution system.

Refer to section 4 which provides a guide to acceptable equipment labelling and identification procedures for large installations.

1.17.10 Termination of cables

The customer shall provide suitable terminating devices if required and enough cable to allow termination at the PCC nominated by the distributor.

If the proposed cable is not single-core insulated and sheathed cable, it shall be suitable for termination to the electricity distributor's distribution system and equipment.

1.17.11 High-voltage installations

Application shall be made to the electricity distributor for the installation of facilities which will enable the connection of a high-voltage installation to the electricity distributor's distribution system.

Installations incorporating high-voltage equipment shall comply with the electricity distributor's requirements and its safety management systems.

Refer to section 7, which provides further information on requirements for high-voltage installations.

1.17.12 Installations on railway land

Specific conditions apply to electrical installations on railway land.

Contact ST for details.

1.17.13 Identification of lighting and other installations (not owned by a distributor) in streets, parks or other public areas

The above installations shall have a clear and indelible sign attached to the outside of each light fitting (or lighting pole or standard if applicable) that indicates that it is a private installation. The sign shall also include the ownership and identify the origin of supply in accordance with AS/NZS 3000. The height of the lettering of the word 'PRIVATE' shall be a minimum of 20mm. The height of the lettering of other words shall be a minimum of 6mm.

1.17.14 Connection points remain separate

Unless formally approved by the distributor as a site-specific condition, a customer shall not interconnect or provide switching facilities between separate physical connection points or points defined by separate NMIs. Each connection point or NMI is to remain totally physically segregated from other sources of network supply and installations.

2 Underground services

2.1 Introduction

This section outlines the requirements for the installation of an underground service.

2.1.1 Underground service

The underground service extends between the electricity distributor's PCC and the connection point on the customer's premises.

The connection point is established at either a private pillar/pit on the customer's premises, or at the customer's main switchboard. Refer to Figure 1-2 Supply from underground distribution mains.

2.1.2 Underground service from an overhead distribution system

The provision of an underground service from the electricity distributor's overhead supply is permitted by the conditions detailed in this section and will be referred to as an underground supply from an overhead distribution system (UGOH). Refer clause 2.10

2.1.3 Specific railway requirements

Application in writing shall be made to ST for the route and installation method for an underground service on railway land.

Special conditions apply and will be advised on application.

Written approval from the party nominated in ST publications is required for any proposed route.

2.1.4 Non-distributor pole use

Non-distributor poles such as communications poles should not be used without prior consultation with the pole owner and distributor.

2.2 Service route

2.2.1 Special considerations

The following factors should be considered:

a) the length and route of the service, including the part in the street; obstacles such as trees, major shrubs and other public services should be considered

b) access to the service equipment

c) the location of the proposed and existing underground service, road crossings, and presence of other utilities (i.e. gas, water and communications).

d) the location of any additional customer termination enclosure that may be required

e) the location of electricity distributor poles in the street if connecting to an overhead distribution system

f) a transformer or switchgear on the selected pole if connecting to an overhead distribution system.

2.2.2 Crossing of adjoining property

The route should not cross an adjoining property. If there is no alternative, a suitable easement shall be obtained.

2.2.3 Access

The underground service termination points shall have readily available access.

2.3 Underground consumers mains

2.3.1 Electrically unprotected consumers mains

To provide similar performance characteristics to the underground service cable, electrically unprotected underground consumers mains shall be installed using the same cable type and minimum size as specified for the underground service cable. Refer to clause 2.6.1.

2.3.2 Electrically protected underground consumers mains

Electrically protected underground consumers mains shall comply with the requirements of AS/NZS 3000.

2.3.3 Alterations and additions

Alterations or additions to existing underground consumers mains shall be treated as a new installation as per clause 1.12.9. This need not apply where additional phase conductors are added to existing electrically unprotected single-phase underground consumers mains, provided the cross-sectional area of the additional conductors is not smaller than the existing conductors.

2.3.4 Connection on relevant land

Where the connection point is nominated on a distribution pole or transformer pole on relevant land, the installation and termination of the consumer mains above 3m shall only be completed by a Class 2C authorised person.

The installation method for the unprotected underground consumers mains on the electricity distributor's pole is to be in the same method as described in Figure 2-8 and Figure 2-9. Flexible hose shall be used from 1m from the base of the pole to the end of the drip loop.

A drip loop is not required when the consumer mains are direct buried.

Connections on new transformer poles may be terminated directly at the load side of the transformer low-voltage fuse or links instead of 3m above ground where possible, subject to the approval of the electricity distributor.

Where the electricity distributor's pole on which the consumer main is attached supports a high-voltage earthing conductor or high-voltage equipment that is earthed, all mechanical protection for the consumer main is to be of non-conductive material and meet the distributor's requirements.

2.3.4.1 Underground consumer mains installed on distributor conductive (concrete and steel) poles

Where concrete and steel poles are used, stainless steel 'band-it' or similar bands shall be used. The bands shall have suitably sized conduit saddles to fix the conduit to the pole.

Equipment mounted on the pole shall also use bands to fix in place . **Do not drill any holes in concrete or steel poles for fixings.**

2.4 Installation of underground service

Caution: the installation of an underground service shall be carried out only by an ASP.

2.4.1 Installation requirements

The customer is responsible for all costs and for providing all works and material in relation to installing an underground service cable.

All new service cables within the customer's property shall be installed in conduit suitable for the drawing in and drawing out of the cable.

2.4.1.1 Underground service cables installed in conduit

Underground service cables of less than 240mm^2 shall be installed in conduit throughout their entire length.

Furthermore, underground services installed in conduits shall meet the following requirements:

a) Cables shall be installed in UPVC conduits as specified in AS/NZS 3000 for a Category A system enclosure, or as determined by the electricity distributor.

b) The underground conduit shall maintain a minimum 500mm depth throughout the entire length.

Note: Where the ground or obstructions prevent maintaining the 500mm depth, the underground wiring requirements of AS/NZS 3000 will prevail. The electricity distributor shall be notified by the NOSW of the method used.

c) Orange marker tape shall be positioned at approximately 50% of the depth of cover above the underground conduit for its entire length. Marker tape is not required when under-boring techniques are used to install an underground service. The marker tape shall meet the requirements of *AS/NZS 2648.1:1995 Underground marking tape – Part 1 Non-detectable tape*.

d) The cables of each underground service shall be identified with a permanently installed water-resistant tag. The tag is to be indelibly marked to nominate the street number and name of premises supplied.

e) Unless using 240mmsq, the cable ends shall extend to a minimum of 1m above ground level.

2.4.1.2 Underground service cables – direct buried

Underground service cables comprising circular multicore conductors 240mm^2 or larger may be direct buried.

The underground service cable shall maintain a minimum 500mm depth throughout its entire length.

Note: Where ground material/obstructions prevent maintaining the 500mm depth, the underground wiring requirements of the AS/NZS 3000 will prevail. The electricity distributor shall be notified via the NOSW of the method used.

Where the direct buried technique is used, service cables shall be mechanically protected by means of a light-orange coloured polymeric cable cover strip of a material equivalent to UPVC conduit complying with *AS 4702:2000 Polymeric cable protection covers* having a thickness not less than 3mm.

This cover strip will fulfil the requirements of a marker tape and shall be positioned approximately 50% depth of cover above the cable.

2.4.1.3 Underground service cables – in a public reserve/easement (off the customer's property)

Where the underground service is installed **within the boundaries of a public road, public reserve or easement** (off the customer's property), the underground service shall be installed in accordance with the following:

a) 150mm lateral separation maintained between the underground service cable and the electricity distributor's cables and services belonging to other utilities

b) parallel to the property line and within the electricity distributor's easement or allocation, or at 90° to the property line

c) the specific requirements of the electricity distributor (where applicable)

d) all relevant Acts, Regulations and other statutory requirements, including notification requirements of local councils and restoration obligations in the public allocation.

2.4.2 Searches for underground utility services

The ASP shall carry out a search for underground utility services, before excavating. Adequate clearances shall be obtained between the proposed underground service and underground utility services. Check with the appropriate utility to determine required clearances.

Utilities may include:

- water
- sewer
- drainage
- gas
- communication cables
- other power cables
- railway power, signalling and communication cables (which may also be located in public streets, parks etc).

Before You Dig Australia

Phone 1100 – free call (except from mobiles)
Website www.byda.com.au

Australia's major service providers have a single web-enabled information service for information on the location of underground communications, gas, water and electricity infrastructure. Use the website to ensure that you contact 'Before You Dig Australia' before any excavation work. If calling, be ready to provide the operator with:

- your name and address

- name of company
- contact telephone number
- email for return information
- contact name on site
- site address and both nearest cross streets
- start date of proposed work
- type of work being carried out.

Caution: all buried cables shall be considered as energised.

2.4.3 Provision for other utility services on customers' premises

Other utility services may be located in the same trench as the underground service provided they comply with the requirements of AS/NZS 3000. Other utilities may have additional requirements.

2.4.4 Position of underground service / consumers mains

2.4.4.1 On the premises

A sketch of the underground service / consumers mains route shall be clearly marked on the inside of the service equipment enclosure. Additionally, a suitable sketch placed in a clear plastic envelope may be permanently attached within the main meter board. Figure 2-1 shows a typical sketch.

2.4.4.2 Off the premises

When notifying the electricity distributor of completed works, the ASP shall supply a sketch detailing the route of the underground service off the customer's property. The NOSW is to be used.

Refer to Figure 2-2 for a typical sketch of the underground service route off the premises.

The sketch shall clearly show:

a) street alignments
b) lot boundaries
c) lot/house no's
d) name of street and suburb in which the work is being done
e) north point
f) route of underground service
g) start and finish points of any conduits
h) reference the position of the service in the ground at all deviation points
i) depth of cover over the service
j) position of cable joints
k) type of cable used
l) type of joint made (if any)

m) the ASPs full name and phone number

n) reference points from which all other measurements shall be taken.

Figure 2-1 Typical sketch of the underground service route on the premises

To be placed in the main switchboard enclosure

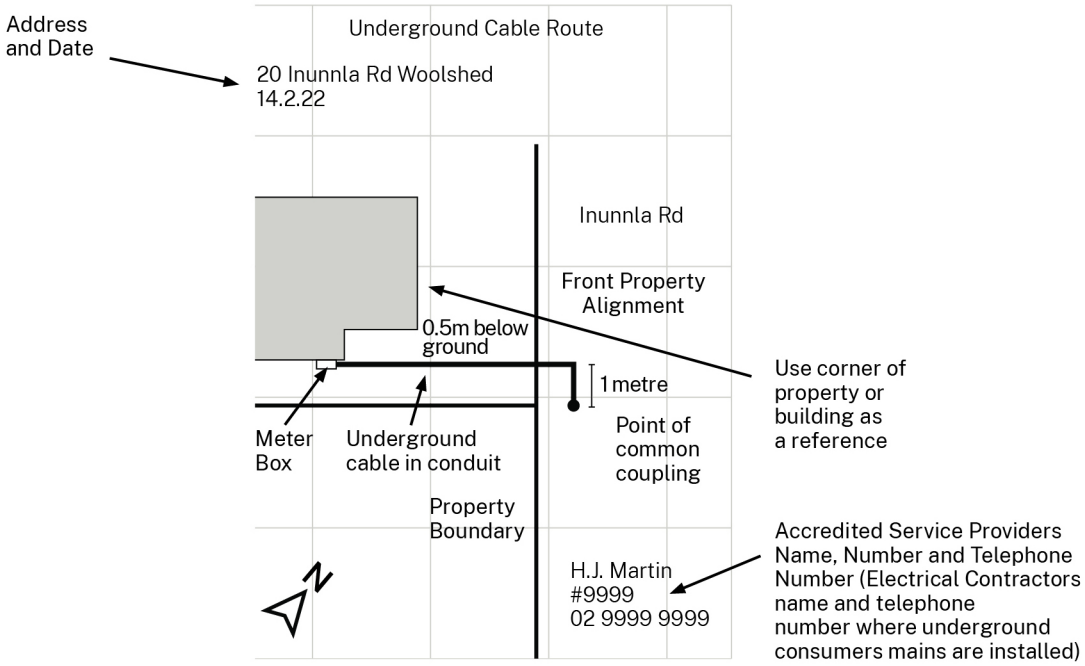
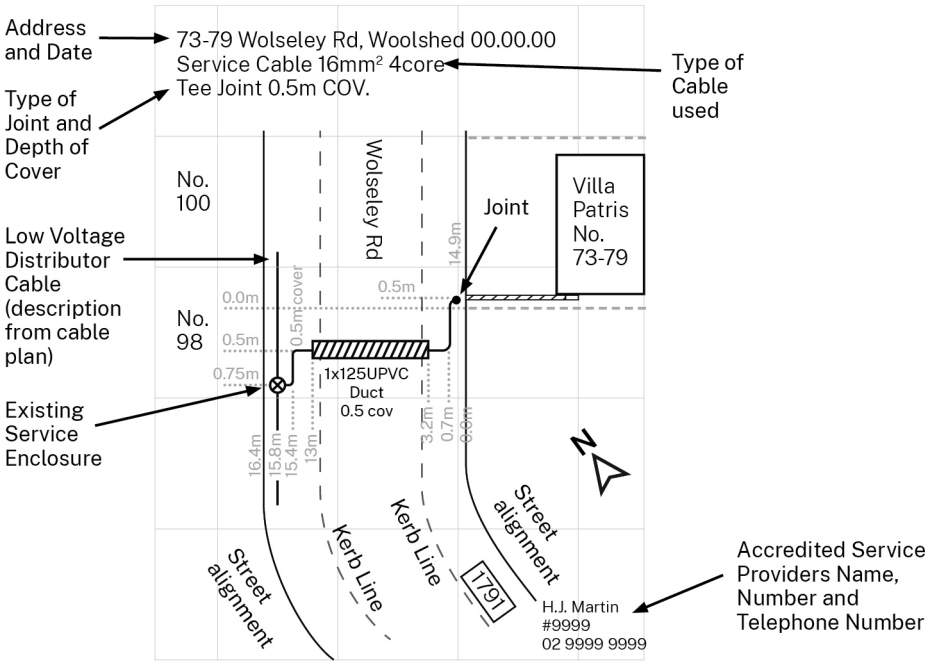


Figure 2-2 Typical sketch of the underground service route off the premises

To be submitted to the electricity distributor by way of a NOSW form. This figure does not necessarily show the specific design requirements for a service install.



2.5 Conduit requirements

2.5.1 Sizes

The minimum conduit size used to enclose an underground service cable is 40 mm diameter. Conduit shall be rigid, and no other cables apart from service mains are allowed to be installed inside service mains conduits.

The conduit is limited to 63mm when associated with a standard switchboard due to the restricted space behind the panel.

2.5.2 Installing service conduits

Underground service conduits shall be laid in a straight line, and any conduit bend shall be a sweep bend. Only one sweep bend with a minimum internal angle of 90° is permitted on the customer's premises.

A minor deviation in the straight-line run of conduits is permissible, i.e. within the flexibility of the conduit. Do not use heat on the conduit to aid bending. Heat can cause damage to conduit which may impede the serviceability of cable.

Where the underground service cable terminates in the meter enclosure, the conduit shall enter the enclosure.

Where permitted by the electricity distributor, a draw-in box located on the external wall may be installed. The draw-in box is to be located above finished ground level.

The draw-in box shall have an ingress protection (IP) rating suitable for the area in which it is located. The draw-in box shall be of a suitable size to maintain the cable bending radius integrity.

A length of heavy-duty corrugated conduit (up to 1.2m) may be used to allow the service cable to enter the cavity and main switchboard. Where exposed, this conduit shall be covered by a steel guard.

The underground service may then pass through the wall into the cavity in such a way that will permit the cables to be drawn in or out without damage.

2.5.3 Joints

Join the conduit using sockets or fittings. Install the sockets or fittings so the bore of the system is continuous and smooth and presents no obstruction to pulling in the cable. Make joints watertight. Bond them using an appropriate jointing method.

2.5.4 Draining

Install a drain in a conduit when the ground level at the street end of the conduit is above the floor level of a building in which the conduit terminates. Refer to Figure 2-3 for installation details.

Position the drain approximately 300mm above ground level. It should include:

a) a 10mm diameter hole facing the wall if the conduit rises on the outside of a building, or

b) a minimum 10mm diameter non-metallic pipe fitted into the conduit. The pipe shall not protrude into the bore. Arrange the pipe so that it drains to the exterior of the building above ground level when the conduit is on the inside of a building.

Refer to Figure 2-3 to Figure 2-6 for typical conduit installations details.

Figure 2-3 Typical service conduit in domestic premises

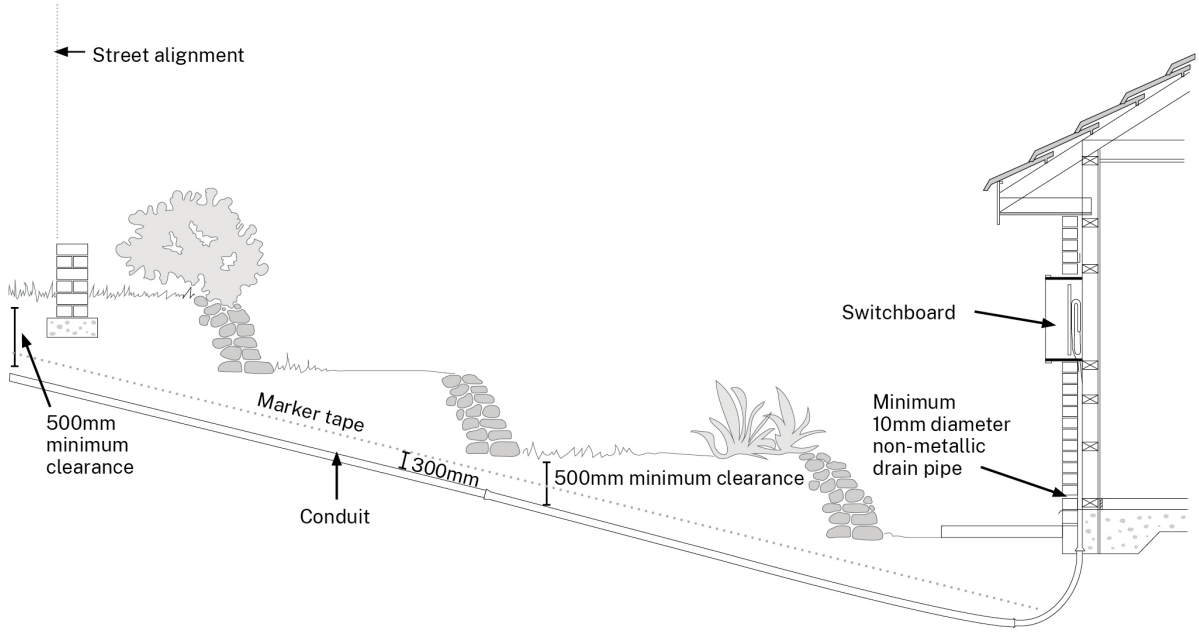
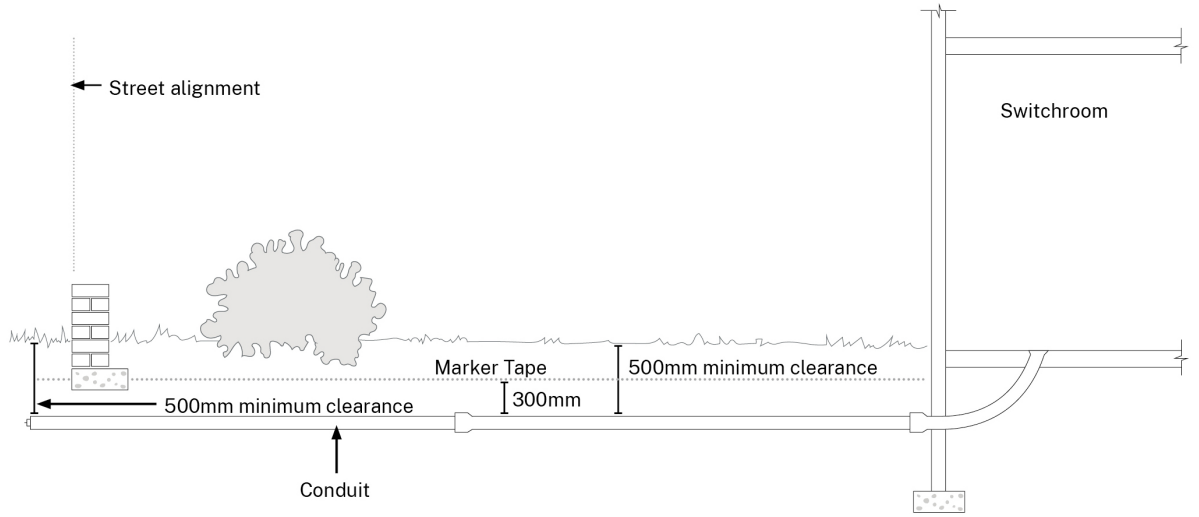


Figure 2-4 Typical service conduit – non-domestic



2.6 Cable requirements

2.6.1 Cable specifications

The following information provides the minimum specifications for single and multiphase underground service cables:

All underground services shall be 4-wire 3 phase, except for single domestic premises, duplexes and builder's services. In these cases, a 2-wire single-phase service is permissible provided the service cable does not require a direct buried joint.

The cable size and service ratings are set out in Table 2-1.

Service cables shall be XLPE insulated PVC sheathed, comply with *AS/NZS 5000.1:2005 Electric Cables–Polymeric insulated – For working voltages up to and including 0.6/1 (1.2) kV* and be comprised of either:

a) single-core cables

b) 2-core cable(s)

c) one 4-core circular cable

Service cables shall be approved by the electricity distributor; refer to the electricity distributor for its approved material list.

Service cables with a cross-sectional area (CSA) of 240mm^2 shall be of 4-core aluminium, XLPE insulated, PVC-sheathed construction. Single core cables shall only be connected at pillars or to service tails. Check what method of connection is required before purchasing cable.

Table 2-1 Service cable sizes and ratings

Cable CSA (mm^2)	Conductor material	Cable rating (A)	No. of cable cores
16	Cu	100	1 or 4
25	Cu	100	1 or 4
50	Cu	200	1 or 4
70	Cu	200	1 or 4
240	Al	400	4

Note: 4 × 185mm^2 CU1XQZ single-core cables are acceptable alternatives for 400A services in city locations, where it is physically impractical to install and terminate the 240mm^2 Al 4-core cable. Other locations may also be accepted, where the electricity distributor has granted prior approval.

Table 2-1 and the above note specify the **only** service cables that may be used for various service ratings. Any intermediate service ratings (based on the assessed demand of the installation) shall use the next largest service rating/cable available.

The 50mm^2 cable may also be used for a 100A service to satisfy the voltage drop requirement.

In addition, underground service cables shall be brand new and joints are not permitted unless otherwise approved by the electricity distributor.

If these requirements are incompatible with the electricity distributor's design standards, the electricity distributor will specify the number and size of conductors and stipulate a method of

termination. For example: where the PCC is buried directly in the ground, the underground service cable shall comprise single-core insulated and sheathed conductors.

Consult with the electricity distributor for services greater than 400A.

2.6.2 Maximum length

The maximum total length of an underground service is 50m providing the connection point is established at the main switchboard. Refer to Figure 2-3.

If this condition cannot be met, refer to clause 2.7.

2.6.3 Non-urban installations

Where the PCC is located on relevant land, the electricity distributor will nominate the location of the connection point. Refer to clause 2.3.4 and Figure 2-8.

2.6.4 Spare conductors

The authorised ASP shall energise any spare underground service conductors installed to provide for future phase connections.

Spare conductors are to be terminated in a sealable fuse or in a sealable link.

2.6.5 Alterations and additions

Alterations or additions to an existing underground service or unprotected consumers mains shall be treated as a new installation as per clause 1.12.9. This need not be applied where:

a) additional phase conductors are added to an existing single-phase service cable or unprotected single-phase consumers mains – provided the cross-sectional area of the additional conductors is not smaller than the existing conductors, or

b) the existing conduit is smaller than 40mm but can accommodate the additional or replacement conductors.

2.7 Connection point enclosure – other than the main switchboard

2.7.1 Enclosure

An appropriately manufactured (with appropriate waterproofing and method of connections) electrical termination enclosure (pit or pillar) is required where the connection point is not established at the main switchboard.

2.7.2 Access

The customer shall supply and install the enclosure in a way that allows the underground service conduit to meet the requirements of these Rules and provide unrestricted access from 2 sides and above.

The cover of the pillar/pit shall, with the use of a tool, be totally removable from the base, allowing full access to the contents. Where the pit or pillar is prone to mechanical damage at or above ground level, suitable mechanical protection shall be installed.

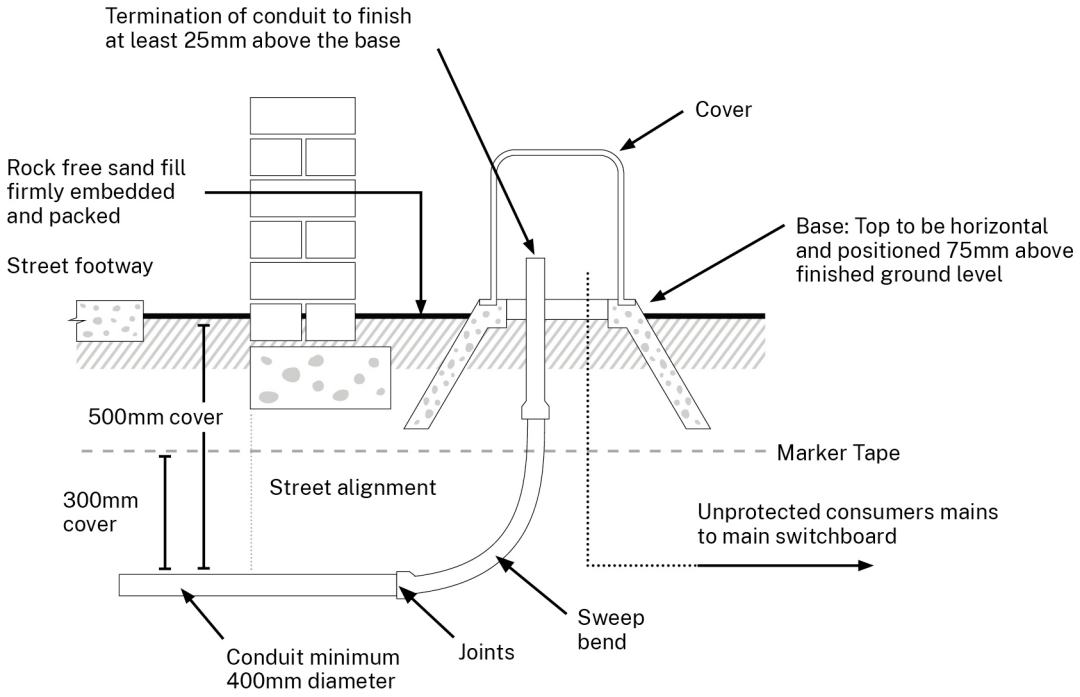
2.7.3 The termination enclosure

Where the connection point is not established at the main switchboard, the termination facility shall be located within 1m of the property alignment under which the underground service passes. Refer Figures 2-5 and 2-6. Refer to electricity distributor for requirements of termination details and enclosure type.

2.7.4 Labelling

The top of the cover for the termination enclosure shall be clearly labelled to indicate it contains electrical apparatus, with the following wording: 'CAUTION ELECTRICITY' and 'PRIVATE PIT' or 'PRIVATE PILLAR'. The height of the lettering shall be at least 20mm.

Figure 2-5 Typical underground service installation to customer's termination enclosure – (pillar)



Notes:

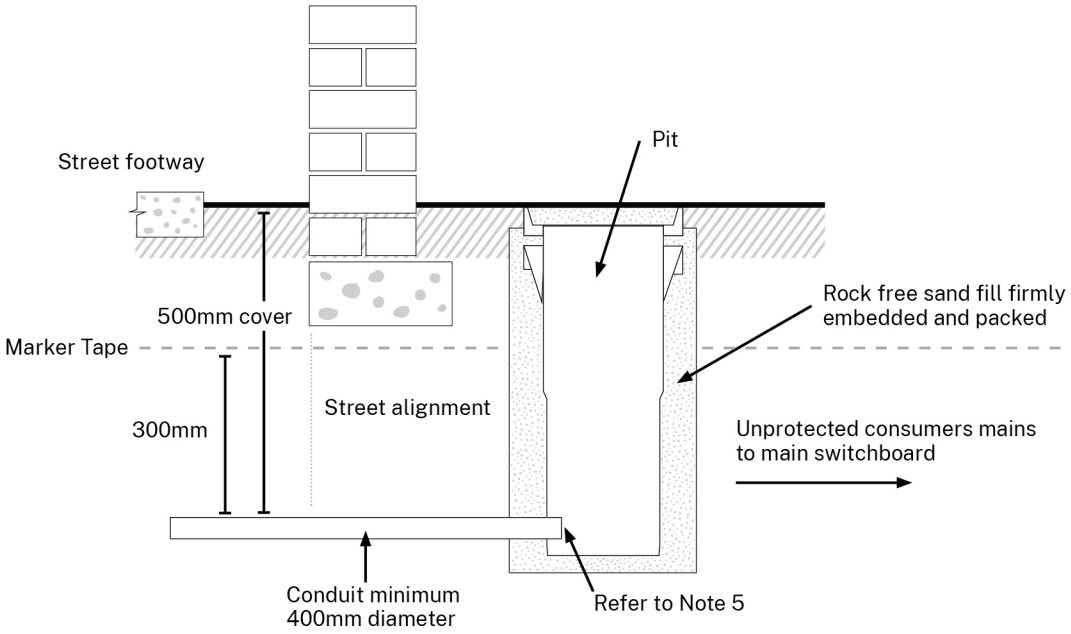
1 For services rated above 100A, the ASP shall on each occasion consult the electricity distributor.

2 Locate enclosure within 1m of the property alignment under which the underground service passes.

3 Marker tape positioned at approximately 50% of depth of cover above conduit (clause 2.4.1.1 (c)).

4 Only one sweep bend with a minimum internal angle of 90° is permitted on the customer's property.

Figure 2-6 Typical underground service installation to customer's termination enclosure – (pit)



Notes:

1 For services rated above 100A, the ASP shall on each occasion consult the electricity distributor.

2 Locate enclosure within 1m of the property alignment under which the underground service passes.

3 Top of pit to be level with final ground or footpath level.

4 Coil a minimum of 1500mm of service cable and consumers mains in the pit.

5 Service conduits are to extend at least 40mm into the pit.

6 Marker tape positioned at approximately 50% of depth of cover above conduit (clause 2.4.1.1 (c)).

2.8 Service cable connection requirements

ASPs should consult with the electricity distributor before carrying out service connection or disconnection work at pillars and pillar standards with exposed live parts, as restrictions on live work at these may apply.

Electricity distributors will supply details of their standard connection arrangements to ASPs working in their distribution area.

2.8.1 Colour coding

The phase/neutral colour coding shall meet the specifications of the AS/NZS 3000 requirements for consumers mains.

2.8.2 New termination enclosure required in public area with existing distribution system

Where a new PCC is established in a public area, the work shall be carried out by an appropriately authorised Level 1 ASP. The electricity distributor will determine the need for the location of the enclosure.

2.8.3 Pit and duct systems

Where the electricity distributor's low-voltage distribution system is installed as part of a pit and duct system, the connection will be made at a pit. Existing pits and ducts from the customer's premises shall not be used without the agreement of the electricity distributor.

The electricity distributor will nominate the PCC and whether a new pit needs to be constructed. Where no suitable pit exists for connection, a Level 1 ASP or the electricity distributor will supply and install one.

Only an ASP authorised by the electricity distributor may work on or near an electricity distributor's pit or pillar.

Where a suitable cable entry is not provided in the pit, it shall be installed by an appropriately authorised ASP.

2.8.4 Phase selection for the connection of services

Single-phase customers should be connected to the following phase arrangement:

c) reconnect existing service cable to the same phase as previously connected, or

d) connect the new underground service cable as listed in Table 2-2.

Table 2-2 Phase selection

For lot or street number ending in:	Connect to:
1	A phase
2	B phase
3	C phase
4	A phase
5	B phase
6	C phase
7	A phase
8	B phase
9	C phase
10	A phase
20	B phase
30	C phase

2.8.5 Earthing of equipment

The enclosure shall be earthed in accordance with the equipotential bonding arrangements of AS/NZS 3000.

2.8.6 Phase selection for single-phase controlled loads, supplied from a 3-phase service

Where a single-phase controlled load (e.g. off-peak hot water system) is installed on a premises supplied from a 3-phase service, apply Table 2-2 for the connection of the single-phase controlled load.

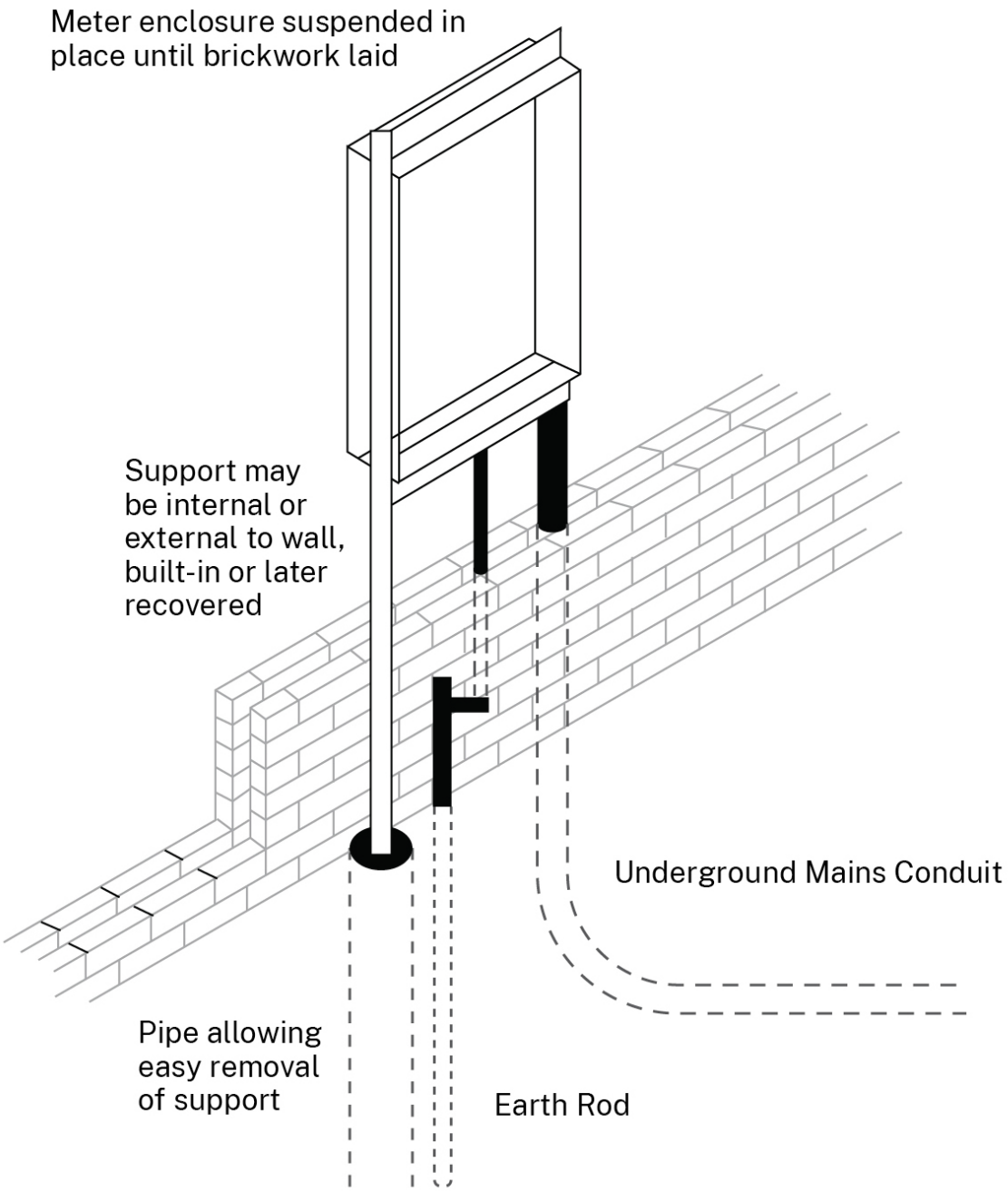
2.9 Temporary support in a permanent position for building purposes

Supply may be taken via a service equipment enclosure, supported in a way that allows building construction to proceed. The service equipment enclosure shall encompass the switchboard enclosure and secure it in its permanent building position.

Figure 2-7 shows a main switchboard temporarily supported to provide supply for building purposes. Other configurations of this support, provided they meet safety requirements, are acceptable.

Caution: Attention is drawn to: *AS/NZS 3012 Electrical Installation – construction and demolition sites, Work Cover NSW Code of Practices for construction work*, and any other requirements of other authorities.

Figure 2-7 Typical main switchboard temporarily supported in permanent position to provide supply for building purposes



Notes:

1 Install a permanent main earth conductor and electrode.

2 Adequate protection against mechanical damage during the construction phase, to the underground service / consumers mains, main earthing conductor and earthing electrode to be provided.

3 The construction site to comply with applicable codes and legislation.

4 Adequate protection for flexible cords entering the meter enclosure to be provided. Flexible cords shall be protected from mechanical damage caused by the meter enclosure door.

2.10 Underground supply from an overhead distribution system (UGOH)

2.10.1 UGOH

A customer may request supply by way of an underground service from the overhead distribution system. This will be provided by an underground to overhead connection (UGOH) at the nearest electricity distributor pole. The following conditions apply:

a) The arrangement shall not require any additional street poles.

b) The electricity distributor may inspect the site before agreeing to the proposal.

c) In footpaths, the conduit shall be parallel to the property line and within the electricity distributor's easement or allocation, or at right angles to the property boundary.

2.10.2 Installation on the electricity distributor's pole for an underground service with conductors up to a maximum 70mm²

For an underground service with conductors up to a maximum of 70mm², the method of installation on the electricity distributor's pole shall meet the following requirements (refer to Figure 2-9 for details).

a) The underground service cable shall be installed in flexible plain conduit according to AS/NZS 2053.4:1995 Conduits and fittings for electrical installations – Flexible plain conduits and fittings of insulating material.

b) Where the Class 2B ASP is not authorised as Class 2C, the conduit and cable on the pole shall be left coiled and securely attached 3000mm above ground level.

c) The flexible conduit shall extend a minimum of 1000mm underground from the base of the pole and be protected against mechanical damage.

d) The conduit on the pole shall be protected against mechanical damage up to 2500mm above and 300mm below finished ground level. The protection shall be a close fit tubular or 'U'-section construction with no side flanges (side-securing tabs are permitted). This is to minimise the surface area of the pole that is covered and help prevent climbing. Timber is unacceptable. Refer to Figure 2-9.

e) Where fabricated metal enclosures are used to provide mechanical protection, they shall be hot-dipped galvanised to meet the specifications in *AS/NZS 4534:2006 Zinc and zinc/aluminium-alloy coatings on steel wire, AS/NZS 4680:2006 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*, and *AS/NZS 4792:2006 Hot-dip galvanized (zinc) coatings on ferrous hollow sections*, applied by a continuous or a specialized process.

f) Where the electricity distributor's pole on which the underground service is attached supports a high-voltage earthing conductor or high-voltage equipment that is earthed, all mechanical protection for the service cable is to be of non-metallic material. Specific (non-conductive) material is available.

g) The underground service shall be installed to comply with the requirements of this document.

h) The amount of flexible plain conduit left coiled on the pole shall be sufficient to reach the cross arm and enable a weather loop to be formed adjacent to the PCC. Allow for 1500mm

of cable to be free of the conduit at the PCC to enable connection to the distribution system. Refer to Figure 2-9.

2.10.3 Installation on the electricity distributor's pole for an underground service with conductors larger than 70mm²

Where an underground service cable comprises conductors larger than 70mm², the cables shall be installed in accordance with the distributor's construction / approved materials inventory and installation method. Refer to Figure 2-10.

2.10.4 Maximum number and location of underground services that can be installed on an electricity distributor's pole

The number of underground to overhead services that may be attached to the electricity distributor's pole is limited to the numbers shown in Table 2-3.

Cable attached to the side of a pole for the purpose of connecting aerial construction to underground construction or earth, except for cables used to earth the electricity distributor's equipment, is considered an underground to overhead service. This includes all telecommunication cabling.

Where there is a requirement to put more than the permitted number of underground services on one pole, the electricity distributor shall be consulted for the requirements of the underground pillar/pit in the footway allotment for the connection of additional underground service cables.

This is carried out at a cost to the customer requiring the last connection, or the connection that exceeded the permitted number of underground services on the electricity distributor's pole.

Additional underground services, where required, will be connected to the pillar/pit.

2.10.5 Underground supply from overhead reticulation

Street poles on which distribution transformers, air break switches or similar equipment are mounted, or poles belonging to other statutory authorities (e.g. Telstra), will not be used except as a last resort where agreed to by the distributor.

Table 2-3 Maximum number of underground to overhead (UGOH) service cables allowed on an electricity distributor's pole

Total number of all types of existing UGOHs on the distributor's pole (refer to clause 2.10.4)	Additional number of customer UGOHs that can be placed on an electricity distributor's pole			
	Conductors up to a maximum of 70mm²			Conductors greater than 70mm²
	Line pole	Transformer pole	Air break switch pole	All situations
0	3	1	1	1
1	2	#	#	#
2	1	*	*	
3	*			

* The customer shall apply to have a UGOH installed to a pillar in the footway.

One additional UGOH may be installed provided one is not connected to the LV mains, e.g. HV or telecommunications.

Figure 2-8 Example of locating the connection point when the point of common coupling is located on relevant land. Refer clause 2.3.4

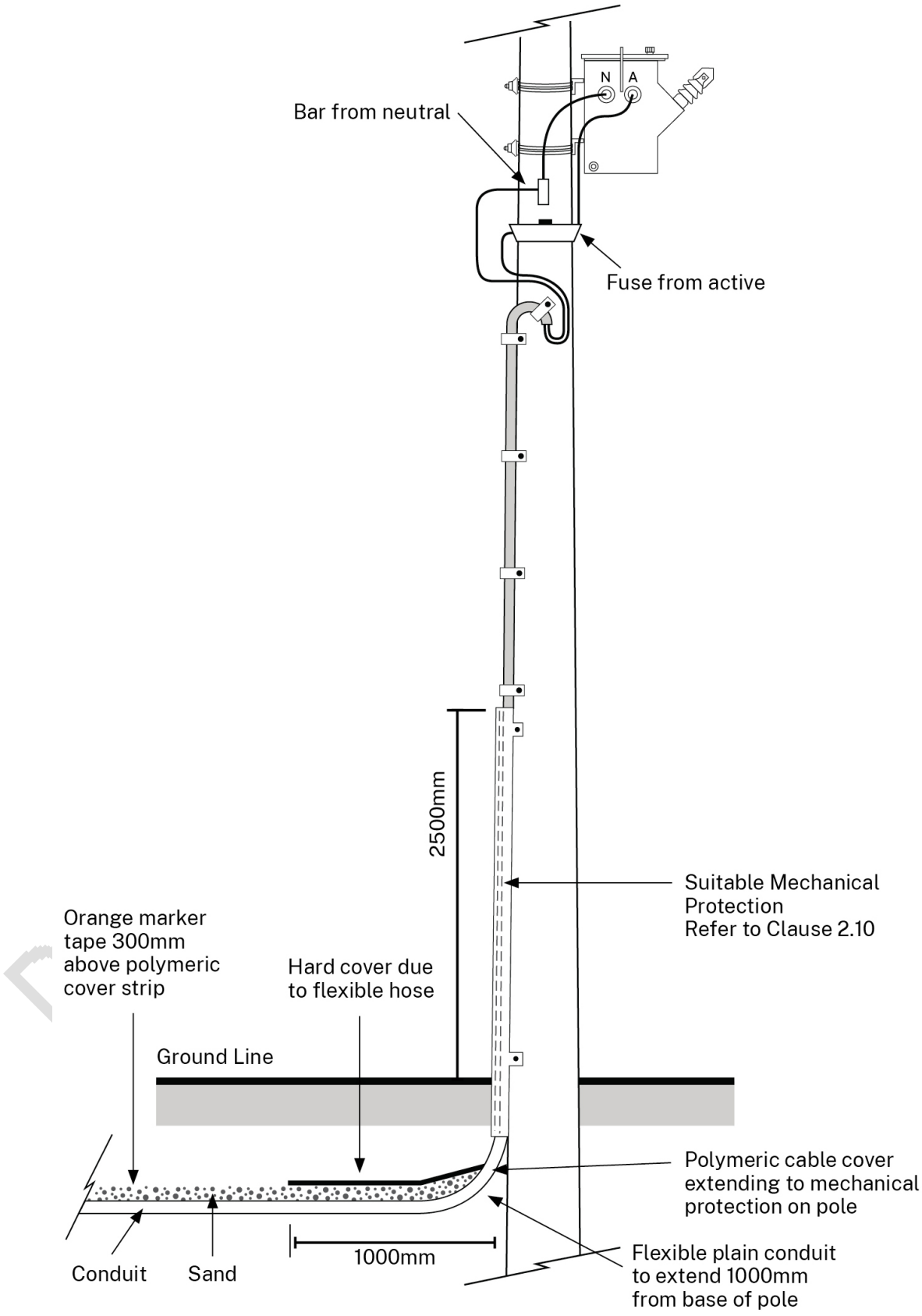


Figure 2-9 Typical underground supply with conductors up to a maximum of 70mm² installed on an electricity distributor's pole

(Refer to Table 2-3)

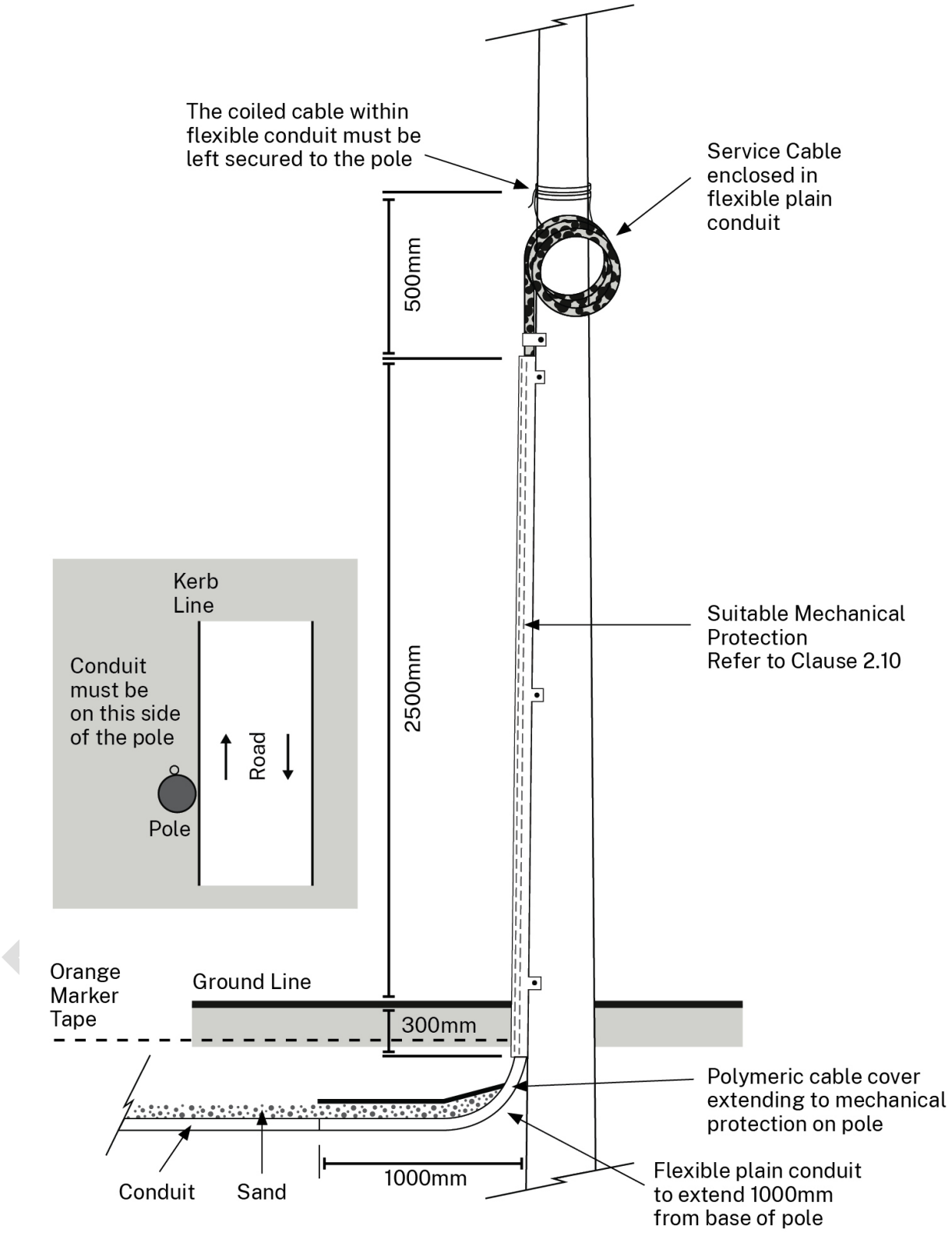


Figure 2-10 Typical underground service with conductors larger than 70 mm² installed on an electricity distributor's pole

(Refer to Table 2-3)

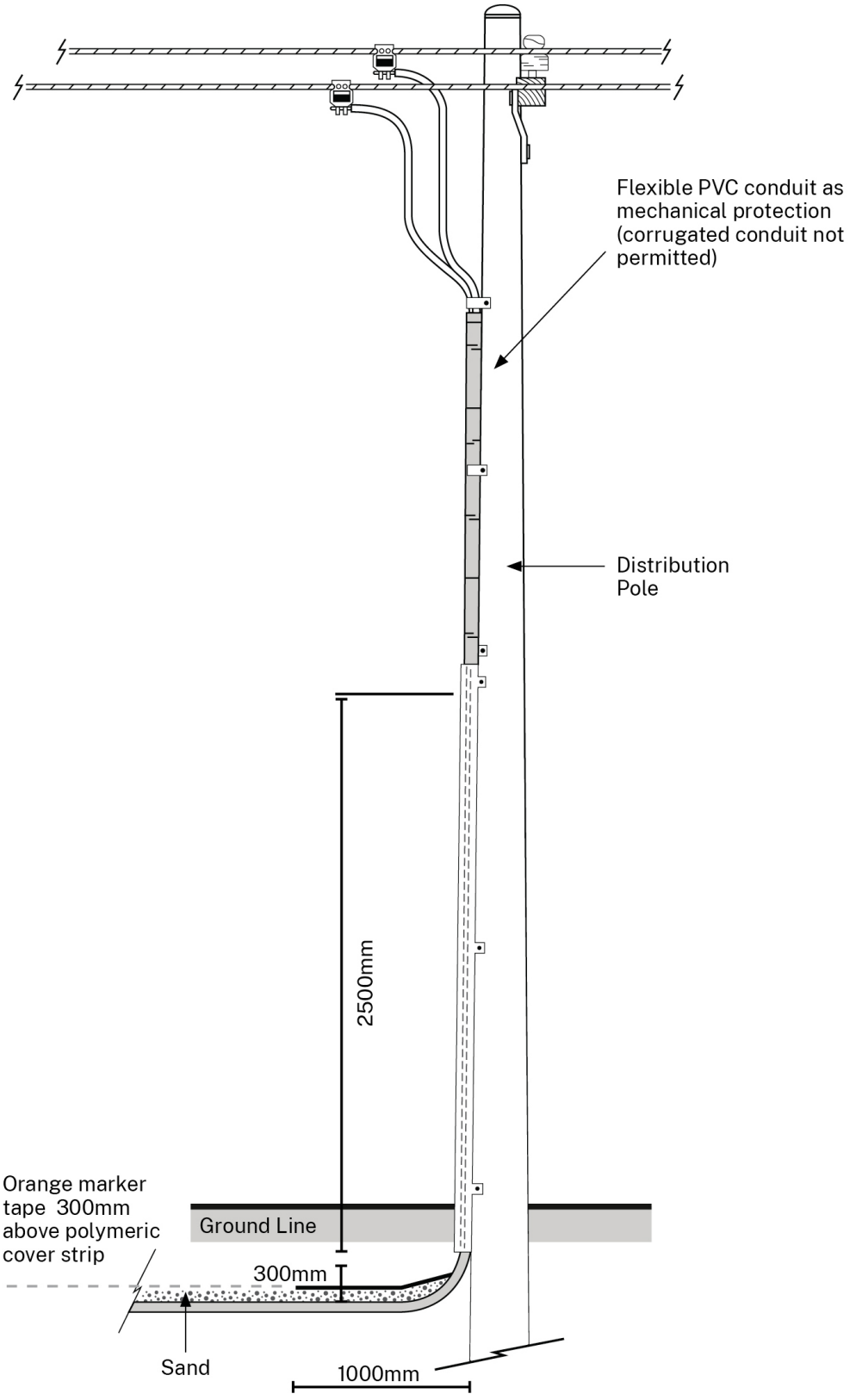
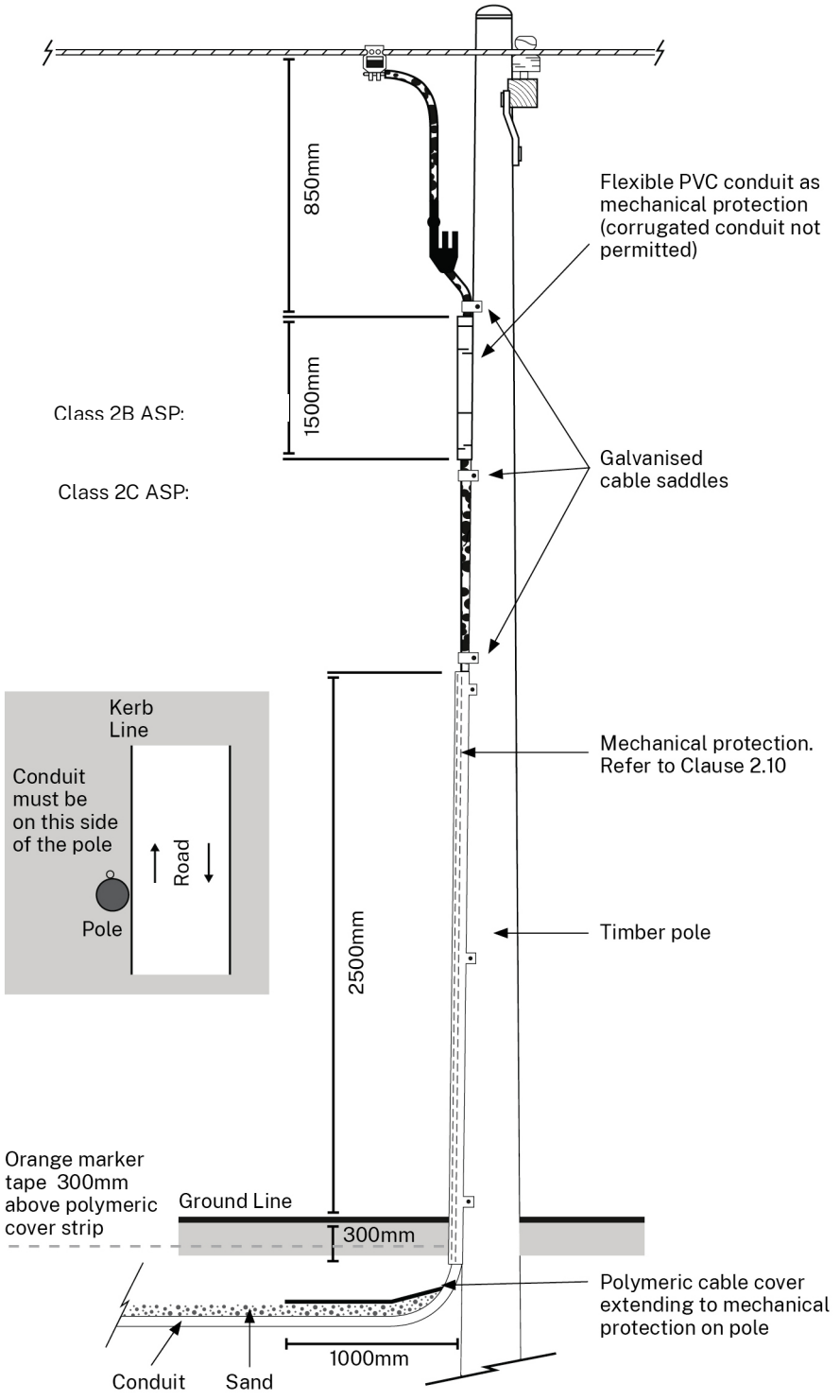


Figure 2-10(a)



3 Overhead services

3.1 Introduction

This section outlines installation requirements for an overhead service rated at 100–400A.

3.1.1 Approval for an overhead service

The electricity distributor may determine whether premises will be supplied by an overhead service. The electricity distributor shall approve the:

a) point of common coupling (PCC)

b) type of construction

c) point of attachment (POA)

d) route of service.

ASPs are qualified to determine whether an overhead service is required in accordance with the distributor's requirements. However, to ensure bushfire risk management is addressed, ASPs and electrical contractors should obtain electricity distributor requirements before installing overhead services in rural areas.

3.1.2 Alternative to an overhead service

If a customer does not wish to take supply from an overhead service for any reason, an underground service may be provided (refer to section 2) and the customer may be required to bear any additional costs incurred.

3.1.3 Distributor's street poles

The electricity distributor will not erect a street pole to facilitate connection of the electrical installation to the electricity distributor's network unless, in the electricity distributor's opinion, no practical alternative is available.

3.1.4 Specific railway requirements

Application in writing shall be made to ST for the route, construction, and POA for an overhead service on railway land.

Special conditions apply which will be advised on application. Written approval from the party nominated in the ST publications is required for any proposed route.

3.1.5 Existing service – alterations and additions

This clause outlines the requirements for alteration and addition by or for the customer of any of the following:

a) overhead service (refer to clause 1.12.9).

b) point of attachment

c) consumers mains (including aerial consumers mains).

Table 3-1 summarises these requirements for the most common alterations and additions, and the customer is required to fund the work unless otherwise stated.

Note: only ASPs are permitted to perform the overhead service work outlined in Table 3-1.

The requirements should be confirmed with the electricity distributor if doubt exists (before commencing work).

3.1.6 Retaining an existing service

Where work is being carried out, and it is proposed to retain the existing overhead service cables or a property crossing (see Table 3-1), all the following provisions shall apply:

a) The service cable and its associated fittings shall be in good condition.

b) The service cable shall be PVC or XLPE insulated.

c) All other aspects of the installation shall comply with these Rules (*Service and Installation Rules of NSW)*, i.e. access to and height of the POA, service clearances, etc.

Note: In certain instances (refer to Table 3-1) the electricity distributor as part of its maintenance responsibility will fund the replacement of the service line where conditions (a) and (b) above are not satisfied. The customer shall fund any work required to satisfy condition (c) above.

The customer should arrange with the electricity distributor to replace the service cable (where the electricity distributor has agreed to fund the new service) in conjunction with the alterations or additions. Where the electricity distributor carries out this work the customer will be required to pay for the cost of the disconnection and reconnection (of the new service cable) at the connection point.

Alternatively, an ASP (Level 2, Class C – Overhead) can complete this service replacement work. The electricity distributor will not reimburse ASPs for this work.

3.1.7 Non-distributor pole use

Non-distributor poles such as communications poles should not be used without prior consultation with the pole owner and distributor.

Table 3-1 Requirements of clause 3.1.5 for existing overhead services and consumers mains (100–400A) affected by alterations or additions

Nature of the alterations or additions	Service cable requirements	Consumers mains requirements
Uprating the consumers mains (cable being replaced)	Install as new if cable rating exceeded. If rating satisfactory apply clause 3.1.6 to determine need for replacement.	Install as new
Repairing the consumers mains	N/A	Repair as existing
Altering/relocating the point of attachment	Install as new if service needs to be extended	Install as new if cable rating exceeded
Increasing the number of phases (additional service cable required)	The service shall now comply with these Rules	Install as new if cable rating exceeded
Increasing the number of phases (no additional service cable required).	Refer to clause 3.1.6	Install as new if cable rating exceeded
Uprating the service (cable being replaced)	Install as new	Install as new if cable rating exceeded

Nature of the alterations or additions	Service cable requirements	Consumers mains requirements
Re-routing a cross-property service line	Install as new	Install as new if cable rating exceeded

Note:

Unless otherwise stated the customer shall fund this work

Reference to 'as new' means the final installation shall comply with the current requirements of these Rules and AS/NZS 3000 as applicable.

100A service cables shall not be paralleled to form 200A or greater. Existing 6mm^2 PVC insulated service cable has a rating of 70A/conductor.

3.2 Service route and point of attachment

3.2.1 Special overhead considerations

The following factors should be taken into consideration:

a) the location of the electricity distributor's poles in the street supplying adjacent properties

b) a transformer located on the pole selected for the connection of a service

c) the position, including its height above ground, of the POA

d) the existence of trees and large shrubs

e) required clearances

f) the location of any additional pole

g) the selection of the POA to ensure the route of the service is clear of swimming pools, vegetation and other relevant building features such as doors, windows, balconies and entrances

h) the location of other utility services, refer to clause 3.5.3.1

i) mitigation of bushfire risks in accordance with the electricity distributor's bushfire risk management plan and procedures.

Connections are generally not permitted at pole substations in urban areas unless no practical alternative exists. The electricity distributor shall approve the proposed connection in advance.

To ensure bushfire risk management is addressed, ASPs and electrical contractors should obtain electricity distributor requirements before installing overhead services in rural areas.

3.2.2 Service route and phase selection

Single-phase customers should be connected to the following phase arrangement:

a) Reconnect existing service cable to the same phase as previously connected, or

b) Connect the new overhead service cable as listed in Table 32. (All tests should be taken to confirm, but nominally neutral-A-B-C from property to kerb.)

Table 3-2 Phase selection

For lot or street number ending in:	Connect to:
1	A phase

For lot or street number ending in:	Connect to:
2	B phase
3	C phase
4	A phase
5	B phase
6	C phase
7	A phase
8	B phase
9	C phase
10	A phase
20	B phase
30	C phase

3.2.3 Phase selection for single-phase controlled loads, supplied from a 3-phase service

Where a single-phase controlled load (e.g. off-peak hot water system) is installed on a premises supplied from a 3-phase service, apply Table 32 for the connection of the single-phase controlled load.

3.2.4 Crossing of adjoining property

A route crossing an adjoining property is only acceptable provided a suitable easement is obtained over the property. The only acceptable methods to prevent crossing of private properties are:

a) a post/pole erected by the customer on the customer's property in accordance with clause 3.7.2. The connection point will be at the post/pole

b) where approved by the electricity distributor's construction standards, a suspended service (or mid-span suspended service from ABC mains) not exceeding 100A, may be used where:

   i) the customer's property is on the same side of the street as the distribution system

   ii) the distance between the line poles does not exceed 45m

   iii) the suspended service line is erected as close as practicable to 90° to the mains and does not exceed 20m in length (longer distances may be approved by the electricity distributor)

   iv) written application for each individual installation shall be submitted to the distributor.

A private pole should be installed to avoid a suspended service. A mid-span/suspended service is permitted only as a last resort. Unusual building and distribution pole locations may warrant a suspended service which should be discussed with the distributor.

The electricity distributor will not consider the installation of a distribution pole unless there is no practical alternative.

Note: if a customer is required to relocate an existing cross-property overhead service, that is not installed with an easement, the customer is responsible for the associated cost.

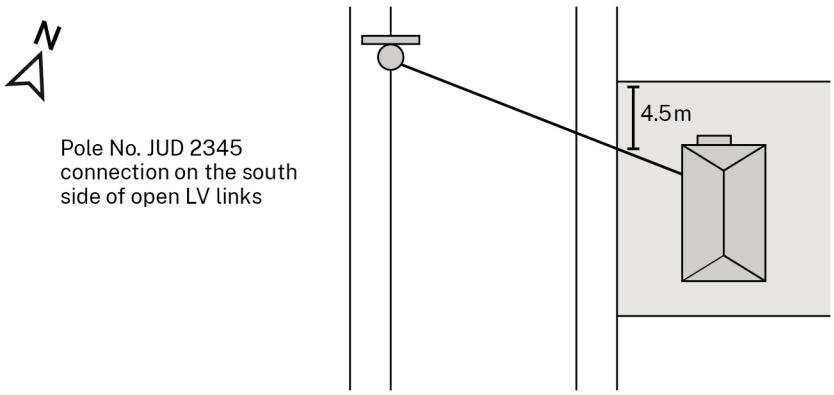
3.2.5 Crossing of swimming pool zones

An overhead service or unprotected aerial consumers mains shall not cross over the top of a swimming pool zone as defined by AS/NZS 3000.

3.2.6 Details of service route

When notifying the electricity distributor of completed works, the ASP shall supply details of the service including a sketch of the route. The NOSW form to be submitted to the electricity distributor provides a means of supplying this information. Refer to Figure 3-1 for a typical sketch and see clause 1.15 for NOSW requirements.

Figure 3-1 Typical sketch of an 'as constructed' overhead service from the distributor's pole to the connection point



Note: the following details shall be included in the sketch:

1 Pole number and if the pole has an LV open point (links), which side of the links the service connection was made

2 Distance between the point where the service crosses the front boundary and the nearest side boundary of the customer's property.

3.3 Aerial consumers mains

3.3.1 Electrically unprotected consumer mains

3.3.1.1 General

Electrically unprotected aerial consumers mains shall comply with the same requirements as the overhead service regarding cable size and compliance with the Australian Standards referred to in clause 3.4.

Where the connection point is nominated on a distribution pole or transformer pole on relevant land, non-authorised persons cannot undertake the installation or connection of consumer mains above 3m from ground level.

3.3.1.2 Other than aerial

Electrically unprotected consumers mains shall have a minimum cross-sectional area of 16mm^2 copper (Cu) or 25mm^2 aluminium (Al), XLPE insulated.

3.3.1.3 Alterations and additions

Alterations or additions to existing consumers mains shall be treated as a new installation as per clause 1.12.9. This need not be applied where additional phase conductors are added to existing electrically unprotected single-phase consumers mains provided the cross-sectional area of the additional conductors is not smaller than the existing conductors.

3.3.1.4 Bushfire precautions

Electrically unprotected aerial consumers mains shall be installed with regard to mitigation of bushfire risks in areas defined as bushfire areas by the NSW Rural Fire Service and the electricity distributor's safety management system and procedures and in accordance with AS/NZS 3000. To ensure bushfire risk management is addressed, ASPs and electrical contractors should obtain electricity distributor requirements before installing overhead consumer's mains in rural areas.

3.3.2 Electrically protected consumers mains

Electrically protected aerial consumers mains shall comply with the requirements of AS/NZS 3000 or *AS/NZS 7000:2016 Overhead line design* 'Detailed procedures'.

3.3.3 Maintenance

The Electricity Supply (Safety and Network Management) Regulation 2014 requires NSW electricity distributors to have a safety management system in place covering the management of bushfire risk relating to electricity lines including electrical installations of customers connected to the network.

Further, in accordance with the *Electricity Supply Act 1995*, in bushfire prone areas, distributors may require customers to rectify defective installations including vegetation management. Where such work is not carried out, distributors may carry out this work at the customer's cost or alternately may disconnect an unsafe installation.

3.4 Cable requirements

3.4.1 Minimum requirements

The minimum requirements for overhead service cable are:

a) Compliance with AS/NZS 3560.1:2000 Electric cables – Cross-linked polyethylene insulated – Aerial bundled – For working voltages up to and including 0.6/1(1.2)kV – Aluminium conductors.

If these requirements are incompatible with the electricity distributor's distribution system design standards, the electricity distributor will specify the conductor size.

Table 3-3 specifies the only service cables that may be used for various service ratings. Any intermediate service ratings (based on the assessed demand of the installation) shall use the next largest service rating/cable available, e.g. a 350A assessed service rating shall use 2 x 95mm^2 Al 4-core cables (i.e. a 400A service).

Table 3-3 Service cable sizes and ratings

Cable CSA (mm^2)	Conductor material	Cable cores	Service rating (A)
25	Al	1 twin or 4 core	100
95	Al	1 x 4 core	200
2 x 95	Al	2 x 4 core	400

Note: before carrying out work at the POA, contact the ASP installing the overhead service to ascertain the cable type and configuration to be used.

3.4.2 Existing overhead service cable ratings

When a customer applies for the connection of additional loads, the existing overhead service shall be replaced where the assessed maximum demand will exceed its current carrying capacity. Overhead services less than $6mm^2$ shall always be replaced. Refer to clause 3.1.6 regarding retention of an existing service.

3.5 Spans, tensions and clearances

3.5.1 Maximum span

The maximum span for an overhead service up to 100A is 50m. For a service greater than 100A the maximum span is 30m. The electricity distributor may consider spans exceeding these distances when requested.

3.5.2 Tensions

The tensions of overhead services are set out in Table 3-8.

Where the requirements set out in this document do not meet the site criteria, a suitable structure and its mounting may be designed. It shall be certified by a structural engineer using the information in Table 3-7 and other publications (e.g. AS/NZS 7000).

3.5.3 Clearances from structures, vegetation and ground

Maintain minimum clearances above ground, and from trees, shrubs and structures, when calculating the height of the supports required for the service. Minimum clearances depend on:

a) whether the ground under the service is likely to be used by vehicular traffic

b) the nature of any nearby structure

c) trees and shrubs. Make adequate allowance for growth and the effect of wind. Minimum clearances are determined in accordance with *ISSC 3: Guideline for Managing Vegetation Near Powerlines* but in no case will be less than1.5 m from bare conductors and 0.5m from insulated conductors.

The required clearances from structures and ground are set out in Table 3-4 and illustrated in Figure 3-2 to Figure 3-4.

Allow for any proposal to change the ground level or build a structure along the route of the overhead service. Overhead services shall not be installed where the required clearances are not obtainable at the time of installation.

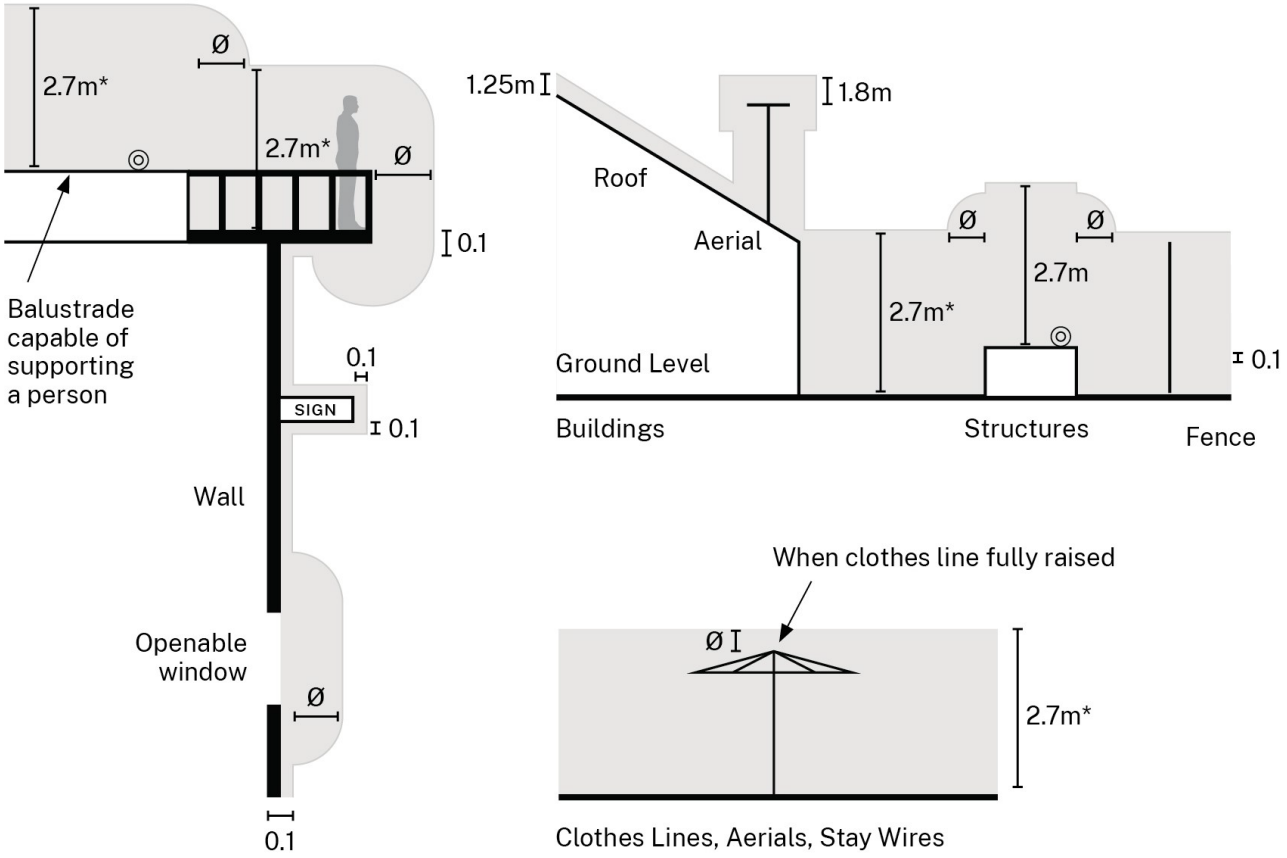
The take-off from the electricity distributor's pole for the overhead service will be in the vicinity of the low-voltage cross arm. The height of the cross arm varies between 6.7 and 8m.

When selecting the POA and route of the overhead service, allow for:

i) the maximum sag when determining the final ground clearance, and

ii) the swing of conductors for clearance to structures.

Figure 3-2 Typical clearance situation – elevation



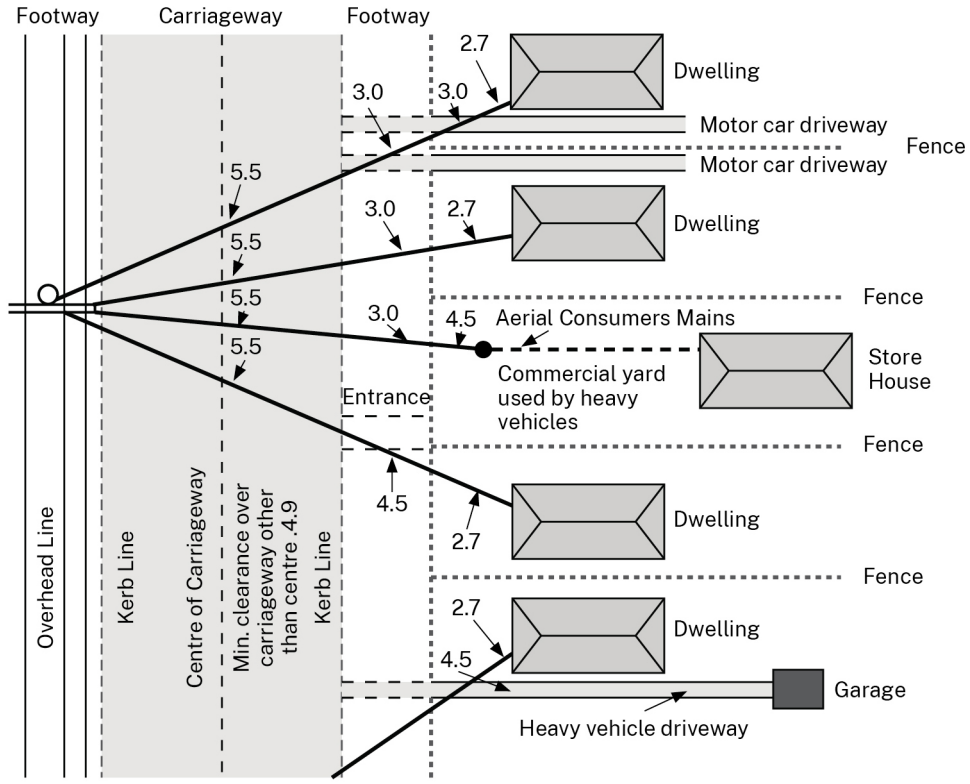
Note: these clearances shall be achieved under all conditions (refer to Note 3 of Table 3-4).

∅ 'Out of normal reach' = 1.25 m (refer to Note 4 of Table 3-4).

* Not used by vehicles

◎ Surface

Figure 3-3 Typical clearance situations – plan



Note: these clearances shall be achieved under all conditions (refer to Note 3 of Table 3-4).

Table 3-4 Minimum clearances to insulated overhead services

From the insulated service conductors to the surface of:		Minimum clearance (m)
1	Any part of a freeway or arterial road	5.5 vertically
2	The centre of a carriageway of a public road	5.5 vertically
3	Any part of a carriageway of a public road (other than the centre)	4.9 vertically
4	Vehicular crossing of a footway in a public road (other than a residential driveway)	4.5 vertically
5	Vehicular crossing of a footway in a public road for a residential driveway and any other part of a footway	3.0 vertically
6	Land which is not associated with a dwelling and which is likely to be used by vehicles, including non-urban small acreages and hobby farms	4.5 vertically
7	Land which is, or is likely to be used by vehicles and is associated with a dwelling	3.0 vertically
8	Land not likely to be used by vehicles	2.7 vertically
9	Those parts of any structure normally accessible to people (see Note 1)	2.7 vertically
10	Any area above a roof	1.25

	From the insulated service conductors to the surface of:	Minimum clearance (m)
11	Any area around a radio or TV aerial	1.8
12	Those parts of any structure not normally accessible to people (see Note 2) (including below a projecting slab, balcony or sign)	0.1 in any direction
13	The edge of any opening window, balcony, verandah, clothesline or fence etc	Out of normal reach (see Note 4)
14	Point of attachment	3.0 vertically not normally accessible without a ladder or other device (see notes 1–4)
15	Farmland where mechanical equipment is used	5.5 vertically
16	Trees and shrubs	0.5 in any direction
17	Vicinity of boat ramps, launching areas (avoid if possible)	10.0 vertically
18	Communications conductors	0.6 in any direction

Notes: interpret the requirements set out in Table 3-4 as follows:

1 **Structure normally accessible to people** includes:

(a) the whole area of any flat roof accessible without the use of a ladder

(b) any part of a hip or gable roof accessible without a ladder up to the nearest hip or gable

(c) any portion of a balustrade or other structure which will support a person and is accessible without a ladder.

2 **Not normally accessible to people** excludes roofs and includes any portion of a fence, balustrade, advertising sign or other structure which will not support a person or is not accessible without a ladder.

3 **The minimum clearances** in Table 3-4 shall be achieved under all conditions regardless of:

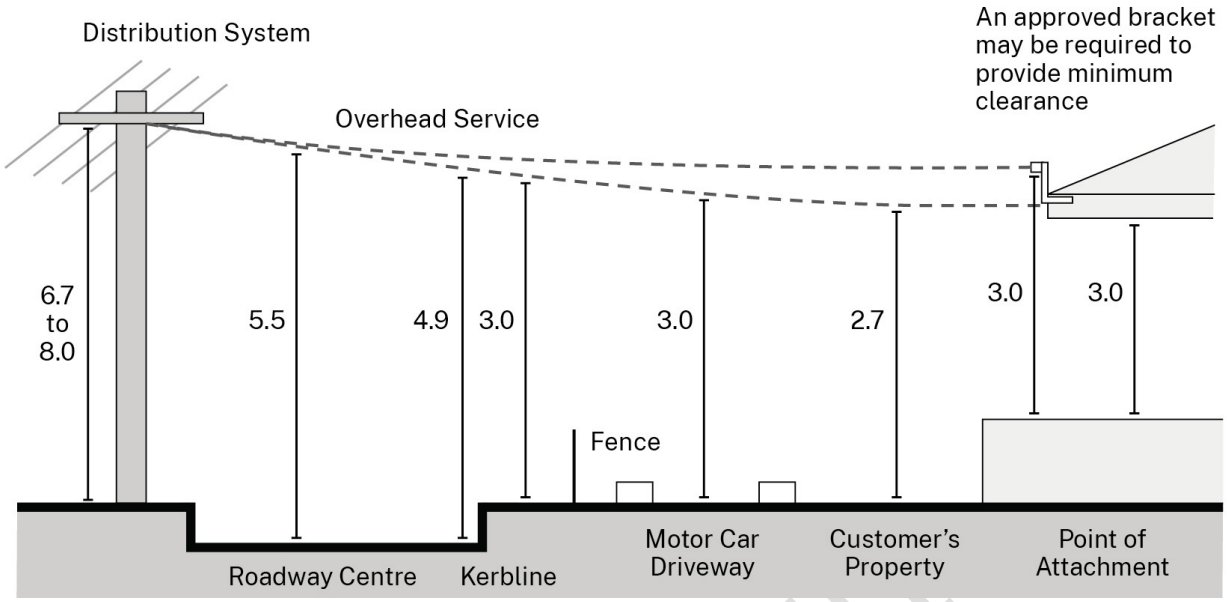
(a) conductor swing due to the influence of wind

(b) conductor sag due to the influence of load current and ambient temperature.

The requirements of Table 3-4 may be achieved if the maximum allowable service line sag for a particular conductor size and span is added to the minimum clearance. Refer to Table 3-8.

4 **Out of normal reach** means 1.25 m from any normally accessible position. The requirement that an overhead service shall be out of normal reach of people may be achieved in some cases by the provision of a permanent insulated barrier (consult with the electricity distributor).

Figure 3-4 Clearances to overhead service – elevation



Note: these clearances shall be achieved under all conditions (refer to Note 3 of Table 3-4).
The point of attachment is to be 3 m minimum above the ground, floor or platform level.

3.5.3.1 Clearances to other utility services

The ASP is responsible for obtaining the required minimum clearance of 600mm between the proposed overhead service and conductive aerial communications cables.

Note: alternative arrangements for non-conductive communications cables may apply.

3.5.3.2 Searches for underground utility services

Electrical contractors shall carry out a search for underground utility services, before excavating for private poles, etc. Adequate clearances shall be obtained between private poles and underground utility services. Check with the appropriate utility to determine any required clearances.

Initial search information can be obtained from Before You Dig Australia.

Utilities may include:

- water
- sewer
- drainage
- gas
- communication cables
- power cables
- railway power, signalling and communication cables (which as well as being located on railway land can be located in public streets, parks, etc).

Before You Dig Australia

Phone 1100 – free call (except from mobiles)
Website www.byda.com.au

Australia's major service providers have made available a single web-enabled information service for information on the location of underground communications, gas, water and electricity infrastructure. Use the website to ensure you 'Before You Dig Australia' before any excavation. If calling, be ready to provide the operator with:

- name and address
- name of company
- contact telephone number
- email for return information
- contact name on site
- site address and both nearest cross streets
- start date of proposed work
- type of work being carried out.

3.6 Access to service and point of attachment

The overhead service and point of attachment (POA) shall be erected with readily available access. The area below the POA should provide a firm, level base with sufficient space to safely erect a standard 4m/7m extension ladder. A space for the ladder 1 m^2 with the centre of the space 1.5 m from the base of the POA is satisfactory.

Unacceptable access to a POA examples are:

a) access using a second ladder, except where the POA is above a shop or commercial building's awning
b) resting a ladder against the balustrade of a balcony to get access to a POA
c) access to the POA by walking upon a building or verandah roofs
d) access through a building; exterior stairs may be used to gain access to a balcony
e) access from adjacent private property.

The POA shall not be accessible without the use of a ladder or other device to assist climbing. If necessary, install a protective guard to prevent unauthorised access. When access is from an awning or balcony, its construction should allow safe working practices to be followed in attaching an overhead service to the building.

3.7 Facilities to be provided by the customer

3.7.1 Point of attachment

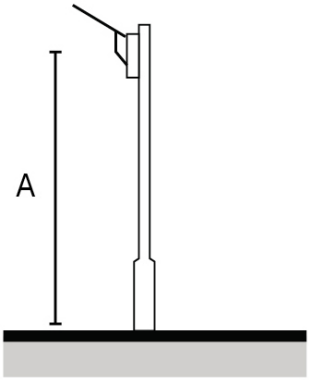
The POA shall be located on the aspect of the building facing the distribution mains, or on a customer pole or other structure accessible to the distribution system.

The POA shall be selected to prevent the crossing of adjoining properties. Refer to clause 3.2.4.

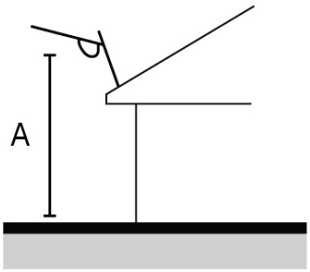
The overhead service support structures shall be able to withstand the tensions listed in Table 3-8.

The minimum height of the POA fixing is 3m; the maximum height on a building or structure is 6.7m above ground. Figure 3-5 illustrates the minimum height at the POA. The unsuitable areas for a POA are shown in Figure 3-6.

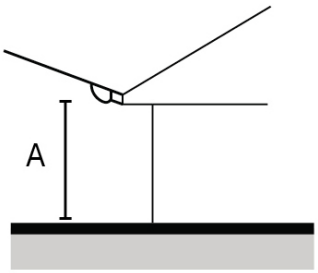
Figure 3-5 Typical points of attachment – elevation



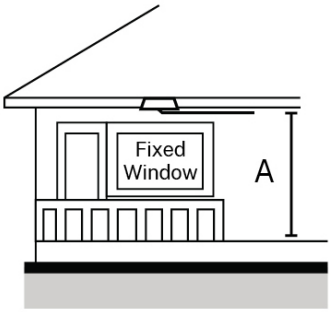
Point of attachment on a Private Pole



Point of attachment on a Riser Bracket



Point of attachment on the Facia

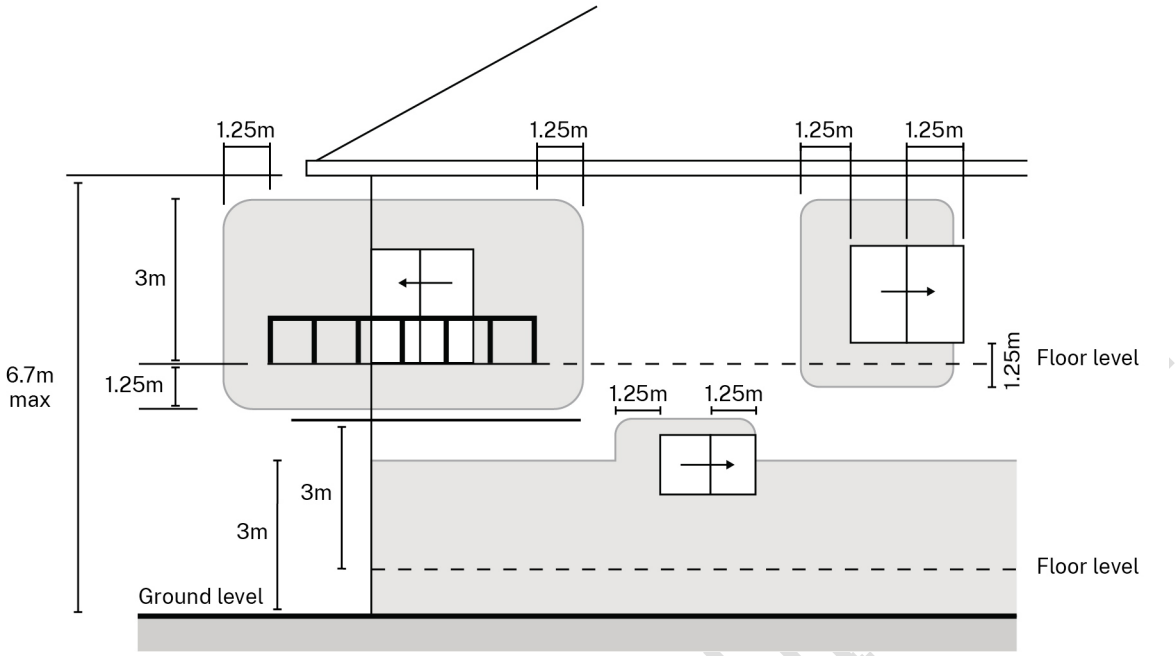


Point of attachment over Patio

A = 2.7m - minimum height to the bottom of the drip loop

Note: The minimum height of the point of attachment is 3 m.

Figure 3-6 Unsuitable points of attachment shown shaded



Note: the point of attachment should not be located in the shaded areas as shown above.

3.7.2 Private post/pole

Where a private post/pole is to be installed, it shall be sized and located to avoid the use of an additional electricity distributor's pole in the street. The circumstances which may require the installation of an additional post/pole are set out as follows.

Note: the overhead service terminates at the connection point. This is the first support on the customer's premise. Refer to Figure 1-1.

3.7.2.1 Private posts/poles

Private posts/poles shall be erected in any of the following circumstances:

a) as an alternative to a road crossing pole, which would otherwise be necessary, to maintain clearance requirements for the overhead service crossing the road

b) the customer wishes to install underground consumers mains within the premises (a sketch of the route of the underground consumers mains shall be provided in accordance with section 2).

c) no suitable POA is available on the building

d) the crossing of adjacent premises shall be avoided and a suspended service (where permitted by the electricity distributor) is not practicable

e) the span would be excessive due to the distance from the electricity distributor's pole to the building. Spans exceeding the distances set out in clause 3.5.1 are regarded as excessive

f) to provide required clearances

g) to provide supply to a battle-axe block.

A private post/pole shall be installed within 1m of the property street alignment which the overhead service passes.

3.7.2.2 Labelling of private post/pole

A customer's pole shall be clearly labelled to indicate 'PRIVATE POLE' to differentiate it from the electricity distributor's and others' utility poles. Lettering shall be a minimum 20mm high.

3.7.2.3 General requirements

Customers may have to obtain approval from the local council before a post/pole is erected on the customer's premises.

Cross arms are not required on customer's posts/poles because the cables are supported using a single bolt per support. Open wire services shall have the bolts separated by 250mm minimum.

If the POA on the customer's post/pole exceeds 6.7m in height, pole steps shall be fitted to the pole. Pole steps shall not be installed within 6m of ground level. They shall have a rise not exceeding 450mm, be located on alternate sides and spaced with 120mm between them.

A post/pole supporting an overhead service and aerial consumers mains shall comply with the requirements of both AS/NZS 3000 and these Rules. It should comply with the most onerous of these requirements.

Posts/poles shall be suitable for supporting the attached load.

If the soil does not provide enough support, e.g. in built-up ground or soft soil, secure posts/poles either by setting them at a greater depth than normally required, or by using bearing blocks or shoes. Refer to Table 3-5 and its notes.

Where, because of unusual circumstances, the butt of the post/pole cannot be sunk to the required depth in the ground, an alternative construction, such as flange mounting on a reinforced concrete structure, may be accepted.

In all such cases, you shall obtain a structural engineer's certification that the mounting has been designed to meet the requirements set out in clause 3.7.6 before construction may proceed.

The required length of the post/pole above ground shall be assessed when selecting post/pole sizes to obtain necessary clearances.

Posts/poles shall be set in the ground, as listed in Table 3-5, considering the soil quality as specified.

Table 3-5 Sinking of posts/poles in ground

Free length to lowest Conductor support (m)	Depth in ground (m)		
	Poor soil	Medium soil	Good soil
3.0	1.6	1.3	1
3.3	1.6	1.3	1
3.6	1.6	1.3	1
3.9	1.6	1.3	1
4.2	1.8	1.5	1.2

Free length to lowest	Depth in ground (m)		
Conductor support (m)	Poor soil	Medium soil	Good soil
4.5	1.8	1.5	1.2
4.8	1.8	1.5	1.2
5.1	1.8	1.5	1.2
5.4	1.8	1.5	1.2
5.7	1.8	1.5	1.2
6.0	1.9	1.6	1.3
6.3	1.9	1.6	1.3
6.6	1.9	1.6	1.3
6.9	1.9	1.6	1.3
7.2	1.9	1.6	1.3

Notes:

1 **Free length** – the free length to the lowest conductor support shown in the table is the distance between the lowest conductor support and ground level.

2 **Soil quality** – soil quality is defined according to AS/NZS 7000:

(a) poor – soft clay, poorly compacted sand and soils that tend to absorb large amounts of water (150kPa/m)

(b) medium – compact medium clay, well-bonded sandy loam, bonded sand and gravel with reasonable surface water drainage (300kPa/m)

(c) good – well-compacted rock soil, hard clay and well-bonded sand and gravel with good surface water drainage (600kPa/m).

3 **Posts/poles set in concrete** – where a post/pole is set in concrete:

(a) It shall be located centrally in a bore hole sized in accordance with Table 3-6.

(b) The concrete should be finished:

(i) for Ausgrid and Essential Energy

- not less than 250 mm below ground level for a wooden post/pole
- at 100 mm above ground level for a steel post/pole in a manner using a water shed

(ii) for Endeavour Energy

- not less than 300 mm below ground for all types of post/pole.

(c) It is equivalent to improving the soil quality by one step, i.e. from poor to medium or from medium to good. This corresponds to a reduction in the required pole sinking depth.

(d) It should be left undisturbed for 3 days, or long enough to ensure the concrete has developed adequate strength before attaching the overhead service.

4 **Posts/poles set in solid rock** – where a post/pole is set in solid rock, the depth in ground may be reduced by 0.3m.

Table 3-6 Minimum size bore holes for posts/poles

Post/pole size	Post/pole material	Minimum bore hole diameter
All sizes	Timber or steel	Post/pole diameter plus 100mm

3.7.2.4 Timber posts/poles

Timber posts and poles shall be of hardwood or other suitable timber as specified by *AS 3818.11: 2009 Timber – Heavy structural products – Visually graded, Part 11: Utility poles*.

a) Table 3-9 to Table 3-11 set out the minimum sizes of timber posts or poles of untreated hardwood timber with durability of Class 1 and 2 and strength rating of S3 or better.
b) AS/NZS 3000 sets out the minimum sizes for preservative-treated hardwood or softwood timbers with durability Class 4 or better and a strength grade S6 or better.

The base of timber posts/poles and surrounding ground shall be treated against insect and fungal attack by environmentally approved methods.

Timber posts/poles shall be capped at the top to prevent water penetration.

The distance between the top anchor bolt and the top of the post/pole shall not be less than 200mm.

3.7.2.5 Steel-pipe posts/poles

The required sizes/grades of steel-pipe posts/poles are set out in Table 3-15 to Table 3-18.

Steel-pipe posts/poles shall be capped at the top to prevent water entry.

3.7.2.6 Other posts/poles

Posts/poles may be made from other suitable materials (e.g. reinforced concrete) provided adequate certification of strength and durability is provided for approval by the distributor.

3.7.3 Attachments to buildings or structures

3.7.3.1 Responsibility for design

It is the customer's responsibility to ensure the support is designed and installed in accordance with sound engineering practice. It shall be suitable for the direction of pull of the proposed or existing overhead service.

The distributor does not accept responsibility for damage to the customer's premises resulting from normal tension in the overhead service or causes beyond the distributor's control. If necessary, the services of a structural engineer should be sought where doubt exists as to the strength of an attachment. AS/NZS 7000 gives guidelines for the design of structures for the support of overhead services.

3.7.3.2 Alternative to attaching to a building

If a customer wishes to avoid attaching the overhead service to a building, this can generally be done by erecting a post/pole and installing underground consumers mains.

3.7.3.3 Horizontal and vertical struts

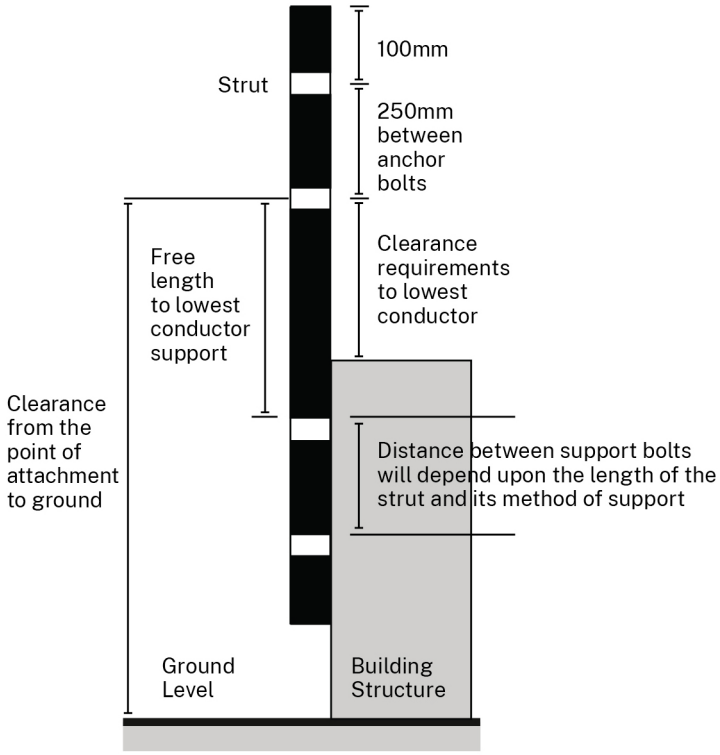
A strut is a straight length of support. Once it is bent, off-set or braced, it is then classed as a bracket.

The sizes of horizontal and vertical struts are set out in Table 3-10, Table 3-12, Table 3-13 and Table 3-15 to Table 3-18. Timber or hollow steel struts shall be capped at the top to prevent water penetration.

Note: the free length to the lowest conductor support shown in the tables is the distance between the lowest conductor support and the closest fixing bolt on a structure (see Figure 3-7).

Two fixing bolts shall be used at a minimum distance of 600mm apart to fix the strut to a structure.

Figure 3-7 Typical strut mounting



3.7.3.4 Service brackets

For a 100A overhead service you may use an approved service bracket to obtain the required clearances, outlined in Table 3-4.

Service brackets shall be fabricated from minimum grade 250 steel. Any joints shall be welded. They shall bear a manufacturer's label indicating they meet the requirements of this clause. Refer to Table 3-7.

Choosing a bracket: Refer to Figure 3-8 for description and Table 3-7 for strength.

An explanation of Table 3-7 follows:

Bracket rise: The numbers 2 to 6 indicate the free length or rise in 150mm steps to 900mm. The rise of the bracket is the dimension from the centre line of the mounting bolts to the centre line of the lowest anchor bolt(s) for the overhead service.

Number of anchor bolts and hooks: The last number in the bracket description indicates the number of 12mm anchor bolts provided for on the bracket to secure the overhead service. The customer provides the bolts. The bolts may be replaced with hooks, as illustrated in Figure 3-9, welded or bolted to the bracket.

Strength rating: The symbols A, B and D are used to indicate strength. The design strengths for A, B and D brackets are 0.59, 1.18 and 2.1 kilonewtons (kN) respectively. The design strengths provide for a factor of safety to meet the specifications in clause 3.7.6.

Example: A bracket having a classification 2B2 would have a free length of 300mm above its mounting point and provision for 2 bolts to anchor insulators. It would be suitable for a loading of up to 1.18kN. A 2D2 bracket would be similar in characteristics to the 2B2 but suitable for a loading of up to 2.1kN. It would therefore be an acceptable alternative where a 2B2 bracket is specified. Similarly, a bracket having a higher rise than that specified is satisfactory.

Table 3-7 Bracket description

Bracket rise	Strength rating	No. of anchor bolts and hooks
2	A	1 or 2

Bracket rises	mm
2	300
3	450
4	600
5	750
6	900

Bracket strength rating kN	
A	0.59
B	1.18
D	2.1

Bracket use:

1 If a bracket's strength rating or rise is unavailable, use the next size up e.g. need a 2A1 bracket – use 2B1 or 3A1.

2 If allowing for future 3-phase, a higher strength is required with an additional anchor bolt, e.g. a 1-phase 10m span needs a 2A1; a 2 or 3-phase 10m span needs 2B2 therefore 2B2 needs to be installed initially. Refer to Table 3-8 for minimum bracket strength rating.

3 One hook or bolt on each bracket is required for each overhead service.

3.7.4 Protection against corrosion

Where steel is used for posts, brackets, struts, hooks, hardware or fittings associated with an overhead service it shall be galvanised to meet the specifications in AS/NZS 4534, 4680 and 4792.

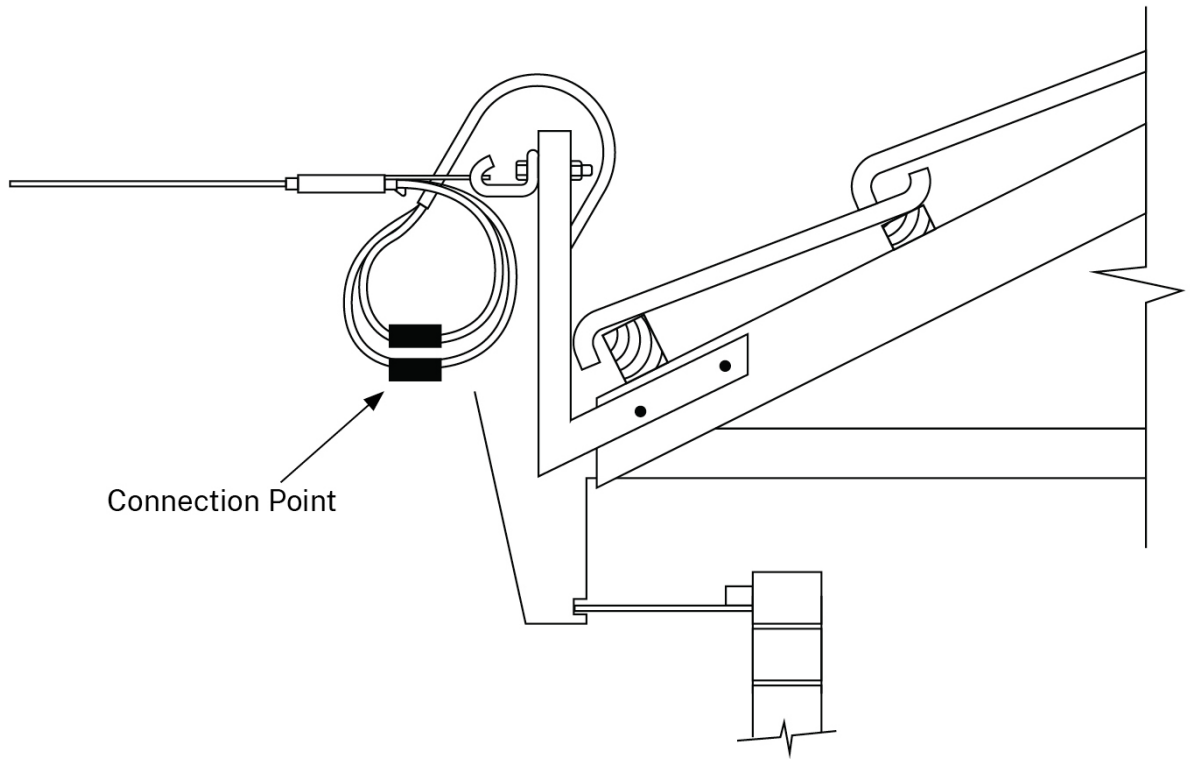
The hot-dip process shall be used. Small areas where the zinc coating has been removed shall be replaced with a durable zinc-rich coating.

The distributor may approve alternative corrosion protection methods if suitable for the location.

3.7.5 Earthing metallic supports

Refer to AS/NZS 3000 for the earthing requirements of metallic supports for aerial service conductors (poles, service brackets, struts, hooks, fittings and attachments, etc).

Figure 3-8 Service bracket installation example



3.7.6 Strength requirements of attachments and supports

Overhead services are installed with an initial tension which will subsequently vary within normal limits.

The customer shall secure anchor bolts, struts or service brackets in such a way that the load (refer to Table 3-8) is safely transmitted to a structurally adequate portion of the building.

The customer shall ensure the building or structure, and the means of fixing the anchor bolts or bracket to it, are at least sufficiently strong to take the normal tension of the overhead service, as indicated in Table 3-8.

3.7.6.1 Fixing of attachments and supports on buildings

Fix brackets to a structurally adequate part of the building using galvanised steel bolts at each fixing hole provided in the bracket. The bolt shall be 12mm diameter except where brackets are fixed to a rafter, in which case 10mm diameter is satisfactory. Nailing of nogging between rafters, and attachment of the bracket to the nogging is not acceptable. Figure 3-8 shows a typical service bracket installation.

Do not attach a strut or service bracket to a brick or masonry wall unless the load on the mounting bolts is transferred to a structural member (unless otherwise approved by a structural engineer).

3.7.6.2 Number and size of anchor bolts

The customer's electrical contractor shall install the required number of galvanised steel anchor bolts or hooks to provide a secure POA for the overhead service. The following service line and anchor bolt arrangements are typical:

- **100A service (single-phase) –** one 2 core Aerial Bundled Cable and one 12mm diameter anchor bolt
- **100A service (2 or 3-phase) –** one 4 core Aerial Bundled Cable and one 12mm diameter anchor bolt.

Note: the 12mm anchor bolt may be replaced with a formed hook bolt or a hook welded to a metal structure. See clause 3.7.6.3 and Figure 3-9 for details of 100A service hooks.

- **200A service** – one 4 core Aerial Bundled Cable and one 16mm diameter minimum anchor bolt
- **300/400A service** – two 4 core Aerial Bundled Cable and two 16mm diameter minimum anchor bolts.

If the head of a bolt is not readily accessible, it shall be securely fixed to prevent rotation. Bolts shall have at least 25mm of thread projecting and be complete with finger-tight galvanised steel nuts.

Where more than one anchor bolt or hook is used, they shall be spaced 250mm minimum, 400mm maximum vertically or horizontally.

3.7.6.3 Service hook

The hook shall be minimum 12mm diameter, grade 250 steel rod. It shall be formed into shape using a die without sharp edges and without using heat treatment.

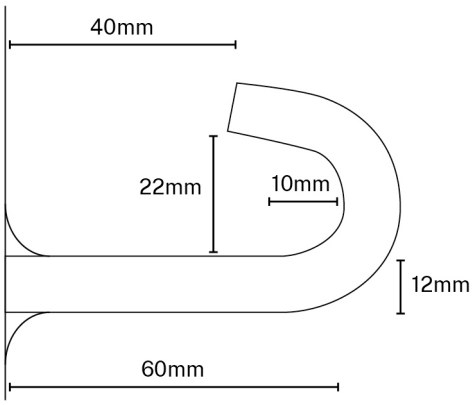
The hook may be:

a) welded to the metal structure so the bond strength is not less than that of the rod

b) bolted to the structure using 12mm diameter bolts

c) threaded like a coach screw hook and screwed to an adequate structural member.

Figure 3-9 100-A service hook



3.7.6.4 Fixing anchor bolts to concrete and brick walls

Anchor bolts may be fixed to:

a) a reinforced concrete wall (at least 300mm from any opening)

b) a reinforced concrete slab provided the point of fixing is in the centre of the slab and at least 300mm from a corner

c) brick walls provided the load on the bolts is transferred off the wall to another structurally adequate portion of the building (unless otherwise approved by a structural engineer).

Note:

1 Wall plugs shall not be used.

2 Expansion fittings shall not be used in brick walls.

3 Chemically set bolts may be used provided the manufacturer's instructions are followed.

3.7.6.5 Stays

Struts and service brackets shall rely on their fixing bolts for support. Secondary supports by way of a stay or brace are not permitted.

3.7.6.6 Abnormal loading

In the event of a vehicle colliding with a pole in the street or a tree falling across the overhead service, the load imposed on the building may be as high as the total breaking strain of the conductors. This load is given in Table 3-8. The customer can either strengthen the structure to provide for this or accept the risk of an accident occurring.

3.8 Builders service

An overhead service may be installed for the purposes of building construction. A suitable service equipment enclosure mounted on either a removable pole/post or on a post made up of 2 sections of timber bolted together (split post) is acceptable. Refer to clause 3.8.1 for details.

Post/pole sizes shall comply with either Table 3-9, Table 3-11 and Table 3-14 to Table 3-18, shall be in good condition, and inspected before each use by the electrical contractor.

Refer to Figure 3-10 for typical installation details.

Refer to clause 3.7.2 for more detailed service post/pole requirements if relevant.

3.8.1 Split posts

A split post may be used for a builder's service installation supplied by a 100A overhead service, provided it is:

a) fixed together with 2 x 16mm diameter bolts and washers, 600mm apart, with a minimum of 150mm to the timber ends.

b) of a minimum 150mm x 150mm CSA; the top of the ground portion is to be capped or chamfered

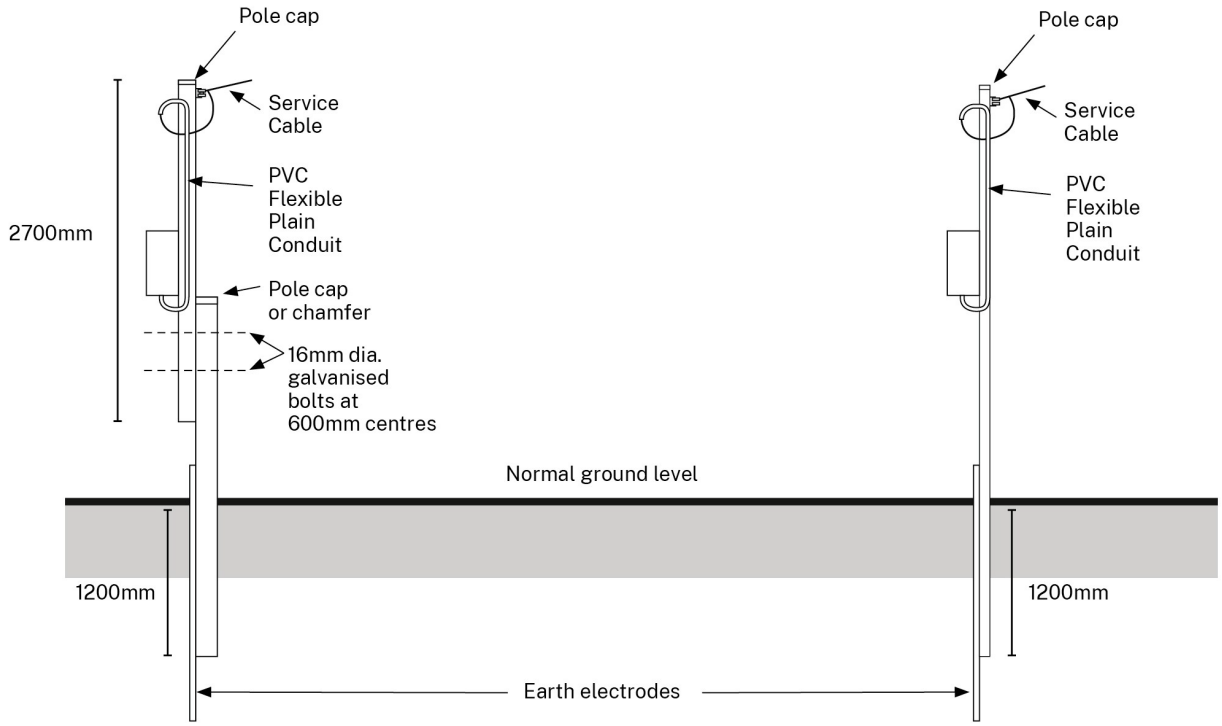
c) erected so the lengths of the bolts are in line with the proposed direction of the service line and the base section sunk to the depth required for permanent posts.

Refer to Figure 3-10 for typical installation.

3.8.2 Consumers mains

The unprotected consumers mains associated with an overhead service on a builder's service post/pole, may have a minimum size of 6mm^2 Cu thermoplastic insulated and sheathed cable (maximum demand permitting) when installed in PVC flexible plain conduit to AS/NZS 2053.4.

Figure 3-10 Typical builder's service



Notes:

1. Pole should be positioned to ensure adequate overhead service line clearances.
2. These installations are acceptable for underground distribution systems.
3. The electrical installation must comply with AS/NZS 3000.
4. Unprotected consumers mains associated with an overhead service line on a builder's service pole, may have a minimum size of 6mm2 copper (maximum demand permitting) when installed in PVC flexible plain conduit to AS/NZS 2053 Part 4.

3.9 Underground supply from overhead distribution system (UGOH)

Refer to section 2 'Underground services'.

3.10 Minimum sizes of posts, poles and struts for overhead services

The following tables specify the required sizes of conductor support structures. The tables cover the standard overhead service conductors used in NSW. The conductor support structures covered are:

a) timber posts and poles

b) square timber struts

c) angle iron struts

d) steel poles

e) steel square section

f) fabricated steel pole.

Table 3-8 gives the forces exerted by service lines. This is a function of:

g) the type of conductor being used

h) the span length

i) the design sag.

These factors combine to give the **normal tension of an overhead service in kN**. The last column of Table 3-8 indicates the minimum pole or strut strength required (S rating).

Using this strength rating, refer to the following Table 3-8 to select the appropriately sized post, pole or strut. Make sure the S rating selected from Table 3-9 to Table 3-18 is equal or greater than the required S rating derived from Table 3-8.

Notes:

1 The free length to lowest conductor support shown in the tables is the distance between the lowest conductor support and:

   i) the ground for a pole or post

   ii) the closest fixing bolt on a structure for a strut.

2 Galvanised steel-pipe posts with outside diameters up to and including 165mm are Grade 250 steel water pipe commercially available in 6.5m lengths. Posts specified with diameters of 168 mm or greater are of Grade 350 structural steel circular hollow sections and may need to be specially ordered. The electricity distributor shall assume that steel-pipe posts, installed by electrical contractors, are Grade 250, unless the electrical contractor can substantiate otherwise.

3 Service spans above 30m for 1 x 95mm^2 or 2 x 95mm^2 (4-core LV aerial bundled cable [ABC]) shall be approved only for connection to street mains, following an investigation by the electricity distributor. The tension of these overhead services may damage the distribution system construction.

4 Any post/pole supporting an overhead service and aerial consumer mains shall comply with the requirements of both AS/NZS 3000 and these Rules. It should comply with the most onerous of these requirements.

EXAMPLE 1

Problem

Erect a 19m length of 100A 3-phase service (using 1 x 25mm^2 Al 4-core LV ABC).

What:

(a) sag required for the span

(b) height of conductor support to give clearances to ground or other structures

(c) size structure is required.

Solution

From Table 3-8

Pick:

j) 100A 3-phase from size of service column

k) 1 x 25mm^2 Al from conductor size column

l) 20m from span column.

Table 3-8 gives:

m) normal tension of service line = 0.77kN

n) maximum sag = 0.6m.

o) minimum bracket strength rating = B1

p) minimum pole or strut strength rating = S11.

Table 3-4 gives:

q) inspecting the route of the service line shows that 3m is required

r) adding 0.6m sag to 3m gives a free length to lowest conductor support = 3.6m.

If the structure is a square hardwood post:

s) refer to Table 3-9

t) for a free length to lowest conductor support of 3.6m

u) select an S rating of S11 or higher

v) minimum size is a 125mm x 125mm post.

If the structure is a square hardwood strut (Figure 3-7):

w) refer to Table 3-10

x) for a free length to lowest conductor support of say 1.4m to obtain clearances

y) select an S rating of S11 or higher

z) minimum size is 100mm x 100mm strut.

If the structure is an angle iron strut Grade 250:

aa) refer to Table 3-12

bb) for a free length to lowest conductor support of 0.2m

cc) select an S rating of S11 or higher

dd) minimum size is 40mm x 40mm, thickness = 6mm.

Other conductor support structures are handled using the same method.

Table 3-8 Force exerted by overhead service lines

Size of service	Service line conductor size (mm^2)	Weight of conductor (kg/m)	Service line span (m)	Normal service line sag (m)	Maximum allowable service line sag (m)	Normal service line tension (kN)	Minimum service line breaking tension (kN)	Minimum bracket strength (S rating)	Minimum pole or strut strength (Rating)
			10	0.09	0.2	0.49		A1	S4
	1 x 16		15	0.17	0.4	0.58		A1	S7
100 A	Cu	0.35	20	0.26	0.6	0.67	12.4	B1	S9
1-phase	Twisted		30	0.43	1.0	0.92		B1	S13
	Twin		40	0.57	1.3	1.23		D1	S17
	XLPE#		50	0.73	2.0	1.50		D1	S20
			10	0.09	0.2	0.28		A1	S1
	1 x 25		15	0.17	0.4	0.33		A1	S2
	Al	0.2	20	0.26	0.6	0.38	7	A1	S3
	Twisted		30	0.43	1.0	0.52		A1	S5
	Twin		40	0.57	1.3	0.70		B1	S10
	XLPE		50	0.73	2.0	0.86		B1	S12
			10	0.09	0.2	0.97		B2	S14
100 A	2 x 16		15	0.17	0.4	1.16		B2	S16
3-phase	Cu	0.7	20	0.26	0.6	1.35	24.8	D2	S18
	Twisted		30	0.43	1.0	1.83		D2	S22

Size of service	Service line conductor size (mm^2)	Weight of conductor (kg/m)	Service line span (m)	Normal service line sag (m)	Maximum allowable service line sag (m)	Normal service line tension (kN)	Minimum service line breaking tension (kN)	Minimum bracket strength (S rating)	Minimum pole or strut strength (Rating)
	Twin		40	0.57	1.3	2.46			S25
	XLPE		50	0.73	2.0	3.00			S28
			10	0.09	0.2	0.56		A1	S6
	1 x 25		15	0.17	0.4	0.66		B1	S8
	Al	0.4	20	0.26	0.6	0.77	14	B1	S11
	4-core		30	0.43	1.0	1.05		B1	S15
	LVABC		40	0.57	1.3	1.40		D1	S19
			50	0.73	2.0	1.71		D1	S21
			10	0.09	0.2	1.88		D1	S23
200 A	1 x 95		15	0.17	0.4	2.23			S24
3-phase	Al	1.35	20	0.26	0.6	2.57	53.2		S26
	4-core		30	0.59	1.0	2.57			S26
	LV ABC		40	1.05	1.3	2.57			S26
			50	1.64	2.0	2.57			S26
			10	0.09	0.2	3.75			S29
300/400 A	2 x 95		15	0.17	0.4	4.47			S30
3-phase	Al	2.7	20	0.26	0.6	5.14	106.4		S31
	4-core		30	0.59	1.0	5.14			S31

Size of service	Service line conductor size (mm^2)	Weight of conductor (kg/m)	Service line span (m)	Normal service line sag (m)	Maximum allowable service line sag (m)	Normal service line tension (kN)	Minimum service line breaking tension (kN)	Minimum bracket strength (S rating)	Minimum pole or strut strength (Rating)
	LV ABC		40	1.05	1.3	5.14			S31
			50	1.64	2.0	5.14			S31

Note: maximum allowable service line sag (m) shall be allowed for when determining adequate clearances (refer to Note 3 of Table 3-4).

Data provided for reference and for alterations where the service doesn't need to be extended. Refer to clause 3.1.5 and Table 3-1.

Table 3-9 Square hardwood post (100 MPa] timber to AS 3818.11-2009) strength ratings

Free length to lowest conductor support (m)	Direct in ground	Concrete in ground	Direct in ground	Concrete in ground	Direct in ground	Concrete in ground	Direct in ground	Concrete in ground	Direct in ground	Concrete in ground
	100 mm x 100 mm	100 mm x 100 mm	125 mm x 125 mm	125 mm x 125 mm	150 mm x 150 mm	150 mm x 150 mm	175 mm x 175 mm	175 mm x 175 mm	200 mm x 200 mm	200 mm x 200 mm
3.0	S7	S7	S17	S17	S20	S24	S21	S29	S23	S29
3.3	S4	S4	S15	S15	S19	S23	S20	S28	S22	S29
3.6	S3	S3	S14	S14	S17	S22	S19	S26	S20	S28
3.9			S12	S12	S15	S20	S17	S26	S20	S28
4.2			S10	S10	S19	S19	S22	S25	S23	S29
4.5			S8	S8	S18	S18	S20	S24	S23	S28
4.8			S7	S7	S16	S16	S20	S23	S21	S28
5.1			S4	S4	S15	S15	S19	S23	S20	S28

Free length to lowest conductor support (m)	Direct in ground 100 mm x 100 mm	Concrete in ground 100 mm x 100 mm	Direct in ground 125 mm x 125 mm	Concrete in ground 125 mm x 125 mm	Direct in ground 150 mm x 150 mm	Concrete in ground 150 mm x 150 mm	Direct in ground 175 mm x 175 mm	Concrete in ground 175 mm x 175 mm	Direct in ground 200 mm x 200 mm	Concrete in ground 200 mm x 200 mm
5.4			S3	S3	S13	S13	S17	S21	S20	S26
5.7			S3	S3	S12	S12	S20	S20	S20	S26
6.0					S11	S11	S18	S19	S20	S24
6.3					S10	S10	S17	S17	S19	S23
6.6					S7	S7	S16	S16	S17	S23
6.9					S5	S5	S15	S15	S17	S22
7.2					S3	S3	S14	S14	S15	S20

Table 3-10 Square hardwood struts (100 MPa timber to AS 2209) strength ratings

Free length to lowest conductor support (m)	100 mm x 100 mm	125 mm x 125 mm	150 mm x 150 mm	175 mm x 175 mm	200 mm x 200 mm
0.3					
0.6	S29				
0.9	S27	S32			
1.2	S23	S29	S32		
1.5	S20	S28	S32		
1.8	S17	S25	S29		
2.1	S14	S23	S29	S32	
2.4	S12	S21	S28	S32	
2.7	S10	S20	S27	S30	
3	S7	S18	S25	S29	S32

Table 3-11 Round hardwood pole (100 MPa timber to AS 2209) strength ratings

Free length to lowest conductor support (m)	Height reduced from base 8m/2kN	Height reduced from base 8m/4kN	Height reduced from base 8m/6kN	Height reduced from base 9.5m/2kN	Height reduced from base 9.5m/4kN	Height reduced from base 9.5m/6kN
3.0	S23	S29	S32	S23	S29	S32
3.3	S23	S29	S32	S23	S29	S32
3.6	S23	S29	S32	S23	S29	S32
3.9	S23	S29	S32	S23	S29	S32
4.2	S23	S29	S32	S23	S29	S32
4.5	S23	S29	S32	S23	S29	S32
4.8	S23	S29	S32	S23	S29	S32
5.1	S23	S29	S32	S23	S29	S32
5.4	S23	S29	S32	S23	S29	S32
5.7	S23	S29	S32	S23	S29	S32
6.0	S23	S29	S32	S23	S29	S32
6.3	S23	S29	S32	S23	S29	S32
6.6		S29	S32	S23	S29	S32
6.9		S29	S32	S23	S29	S32

Free length to lowest conductor support (m)	Height reduced from base 8m/2kN	Height reduced from base 8m/4kN	Height reduced from base 8m/6kN	Height reduced from base 9.5m/2kN	Height reduced from base 9.5m/4kN	Height reduced from base 9.5m/6kN
7.2		S29	S32	S23	S29	S32

Free length to lowest conductor support (m)	Height reduced from top 8m/2kN	Height reduced from top 8m/4kN	Height reduced from top 8m/6kN	Height reduced from top 9.5m/2kN	Height reduced from top 9.5m/4kN	Height reduced from top 9.5m/6kN
3.0	S29			S32		
3.3	S29			S30		
3.6	S28			S29		
3.9	S28	S32		S29		
4.2	S28	S32		S29		
4.5	S27	S32		S28		
4.8	S27	S32		S28	S32	
5.1	S25	S30		S28	S32	
5.4	S24	S30	S32	S27	S32	
5.7	S23	S29	S32	S27	S32	
6.0	S23	S29	S32	S27	S32	
6.3	S23	S29	S32	S25	S30	
6.6				S24	S30	
6.9				S24	S30	S32
7.2				S23	S29	S32

Notes:

1. **Height reduced from top:** A standard pole is reduced in length by cutting off a section from the top of the pole.
2. **Height reduced from base:** A standard pole is reduced in length by cutting off a section from the bottom of the pole.
3. The table shows reducing the height from the:
   - top increases the kN rating of the pole
   - bottom results in an unchanged kN rating of the pole.

Table 3-12 Angle iron struts Grade 250 (cross-section dimensions x thickness [mm]) strength ratings

Free length to lowest conductor support (m)	25 x 25 x 6	30 x 30 x 5	30 x 30 x 6	40 x 40 x 3	40 x 40 x 5	40 x 40 x 6	45 x 45 x 3	45 x 45 x 5	45 x 45 x 6
0.3	S1	S2	S3	S3	S10	S12	S7	S13	S16
0.6					S2	S3	S1	S3	S6
0.9								S1	S2
1.2									
1.5									
1.8									
2.1									
2.4									
2.7									
3									

Free length to lowest conductor support (m)	50 x 50 x 3	50 x 50 x 5	50 x 50 x 6	50x 50 x 8	55 x 55 x 5	55 x 55 x 6	65 x 65 x 5	65 x 65 x 6	65 x 65 x 8	65 x 65 x 10
0.3	S10	S16	S20	S21	S19	S24	S23	S27	S28	S29
0.6	S2	S7	S10	S12	S10	S16	S14	S17	S20	S23
0.9		S2	S3	S6	S3	S10	S7	S11	S15	S17
1.2			S2	S3	S1	S5	S3	S7	S11	S12
1.5				S1		S3	S2	S3	S7	S9
1.8						S1		S2	S3	S5
2.1								S1	S3	S3
2.4									S1	S2
2.7										S1
3										

Free length to lowest conductor support (m)	75 x 75 x 5	75 x 75 x 6	75 x 75 x 8	75 x 75 x 10	90 x 90 x 6	90 x 90 x 8	90 x 90 x 10	100 x 100 x 6	100 x 100 x 8	100 x 100 x 10	100 x 100 x 12
0.3	S26	S28	S30	S32	S30	S32		S32			
0.6	S17	S21	S24	S27	S24	S28	S29	S27	S29	S30	S32
0.9	S11	S15	S19	S21	S20	S23	S27	S23	S27	S28	S29
1.2	S7	S11	S15	S17	S16	S20	S23	S19	S23	S24	S27
1.5	S3	S7	S11	S14	S12	S16	S20	S15	S20	S23	S24
1.8	S2	S4	S8	S11	S10	S14	S16	S12	S17	S20	S23
2.1		S3	S5	S7	S7	S11	S14	S10	S14	S17	S20
2.4		S1	S3	S5	S3	S9	S11	S7	S11	S15	S17
2.7			S2	S3	S3	S6	S10	S3	S10	S13	S16
3			S1	S2	S1	S3	S7	S3	S7	S11	S14

Table 3-13 Angle iron struts Grade 300 strength ratings (cross-section dimensions x thickness [mm])

Free length to lowest conductor support (m)	125 x 125 x 8	125 x 125 x 10	125 x 125 x 12	125 x 125 x 16	150 x 150 x 10	150 x 150 x 12	150 x 150 x 16	150 x 150 x 19	200 x 200 x 13
0.3									
0.6									
0.9	S30	S32							
1.2	S28	S30	S32		S32				
1.5	S27	S28	S30	S32	S32	S32			
1.8	S24	S28	S28	S30	S29	S32			
2.1	S23	S27	S28	S29	S28	S30	S32	S32	
2.4	S21	S24	S27	S28	S28	S29	S32	S32	
2.7	S20	S23	S25	S28	S27	S28	S30	S30	S32
3	S19	S21	S23	S27	S25	S28	S29	S30	S32

Table 3-14 Fabricated Riverton octagonal steel pole strength ratings

Free length to lowest conductor support (m)	Octagonal pole
3.0	

Free length to lowest conductor support (m)	Octagonal pole
3.3	
3.6	
3.9	
4.2	
4.5	
4.8	S16
5.1	S16
5.4	

Note: these poles should not be modified.

Table 3-15 Grade 250 steel pipe (diameter x thickness [mm]) strength ratings

Free length to lowest conductor support (m)	34 x 3.2	34 x 4	34 x 4.5	42 x 3.2	42 x 4	42 x 4.9	48 x 3.2	48 x 4	48 x 5.4	60 x 3.6	60 x 4.5	60 x 5.4	76 x 3.6
0.3	S15	S17	S19	S22	S23	S26	S24	S27	S28	S29	S32	S32	
0.6	S5	S7	S10	S12	S15	S17	S16	S19	S22	S23	S27	S28	S28
0.9	S2	S3	S3	S7	S10	S11	S11	S13	S17	S19	S21	S23	S24
1.2		S1	S2	S3	S5	S7	S7	S10	S12	S15	S17	S20	S21
1.5				S2	S3	S4	S3	S6	S10	S11	S14	S16	S18
1.8					S1	S2	S2	S3	S7	S9	S11	S14	S15
2.1							S1	S2	S3	S6	S10	S11	S13
2.4									S2	S3	S7	S10	S11
2.7										S3	S4	S6	S10
3										S2	S3	S3	S7
3.3											S2	S2	S5
3.6												S1	S3
3.9													S3
4.2													S2

Free length to lowest conductor support (m)	34 x 3.2	34 x 4	34 x 4.5	42 x 3.2	42 x 4	42 x 4.9	48 x 3.2	48 x 4	48 x 5.4	60 x 3.6	60 x 4.5	60 x 5.4	76 x 3.6
4.5													S1

Free length to lowest conductor support (m)	76 x 4.5	76 x 5.9	89 x 4	89 x 5	89 x 5.9	102 x 4	102 x 5	114 x 4.5	114 x 5.4	140 x 5	140 x 5.4	165 x 5	165 x 5.4
0.6	S29	S32	S32			S32							
0.9	S27	S28	S28	S30	S30	S29	S32	S32					
1.2	S23	S27	S27	S28	S29	S28	S29	S30	S32				
1.5	S20	S23	S23	S27	S28	S26	S28	S29	S30	S32			
1.8	S18	S21	S21	S24	S25	S23	S27	S28	S29	S32	S32		
2.1	S16	S20	S19	S23	S23	S21	S24	S27	S28	S30	S30	S32	
2.4	S14	S17	S17	S20	S21	S20	S23	S24	S27	S29	S29	S32	S32
2.7	S12	S15	S15	S19	S20	S18	S22	S23	S25	S28	S29	S31	S32
3	S11	S14	S14	S17	S19	S16	S20	S23	S24	S28	S28	S30	S30
3.3	S9	S12	S12	S16	S17	S15	S19	S20	S23	S27	S28	S29	S30

Free length to lowest conductor support (m)	76 x 4.5	76 x 5.9	89 x 4	89 x 5	89 x 5.9	102 x 4	102 x 5	114 x 4.5	114 x 5.4	140 x 5	140 x 5.4	165 x 5	165 x 5.4
3.6	S7	S10	S11	S14	S15	S13	S17	S20	S22	S27	S27	S29	S29
3.9	S4	S7	S10	S12	S14	S12	S16	S18	S20	S24	S27	S28	S28
4.2	S3	S5	S7	S11	S12	S11	S15	S17	S20	S23	S24	S28	S28
4.5	S2	S3	S5	S9	S11	S10	S14	S16	S19	S23	S23	S27	S28
4.8	S2	S3	S4	S7	S9	S7	S12	S15	S17	S22	S23	S27	S27
5.1	S1	S2	S3	S5	S7	S7	S11	S14	S16	S21	S22	S25	S27
5.4		S1	S3	S3	S5	S5	S10	S12	S15	S20	S21	S24	S25
5.7		S1	S2	S3	S3	S3	S7	S11	S14	S19	S20	S23	S24
6			S1	S3	S3	S3	S7	S10	S12	S18	S20	S23	S23
6.3			S1	S2	S3	S3	S5	S9	S11	S17	S19	S23	S23
6.6				S1	S2	S2	S3	S7	S10	S16	S17	S21	S23
6.9				S1	S2	S1	S3	S7	S9	S15	S16	S20	S21
7.2					S1		S3	S5	S7	S14	S15	S20	S20

Table 3-16 Grade 350 steel pipe (diameter x thickness [mm]) strength ratings

Conductor support (m)	34 x 2.0	34 x 2.6	42 x 2.0	42 x 2.6	48 x 2.3	48 x 2.9	60 x 2.3	60 x 2.9	76 x 2.3	76 x 3.2	89 x 2.6	89 x 3.2	89 x 4.0	89 x 5.0
0.3	S15	S17	S21	S23	S25	S28	S29	S30	S32					

Conductor support (m)	34 x 2.0	34 x 2.6	42 x 2.0	42 x 2.6	48 x 2.3	48 x 2.9	60 x 2.3	60 x 2.9	76 x 2.3	76 x 3.2	89 x 2.6	89 x 3.2	89 x 4.0	89 x 5.0
0.6	S5	S7	S11	S15	S17	S20	S23	S25	S28	S29	S30	S32		
0.9	S2	S3	S5	S10	S11	S14	S17	S20	S23	S27	S28	S29	S32	S32
1.2			S3	S4	S7	S10	S14	S16	S20	S23	S25	S28	S29	S30
1.5				S1	S3	S5	S11	S13	S17	S21	S23	S24	S28	S29
1.8					S1	S2	S7	S10	S14	S19	S20	S23	S27	S28
2.1							S3	S6	S12	S16	S18	S20	S25	S27
2.4							S2	S3	S10	S14	S16	S19	S23	S24
2.7							S1	S2	S6	S11	S14	S17	S21	S23
3									S3	S7	S11	S14	S19	S20
3.3									S3	S5	S10	S11	S16	S17
3.6									S1	S3	S7	S10	S14	S15
3.9										S2	S4	S7	S12	S14
4.2										S1	S3	S5	S10	S11
4.5										S1	S3	S3	S7	S10
4.8											S2	S3	S6	S7
5.1											S1	S2	S4	S6
5.4												S1	S3	S4
5.7												S1	S3	S3
6													S2	S3
6.3													S2	S2

Conductor support (m)	34 x 2.0	34 x 2.6	42 x 2.0	42 x 2.6	48 x 2.3	48 x 2.9	60 x 2.3	60 x 2.9	76 x 2.3	76 x 3.2	89 x 2.6	89 x 3.2	89 x 4.0	89 x 5.0
6.6													S1	S2
6.9														S1
7.2														S1

Conductor support (m)	102 x 2.6	102 x 3.2	114 x 3.2	114 x 3.6	114 x 4.8	114 x 6	140 x 3	140 x 3.5	165 x 3	165 x 3.5	168 x 4.8	168 x 6.4	168 x 7.1	219 x 4.8	219 x 6.4
0.3															
0.6	S32														
0.9	S29	S32	S32												
1.2	S28	S29	S30	S32			S32								
1.5	S26	S28	S29	S30	S32		S32	S32							
1.8	S23	S27	S28	S29	S30	S32	S30	S32	S32						
2.1	S21	S24	S27	S28	S29	S32	S29	S30	S32	S32					
2.4	S20	S23	S25	S27	S28	S30	S28	S29	S30	S32					
2.7	S18	S20	S23	S24	S28	S29	S27	S28	S29	S30					
3	S16	S20	S23	S23	S27	S28	S27	S28	S28	S29	S32				
3.3	S15	S17	S21	S23	S27	S28	S24	S27	S28	S29	S32				
3.6	S12	S15	S20	S21	S24	S27	S23	S27	S27	S28	S32				
3.9	S10	S13	S17	S19	S23	S24	S23	S24	S27	S28	S30	S32			
4.2	S7	S11	S15	S17	S20	S23	S21	S23	S24	S27	S30	S32	S32		

Conductor support (m)	102 x 2.6	102 x 3.2	114 x 3.2	114 x 3.6	114 x 4.8	114 x 6	140 x 3	140 x 3.5	165 x 3	165 x 3.5	168 x 4.8	168 x 6.4	168 x 7.1	219 x 4.8	219 x 6.4
4.5	S6	S9	S14	S15	S19	S21	S20	S23	S24	S27	S29	S32	S32	S32	
4.8	S4	S7	S12	S14	S17	S20	S19	S21	S23	S25	S29	S32	S32	S32	
5.1	S3	S5	S11	S12	S15	S18	S18	S20	S23	S24	S28	S30	S32	S32	
5.4	S3	S3	S9	S11	S14	S16	S16	S19	S21	S23	S28	S29	S30	S32	
5.7	S2	S3	S7	S9	S12	S15	S15	S17	S20	S23	S27	S29	S29	S32	
6	S1	S3	S6	S7	S11	S14	S14	S15	S20	S23	S27	S28	S29	S30	
6.3	S1	S2	S4	S6	S10	S12	S12	S14	S19	S21	S24	S28	S28	S30	S32
6.6		S1	S3	S5	S9	S11	S11	S13	S17	S20	S24	S27	S28	S29	S32
6.9		S1	S3	S3	S7	S10	S10	S12	S16	S19	S23	S27	S27	S29	S32
7.2			S3	S3	S6	S9	S9	S11	S15	S17	S23	S24	S27	S29	S32

Table 3-17 Grade 350 steel square section (width x thickness [mm]) strength ratings

Free length to lowest conductor support (m)	30 x 2	30 x 2.5	30 x 3	35 x 1.6	35 x 2	35 x 2.5	35 x 3	40 x 1.6	40 x 2	40 x 2.5	40 x 3	40 x 4	50 x 1.6	50 x 2	50 x 2.5	50 x 3	50 x 4	50 x 5	65 x 2	65 x 2.5	65 x 3	65 x 4	65 x 5	65 x 6
0.3	S12	S15	S17	S14	S20	S19	S21	S17	S20	S23	S24	S27	S23	S26	S28	S28	S30	S32	S29	S32	S32			
0.6	S3	S5	S7	S4	S11	S10	S11	S7	S11	S14	S15	S19	S13	S17	S20	S22	S25	S27	S23	S27	S28	S29	S30	S32

Free length to lowest conductor support (m)	30 x 2	30 x 2.5	30 x 3	35 x 1.6	35 x 2	35 x 2.5	35 x 3	40 x 1.6	40 x 2	40 x 2.5	40 x 3	40 x 4	50 x 1.6	50 x 2	50 x 2.5	50 x 3	50 x 4	50 x 5	65 x 2	65 x 2.5	65 x 3	65 x 4	65 x 5	65 x 6
0.9	S1	S2	S3	S1	S5	S3	S6	S3	S5	S7	S10	S13	S7	S11	S14	S16	S20	S22	S17	S21	S23	S27	S28	S29
1.2					S2	S2	S3	S1	S2	S3	S5	S10	S3	S7	S10	S12	S16	S18	S14	S17	S20	S23	S25	S27
1.5							S1		S1	S2	S3	S5	S2	S3	S7	S10	S13	S15	S10	S14	S17	S20	S23	S24
1.8										S1	S1	S2		S2	S3	S6	S11	S12	S7	S11	S14	S17	S20	S23
2.1														S1	S3	S3	S7	S9	S4	S10	S11	S15	S18	S20
2.4															S1	S3	S3	S4	S3	S7	S10	S13	S16	S18
2.7																S1	S2	S3	S2	S4	S7	S11	S14	S15
3																	S1	S2	S1	S3	S5	S10	S11	S12
3.3																				S2	S3	S7	S9	S10
3.6																				S1	S3	S4	S6	S7
3.9																					S2	S3	S4	S5
4.2																					S1	S2	S3	S3
4.5																						S1	S2	S3
4.8																						S1	S1	S2

Free length to lowest conductor support (m)	30 x 2	30 x 2.5	30 x 3	35 x 1.6	35 x 2	35 x 2.5	35 x 3	40 x 1.6	40 x 2	40 x 2.5	40 x 3	40 x 4	50 x 1.6	50 x 2	50 x 2.5	50 x 3	50 x 4	50 x 5	65 x 2	65 x 2.5	65 x 3	65 x 4	65 x 5	65 x 6
5.1																							S1	S1
5.4																								S1

Free length to lowest conductor support (m)	75 x 2.5	75 X 3.0	75 x 3.5	75 x 4.0	75 x 5.0	75 x 6.0	89 x 3.5	89 x 5.0	89 x 6.0	100 x 3.0	100 x 4.0	100 x 5.0	100 x 6.0	100 x 9.0	125 x 4.0	125 x 5.0	125 x 6.0	125 x 9.0	150 x 5.0	150 x 6.0	150 x 9.0	200 x 5.0	200 x 6.0	200 x 9.0
0.3	S32																							
0.6	S28	S29	S30	S32	S32																			
0.9	S24	S27	S28	S29	S30	S32	S30	S32		S30	S32													
1.2	S20	S23	S24	S27	S28	S29	S28	S30	S32	S28	S30	S32												
1.5	S17	S20	S23	S24	S27	S28	S27	S29	S30	S27	S29	S30	S32		S32									
1.8	S15	S18	S20	S22	S24	S27	S24	S28	S29	S24	S28	S29	S30	S32	S30	S32								

Free length to lowest conductor support (m)	75 x 2.5	75 X 3.0	75 x 3.5	75 x 4.0	75 x 5.0	75 x 6.0	89 x 3.5	89 x 5.0	89 x 6.0	100 x 3.0	100 x 4.0	100 x 5.0	100 x 6.0	100 x 9.0	125 x 4.0	125 x 5.0	125 x 6.0	125 x 9.0	150 x 5.0	150 x 6.0	150 x 9.0	200 x 5.0	200 x 6.0	200 x 9.0
2.1	S12	S15	S17	S20	S23	S23	S23	S27	S28	S23	S27	S28	S29	S32	S29	S32	S32							
2.4	S10	S14	S15	S17	S20	S23	S20	S24	S27	S20	S24	S28	S28	S30	S28	S30	S32		S32					
2.7	S7	S11	S14	S16	S19	S20	S19	S23	S24	S19	S23	S27	S28	S30	S28	S29	S30		S32					
3	S6	S10	S12	S14	S17	S19	S17	S21	S23	S17	S23	S24	S27	S29	S27	S29	S30	S32	S32	S32				
3.3	S3	S7	S10	S12	S15	S17	S15	S20	S23	S15	S20	S23	S25	S28	S25	S28	S29	S32	S30	S32				
3.6	S3	S6	S9	S11	S13	S14	S14	S19	S21	S13	S20	S23	S24	S28	S24	S28	S28	S32	S29	S32		S32		
3.9	S2	S4	S7	S9	S11	S12	S12	S17	S20	S11	S18	S21	S23	S28	S23	S27	S28	S30	S29	S30		S32		
4.2	S1	S3	S5	S7	S9	S11	S11	S16	S18	S10	S17	S20	S23	S27	S22	S26	S28	S30	S28	S30	S32	S32		
4.5		S3	S3	S4	S7	S9	S10	S15	S16	S9	S15	S19	S21	S24	S20	S24	S27	S29	S28	S29	S32	S31		
4.8		S2	S3	S3	S5	S7	S7	S13	S15	S7	S14	S17	S20	S23	S20	S23	S27	S29	S28	S29	S32	S30	S32	

Free length to lowest conductor support (m)	75 x 2.5	75 X 3.0	75 x 3.5	75 x 4.0	75 x 5.0	75 x 6.0	89 x 3.5	89 x 5.0	89 x 6.0	100 x 3.0	100 x 4.0	100 x 5.0	100 x 6.0	100 x 9.0	125 x 4.0	125 x 5.0	125 x 6.0	125 x 9.0	150 x 5.0	150 x 6.0	150 x 9.0	200 x 5.0	200 x 6.0	200 x 9.0
5.1		S1	S2	S3	S3	S5	S6	S11	S13	S5	S12	S16	S18	S21	S19	S23	S24	S28	S27	S28	S32	S29	S32	
5.4			S1	S2	S3	S3	S4	S10	S11	S3	S11	S15	S16	S20	S17	S22	S24	S28	S27	S28	S30	S29	S32	
5.7				S1	S2	S3	S3	S7	S10	S3	S10	S13	S15	S19	S16	S20	S23	S28	S25	S28	S30	S29	S32	
6				S1	S2	S3	S3	S7	S9	S2	S9	S12	S14	S17	S15	S20	S23	S27	S24	S27	S30	S28	S30	
6.3					S1	S2	S2	S5	S7	S1	S7	S11	S12	S16	S14	S19	S21	S25	S23	S27	S29	S28	S30	
6.6						S1	S1	S4	S5		S5	S10	S11	S15	S12	S17	S20	S24	S23	S26	S29	S28	S29	
6.9						S1		S3	S4		S3	S8	S10	S14	S11	S17	S20	S23	S22	S24	S29	S27	S29	
7.2								S3	S3		S3	S7	S9	S12	S10	S15	S19	S23	S20	S24	S28	S27	S29	S32

Table 3-18 Grade 450 steel square section (width x thickness [mm]) strength ratings

Free length to lowest conductor support (m)	30 x 1.6	30 x 2	35 x 1.6	35 x 2	35 x 2.3	35 x 2.5	35 x 2.8	35 x 3	40 x 1.6	40 x 2	40 x 2.3	40 x 2.5	40 x 2.8	40 x 3	40 x 4	50 x 1.6	50 x 2	50 x 2.3	50 x 2.5	50 x 2.8	50 x 3	50 x 4
0.3	S13	S15	S17	S20	S21	S23	S23	S24	S20	S23	S24	S25	S27	S27	S29	S24	S28	S29	S29	S30	S30	S32
0.6	S3	S6	S7	S11	S12	S13	S14	S15	S11	S14	S16	S17	S18	S19	S22	S15	S20	S23	S23	S24	S24	S28
0.9	S1	S2	S3	S4	S6	S7	S9	S10	S5	S9	S11	S11	S12	S14	S17	S10	S15	S17	S17	S19	S20	S23
1.2			S1	S2	S3	S3	S3	S3	S3	S4	S6	S7	S9	S10	S11	S5	S11	S12	S14	S15	S15	S19
1.5							S1	S1	S1	S2	S3	S3	S3	S3	S5	S3	S7	S10	S10	S11	S12	S15
1.8												S1	S1	S1	S2	S2	S4	S6	S7	S7	S9	S11
2.1																	S2	S3	S3	S3	S4	S7
2.4																	S1	S1	S2	S2	S3	S3
2.7																				S1	S1	S2
3																						S1

Free length to lowest conductor support (m)	50 x 5	65 x 2	65 x 2.3	65 x 2.5	65 x 3	65 x 4	65 x 5	65 x 6	75 x 2	75 x 2.3	75 x 2.5	75 x 3	75 x 3.5	75 x 4	75 x 5	75 x 6	100 x 3	100 x 4	100 x 5	100 x 6
0.3		S30	S32	S32					S32											
0.6	S28	S24	S27	S28	S29	S32	S32		S27	S28	S29	S32	S32							

Free length to lowest conductor support (m)	50 x 5	65 x 2	65 x 2.3	65 x 2.5	65 x 3	65 x 4	65 x 5	65 x 6	75 x 2	75 x 2.3	75 x 2.5	75 x 3	75 x 3.5	75 x 4	75 x 5	75 x 6	100 x 3	100 x 4	100 x 5	100 x 6
0.9	S24	S20	S23	S24	S27	S28	S29	S30	S23	S24	S27	S28	S29	S30	S32	S32	S32			
1.2	S21	S16	S19	S20	S23	S27	S28	S29	S19	S21	S23	S27	S28	S28	S29	S30	S29	S32		
1.5	S17	S12	S15	S17	S20	S23	S25	S27	S15	S19	S20	S23	S25	S27	S28	S29	S28	S30	S32	
1.8	S12	S10	S13	S15	S17	S21	S23	S24	S12	S15	S17	S21	S23	S24	S27	S28	S27	S29	S32	S32
2.1	S9	S7	S10	S12	S15	S19	S20	S22	S10	S13	S15	S19	S21	S23	S24	S27	S24	S28	S30	S32
2.4	S4	S4	S7	S10	S12	S15	S17	S19	S7	S11	S13	S17	S19	S20	S23	S24	S23	S28	S29	S30
2.7	S3	S3	S5	S7	S10	S12	S14	S15	S5	S9	S11	S15	S17	S19	S20	S22	S20	S27	S28	S29
3	S2	S2	S3	S4	S7	S10	S11	S12	S3	S7	S9	S13	S14	S15	S17	S19	S19	S24	S28	S28
3.3		S1	S3	S3	S3	S7	S9	S10	S2	S4	S7	S10	S11	S13	S15	S17	S17	S23	S27	S28
3.6			S1	S2	S3	S4	S6	S7	S1	S3	S4	S7	S10	S11	S13	S14	S15	S23	S24	S27
3.9			S1	S1	S2	S3	S4	S5		S2	S3	S5	S7	S9	S11	S12	S14	S21	S23	S24
4.2					S1	S2	S3	S3		S1	S3	S3	S5	S7	S9	S11	S12	S19	S21	S23
4.5						S1	S2	S3			S2	S3	S3	S4	S7	S9	S11	S17	S20	S21
4.8						S1	S1	S2				S2	S3	S3	S5	S7	S10	S15	S18	S20
5.1							S1	S1				S1	S2	S3	S3	S5	S7	S14	S16	S18
5.4								S1				S1	S1	S2	S3	S3	S5	S12	S15	S16
5.7													S1	S1	S2	S3	S3	S11	S13	S15
6														S1	S2	S3	S3	S10	S12	S14

Free length to lowest conductor support (m)	50 x 5	65 x 2	65 x 2.3	65 x 2.5	65 x 3	65 x 4	65 x 5	65 x 6	75 x 2	75 x 2.3	75 x 2.5	75 x 3	75 x 3.5	75 x 4	75 x 5	75 x 6	100 x 3	100 x 4	100 x 5	100 x 6
6.3															S1	S2	S2	S8	S11	S12
6.6																S1		S7	S10	S11
6.9																S1		S5	S8	S10
7.2																		S4	S7	S9

4 Service equipment

4.1 Introduction

The customer shall arrange to provide and install within the main switchboard at the customer's cost:

a) service protection device (SPD) which complies with clause 4.7.

b) service neutral/active links

c) load control devices

d) associated wiring and connections in accordance with AS/NZS 3000

e) any other service equipment required by the distributor

The service equipment enclosure shall be in a location and in conditions acceptable to the electricity distributor.

The customer must arrange to provide and install, at the customer's cost, all required service equipment and metering equipment prior to the installation being energised past the SPD.

4.1.1 Existing installations

In general, repairs on existing installations are permitted. Where installations are upgraded or additional equipment is installed, the installation shall be considered a new installation and the rules in this document apply.

4.2 Location and accessibility of service equipment

Service equipment shall be in an accessible area on common property.

For installations on non-urban properties exceeding 0.4 hectares (Ha) in area, apply to the electricity distributor regarding a suitable location for service equipment.

The customer shall ensure access to any enclosure for service equipment is never restricted or made unsafe. The location shall always be kept clear.

If access is obstructed the customer shall remove the obstruction or relocate the service equipment.

Rooms dedicated to house service equipment shall be well lit, clean, unobstructed and not used for storage of materials or equipment. The door(s) of rooms and enclosures housing service equipment shall be labelled 'Electricity supply equipment'.

Service and load control equipment shall be easily accessible to distributor officers within normal working hours. Where the load control equipment is not located adjacent to the service protection device, its location shall be labelled on the main switchboard. The labelling shall comply with clause 4.17.

Provide access to an elevated position as specified in *AS 1657:2018 Fixed platforms, walkways, stairways and ladders – Design, construction and installation*. The fixed platform, walkway, stairs and/or ladders shall be maintained by the customer so safe access can be gained at all times.

Any gas meter, fittings, enclosures or other obstructions installed below the service equipment panel shall not project further than 300mm from the face of the wall on or in which the service equipment panel is mounted.

The customer shall provide and maintain adequate space in front of the service equipment panel or cabinet, to enable the equipment to be operated or adjusted.

The space shall:

a) be flat and level

b) enable the door or panel to be opened or removed

c) provide a vertical clearance of not less than 2m from the ground, floor or platform and minimum horizontal clearance of not less than 0.6m from the:

   i) equipment mounted on the hinged panel, or

   ii) external front edge of the switchboard enclosure

   whichever point protrudes the most.

A hinged meter panel shall be able to be extended to a 90° open position when all equipment has been fitted.

When a hinged meter panel is extended on its hinge to the 90° open position, a clearance of 200mm shall be maintained between the front face of the panel and any fixed object.

A clearance of 175mm shall be provided from the front of the panel to the door.

Note: The NSW *Local Government Act 1993* requires compliance with the National Construction Code for **exits for fire escape** purposes, or any corridor, hallway, lobby or the like leading to such an exit. This does not apply in single dwellings. In the case of buildings being altered or the use being changed, the local council may require an existing building to be brought up to this standard.

CAUTION

Whenever a property or building is of a type which may be subdivided, care should be taken to ensure the meters and wiring are located within the area which would be set aside as common property or within the individual lot supplied thereby. Wiring installed within an individual lot shall be associated only with that lot.

4.2.1 Single domestic premises

The service equipment shall be located where ready pedestrian access is maintained, in one of the following locations:

a) on the face of the residence facing the front boundary

b) on the adjacent side wall within 1.5m of that face or associated corner window or verandah

c) on a private pole

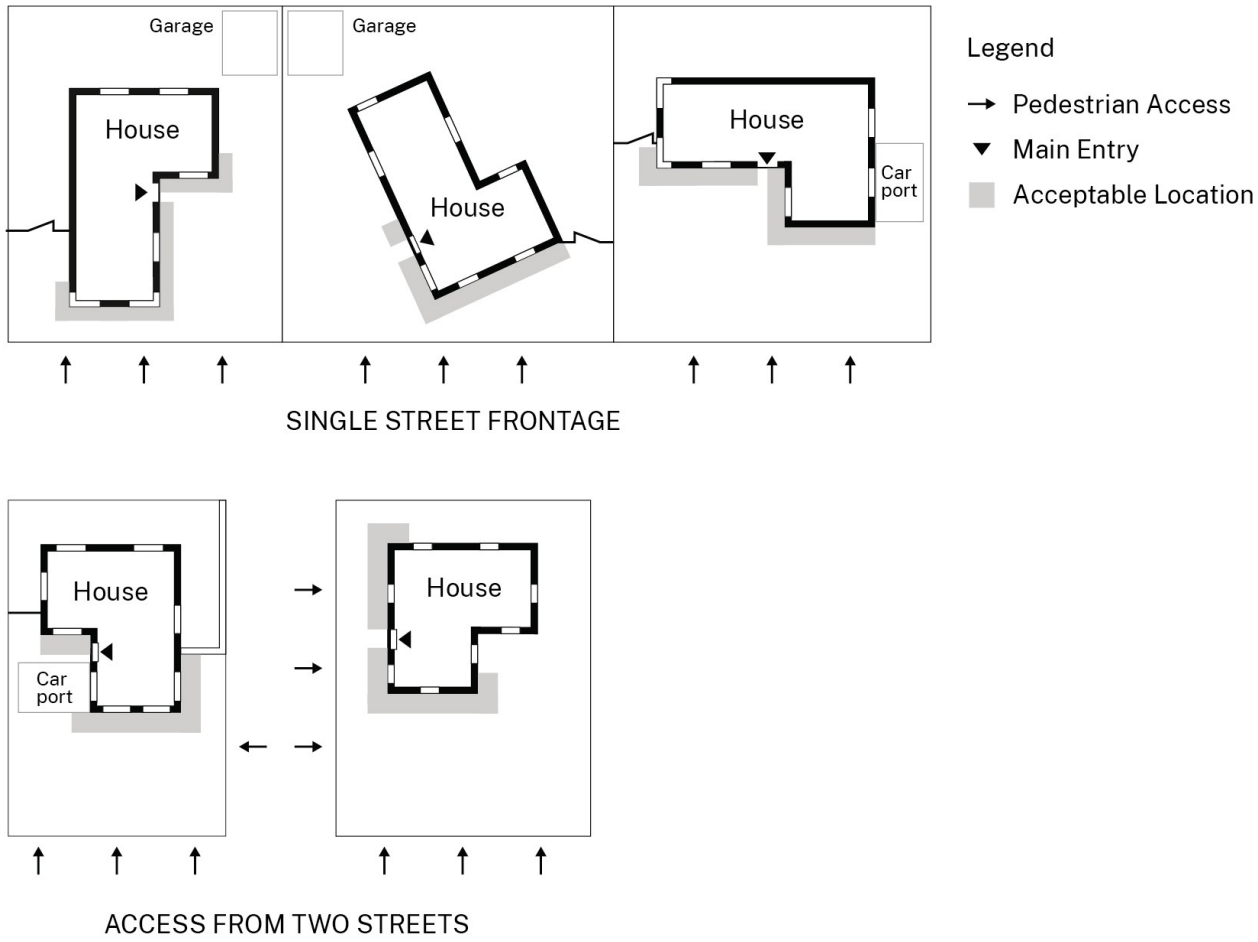
d) within the front boundary fence so isolation and maintenance of service equipment may be carried out without introducing a safety hazard.

Where the main entrance is on the side of a residence, the service equipment may be installed on that side not further than 1.5m beyond the main entrance subject to access being available.

The service equipment position shall not be located behind fences or locked gates unless they are fitted with electricity distributor locking facility.

Suitable locations are shown in Figure 4-1.

Figure 4-1 Suitable service equipment locations for single domestic installations



Notes

1. As load control equipment may produce some slight noise, installing the equipment on a bedroom wall should be avoided.
2. Where a perimeter or security fence is erected between the building and the access street, we recommend that a suitable vandal-resistant box be installed.
3. Take care to select a position that is clear of flyscreen doors.

4.2.2 Other Premises

Unless otherwise approved by the electricity distributor, the service equipment enclosure shall be located as close as practicable to the entrance of the premises and shall be readily accessible (in an area normally open to the public).

Service equipment shall not be installed behind locked gates

If located in a secured common area, access shall be available by means of a standard locking system approved by the DNSP.

In addition, service equipment shall not be located in areas intended for product display such as shop windows or where access is restricted during normal operations for security, health or other reasons.

Access shall be available during the electricity distributor's normal business hours.

4.3 Unsuitable locations

The following locations are considered unsuitable for mounting service equipment:

a) over stairways or ramps, in narrow passageways, or in confined spaces
b) in vehicle docks, driveways, factory passageways where the equipment or a person working on it would not be effectively protected
c) near or over machinery or open type switchgear
d) in locations which are liable to be affected by fumes, vibration, dampness, or dust, which may cause deterioration of equipment or unsatisfactory working conditions
e) in hazardous or prohibited switchboard locations as defined in AS/NZS 3000
f) where the normal ambient temperature exceeds 50°C
g) where there is insufficient light
h) where the use of a portable ladder would be necessary
i) where projections at head height are a hazard
j) in pool or spa zones as defined in AS/NZS 3000
k) in carports, unless with the prior permission of the electricity distributor
l) on enclosed verandas
m) in areas enclosing dogs
n) in areas to which access is normally restricted – for security, health or other reasons (this would include areas in which animals are kept for security reasons)
o) behind a fence without a gate
p) within a gas emitting devices exclusion zone; refer to AS/NZS 5601.1:2022 Gas installations – general installations
q) within LPG cylinder minimum clearance to ignition sources, refer to AS/NZS 5601 (according to AS/NZS 3000 clause 4.18.2 requirements)
r) in fire-isolated stairways, passageways or corridors
s) where access is restricted by vegetation
t) on the electricity distributor's asset unless approved by the electricity distributor

4.4 Hazards of existing switchboard panels that may contain asbestos

ASPs and electrical contractors should not carry out work that disturbs the integrity (e.g. drilling) of existing switchboard panels that may contain asbestos, within electrical installations, without taking suitable precautions. Information in this regard is available from the SafeWork NSW website (www.safework.nsw.gov.au) which lists relevant industry safety guidelines and model procedures.

WARNING – ASBESTOS

Historically, asbestos has been used in switchboard panels used in electrical installations. All electrical personnel who work on switchboard panels need to identify if this hazard may be present, and if necessary, adopt approved industry procedures, when working with switchboard panels.

4.5 Facilities for the installation of service equipment

4.5.1 Service equipment panel

For all new installations the service equipment panels shall:

a) not use materials containing asbestos

b) provide sufficient space for the installation of service equipment.

c) separate the service equipment from the customer's equipment. Separation may be shown by marking.

Where fixed or removable service equipment panels are used, access to the rear of the fixed panel shall be provided without needing to remove the fixed panel to allow for inspection, alterations or additions to be completed safely.

All equipment shall be mounted no closer than 32 mm from the hinged edge of the panel.

4.5.2 Service equipment enclosure

Provide and install enclosures complying with AS/NZS 3000 or AS/NZS61439 as appropriate.

4.5.3 Free length of underground service

The free length of underground service to be installed, measured from where it passes through the hole in the panel, shall be as follows:

a) above fuse (line side) 75mm

b) below fuse (load side) 150mm.

A similar length is required for the neutral conductor. All cables shall be connected to the service protection device and service neutral link by the ASP.

4.5.4 Physical protection of service equipment

Service equipment shall be protected from:

a) the weather

b) mechanical damage

c) salt-laden or dust-laden air or corrosive atmospheres

d) vandalism.

An enclosure shall be fitted with a door and catch.

4.5.5 Isolated and unattended locations

Where service equipment is installed in an enclosure externally on a building or a pole in an isolated and unattended location, the enclosure shall be constructed using galvanised steel or equivalent material of sufficient strength to achieve protection against vandalism, weather or

other external factors. Such enclosures shall be kept locked at all times using an acceptable locking system.

4.5.6 Hinged switchboard doors

If the door is hinged provide a stay fastened to the enclosure to hold the door open greater than 90°.

4.5.7 Glazed switchboard doors

Do not glaze the door if the enclosure is exposed to sunlight or the risk of breakage is high.

4.5.8 Fixing of service equipment enclosure

Ensure the facilities for mounting service equipment and associated surrounds and enclosures are securely fixed to a wall, floor or rigid supporting structure.

4.5.9 Fixing of the service equipment

All service equipment is to be secured using all available fixing points.

For panels with a thickness of less than 20mm, bolts and nuts shall be used to secure the equipment.

Bolts shall not protrude more than 10mm past rear of the panel, nor be capable of damaging any conductor insulation.

Where screws are used, they shall not protrude past the rear of the panel. Screws shall use at least 75% of the panel thickness to secure any equipment.

Where the head of any fixing device is exposed on the front of the panel, it shall be suitably insulated.

4.6 Locking of service enclosures

Locking and restricting access to an enclosure for service equipment is acceptable if the lock or access is by means of a standard locking system.

The following access arrangements are acceptable provided an officer of the electricity distributor is not required to reset security alarms:

a) Where electrically operated security locking is used, a key switch is to be provided and fitted with the electricity distributor's standard cylinder.

b) Where access is given by means of a security card, either a key switch as above or a card left in a locked box provided by the customer and mounted adjacent to the entrance door which can be opened by the electricity distributor's standard key is to be provided. The lock box shall be mounted no lower than 0.6m or no more than 2.0m above the ground, floor or platform.

Note: the electricity distributor's locking system is a restricted key system not a high-security system. The electricity distributor's locking system shall not be installed on doors which give access to any rooms or areas in which portable articles and equipment of any value, personal goods and the like are located.

4.7 Service protection devices

The customer shall provide, install and maintain an approved service protection device in accordance with the following subclauses.

For services up to 100amp, a single HRC fuse per phase or a single device controlling all phases.

For services above 100amp, a singular device controlling all three phase/s.

Selection of fuse carrier and base ratings for fuses as service protection devices. The maximum current rating of any fuse carrier and fuse base combination (the fuse assembly) used for the purposes of a service protection device shall always be equal to or greater than the fuse element rating, but in no case less than 100A.

The fuse assembly shall have a sealable escutcheon, known as an anti-intrusion assembly, which prevents access to the terminals. The fuse carrier does not have to be sealed to the fuse base.

Refer clause 4.7.6 regarding circuit breakers used as SPDs.

4.7.1 Service protection device and meter protection device combined

For single electrical installations that meet the requirements of a service type '100A Single customer' in Table 4-1, the functions of a service protection device can be fulfilled by a combined SPD/MPD per phase provided clause 4.7.2 and the Metering Installation Requirements are complied with.

For existing installations the fuse element rating may be reduced to reflect the current rating of existing consumers or submains and to accommodate load limiting in accordance with AS/NZS 3000 requirements. See clause 4.7.3 (j).

Information on Meter Protection Devices (MPD) can be found in the Metering Installation Requirements.

4.7.2 Location of service protection devices

a) The service protection device shall be located on the distribution network side of the metering equipment.

b) For installations with a maximum demand determined in accordance with AS/NZS 3000 exceeding 100A per phase or the current rating of a meter (or otherwise metered with the use of current transformers), the service protection device shall be located adjacent to or incorporated in the main switchboard

c) Locate the service protection device no higher than 2.0m to the top of the device and no lower than 0.5m to the line side terminals (excluding any connection flags used) of the device above the ground, floor or platform.

d) The requirements of this subclause apply to alterations and additions to existing installations except where the relocation of the service protection device would require upgrading of the service, consumers mains or main switchboard, then the existing service protection device location may be maintained.

For special situations check with the distributor.

Table 4-1 Service protection device requirements

Service type	Service protection device (SPD) element / protection rating per phase	Comments
100A Single customer	Up to 100A	For single-customer installations, the SPD and the MPD can be one device
100A Multiple customer	Up to 100A	For multiple customer installations per phase, there shall be one SPD to provide overload protection to the service supplying the installation. See Note 4.
200A	200A	
300A	300A / 315A	This may cause some grading problems with substation distributor fuses, which if blown are not able to be replaced by the customer. If there are grading constraints, 250A fuse(s) may be used for the SPD as this size would be more likely to grade.
400A	400A	This may cause some grading problems with substation distributor fuses, which if blown are not able to be replaced by the customer.

Notes:

1. When using service protection devices of the larger sizes, ensure grading is achieved below those fuses. The grading prevents nuisance loss of supply as the MPD then protects a smaller portion of the installation by ensuring the fault is seen by the device which is closest to the fault (between the fault and the supply).
2. With supplies direct from a substation, grading shall be achieved.
3. Number of customers per 100A service protection device is determined by the requirements of clause 4.12.
4. Where a multi-phase service supplies the same number of units as there are phases, the SPD and the MPD can be the one device. Where more than one customer per phase, then there shall be an SPD and a separate MPD as required by the Metering Installation Requirements.
5. For existing installations this rating must be reduced to reflect the current rating of existing consumers or sub mains and to accommodate load limiting in accordance with AS/NZS 3000 requirements.

4.7.3 Fuses for combined service protection device/meter protection device, ≤100A single premises

The service protection fuses shall comply with the following requirements:

a) The Service protection fuse assembly shall accept a Type 11b 80A or 100A current limiting (HRC) fusible link. The fusible link shall be manufactured in accordance with international standard *IEC 60269-3 Low-voltage fuses*.

b) The equipment shall be supplied complete with the fusible link, fuse carrier, base and sealed escutcheon.

c) The fuse base may be either front or back connected.

d) The fuse base shall have 2 load terminals.

e) Connect one conductor only to each separate terminal. Protect unused terminals from accidental contact.

f) Where insulating barriers are provided on one terminal only, use that side of the fuse base for the line side connection. (Do not remove barriers.)

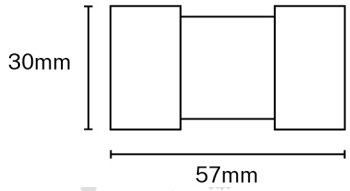
g) If specialised insulated tools shall be used to make connections into the fuse base, the fuse manufacturer's instructions shall be followed.

h) The fuse link dimensions are shown in Figure 4-2.

i) Where alternatives to the fuse shown in Figure 4-2 are used, distributor approval shall be gained before installation and a spare set of fuse links is to be provided by the customer.

Note: electrical installations on railway land in the 1500V DC electrified track area normally requires circuit breakers as service protection devices.

Figure 4-2 100A fuse link dimensions



All service protection and meter protection HRC fuse links have potential to contain friable asbestos materials. Exposure to the asbestos inside may occur through accidental or mechanical damage. As such, when fuse links are replaced, they shall be removed and disposed of as asbestos waste. More information can be found on the SafeWork NSW website.

4.7.4 Enclosures for service protection devices greater than 100A

Service protection devices exceeding 100A rating shall be designed and installed in accordance with *Appendix ZC* of AS/NZS 61439.1 Low-voltage switchgear and control-gear assemblies and all other relevant requirements of AS/NZS 61439 series of standards.

4.7.5 Fuses used for existing service protection devices greater than 100A

Service protection devices exceeding 100A shall comply with:

a) the appropriate parts of the IEC 60269 series

b) *AS 60529:2004 Degrees of protection provided by enclosures (IP Code)*.

The service protection device shall also comply with the following requirements:

i) The assembly shall be suitable for the installation of current limiting (HRC) fuses with a current rating from 200A to 400A.

ii) Rated voltage shall be not less than 500V.

iii) Rated breaking capacity shall be not less than 80kA.

iv) The equipment shall be supplied with the requested current-rated fusible links. Where requested by the distributor, solid links shall be fitted in lieu of fuses.

v) The fuse link dimensions shall be B4 or C1 for bolted connected fuse links and Size 2 for blade-connected fuse links.

vi) Phase segregation dividers shall be fitted to prevent phase-to-phase faults, separately enclosed phase fittings shall be used. Where practical the fixed contacts should be shrouded to reduce the risk of contact with live parts.

vii) The fuse assembly shall be contained by an insulated enclosure. If within a metal switchboard, the sides of the enclosure shall be insulated.

viii) The fuse assembly cover shall be able to be adequately sealed, with or without the fuse link fitted. No live parts shall be exposed during the sealing operation.

ix) The fuse assembly may be either front or back connected.

x) A combined fuse-switch unit with segregation is satisfactory.

xi) Grade (discriminate) with the distributor's protection starting at 100ms and above and up to the arcing fault level deemed to be at 30% of the prospective short circuit current.

Where the service protection device consists of a base, insulating cover (turret) and fuse carrier, the insulating cover (turret) shall be installed and secured before inserting the fuse carrier.

Where specialised insulated tools are necessary to make connections into the fuse base then the fuse manufacturer's instructions shall be followed.

Service protection devices greater than 100A using fuses shall be vertically orientated with fuse withdrawal towards the operator and shall comply with other conditions of clause 4.7 of these Rules.

4.7.6 Circuit breakers in lieu of fuses

Circuit breakers may be used as a service protection device in accordance with the following requirements.

Circuit breakers to be installed shall:

a) be of the fault current limiting type, without considering the effects of cascading (if used)

b) have a rated short circuit current capacity equal to or greater than the prospective short circuit current at the point of its installation

c) grade (discriminate) with the electricity distributor's protection

d) have the facility for locking and sealing in the 'off' position

e) comply with *AS/NZS 60947.1:2021 Low voltage switchgear and controlgear* – 'Circuit breakers' and the emergency systems provisions of AS/NZS 3000.

f) have any adjustable settings and their individual covers sealed such that only authorised persons have access. A sealed escutcheon does not satisfy this requirement

Note: tampering with the settings of a service protection device is a breach of the *Electricity Supply Act 1995*.

g) have unmetered active/live connections enclosed and have facilities for sealing to prevent unauthorised access be maintained by the customer in accordance with the manufacturer's specifications have a label describing the circuit-breaker load current settings attached

adjacent to the circuit breaker. Electrical installations on railway land in the railway 1500V DC electrified track area normally require circuit breakers instead of fuses.

4.7.7 Connection to service protection devices

The line-side connection of service protection devices shall:

a) be at the top where mounted vertically, or

b) have the line side labelled.

4.7.8 Identification

The service protection device is to be clearly identified. Every fuse that is used for service protection devices shall have the fuse link element rating clearly marked **below** the device.

Where an existing service protection device is not fitted in accordance with these Rules or is not clearly visible, a notation on the main switchboard shall describe the location of the device.

All labelling shall be in a legible and durable manner, in accordance with the AS/NZS 3000.

4.8 Rewireable fuses

When altering the service or consumers mains terminated at existing rewireable service protection fuses or carrying out any work on existing rewireable service protection fuses, the rewireable service protection fuse assembly shall be replaced with a service protection device complying with clause 4.7 of these Rules.

4.9 Service active link

The link shall:

a) be the all-insulated type

b) be fitted with a cover suitable for sealing

c) have a separate terminal for each conductor

d) have a current rating not less than the capacity of the incoming conductor

e) be located so it is easily accessible and safe to work on

f) be identified to indicate it is a ‘service active link’ in a legible and durable manner in accordance with AS/NZS 3000.

Hinged panel construction may enable the link to be located on the rear of the panel; see AS/NZS 3000.

4.10 Service neutral links

There shall be a service neutral link and it shall:

a) be the all-insulated type

b) be fitted with a cover suitable for sealing

c) have a separate tunnel terminal for each conductor which is clamped by not less than 2 screws

d) have a current rating not less than the current carrying capacity of the associated incoming conductor

e) be located so it is not higher than 2.0m and not lower than 0.5m above the ground, floor or platform; for special situations check with the distributor

f) be identified to indicate it is a 'service neutral link'; labelling shall be legible and durable in accordance with AS/NZS 3000.

Hinged panel construction enables the service or meter neutral link to be located on the rear of the panel.

4.10.1 Service neutral link

The service neutral link shall accommodate:

a) the incoming main neutral conductor

b) the neutral connection to the customer's neutral link

c) a separate neutral conductor for load control device being installed

d) the operating coil of the controlled load contactor if provided.

4.10.2 Load control equipment

Where electricity is to be supplied only during certain hours in accordance with the provisions of a published tariff, the electricity distributor may require the customer to provide and install a load control device to directly control the load supplied under that tariff.

The electricity distributor will either provide or specify the type of load control device to be used.

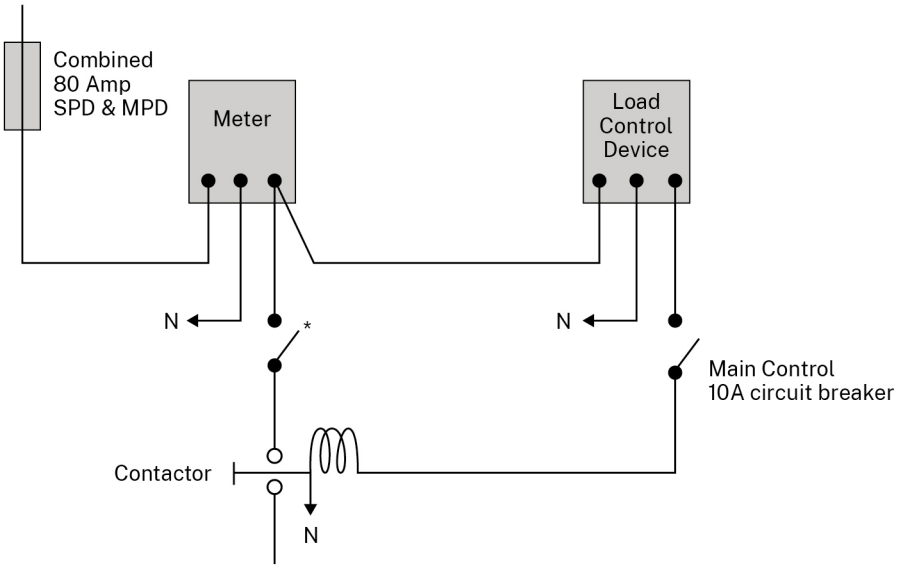
Unless approved by the electricity distributor, controlled load shall not exceed 25A single phase. Where the load exceeds 25A single phase, is polyphase or is inductive, the customer shall provide, install and wire a contactor so it is operated by the load control device. The contactor shall be a non-latching type with provision for sealing and be installed at the metering position.

The contactor control circuit shall be controlled and protected by a 10A circuit breaker which shall be sealable. Refer to Figure 4-3. The neutral conductor for the contactor coil shall be terminated in the service neutral link.

For other methods that may be acceptable, apply to the electricity distributor.

Single-phase controlled-load connected to a three-phase supply shall be connected to the phase indicated in tables 2.2 and table 3.2

Figure 4-3 Controlled load – contactor wiring



Note: Single phase shown for clarity.

* An alternate location for the main switch may be on the load side of the contactor.

4.11 Connections at service equipment

The customer shall arrange with an ASP for the installation and connection of service equipment. If using cables other than thermoplastic, cross-linked polythene (XLPE) or elastomer insulated stranded copper conductor cable, joint the cables, or connect them in an approved manner, to a cable of the required type and size for connection to this equipment.

A single cable only is to be connected to any one terminal of service equipment.

4.11.1 Cable preparation and termination

The preparation and termination of cables into service equipment shall comply with the manufacturer's guidelines.

All cables connecting to service equipment shall be prepared and terminated in the following manner.

a) Only a single conductor per terminal is permitted.

b) Single cables with a cross-sectional area of less than 10mm^2 shall be twisted and doubled over.

c) Soldering is not acceptable. Cables shall be adequately secured under all available termination screws.

d) There shall be no more the 1mm of exposed conductor protruding from any termination where located under a sealed enclosure.

4.11.2 Maximum conductor sizes for services rated to 100A

The maximum total conductor cross-sectional area which is permitted to be terminated directly at a 100A service protection device shall not exceed the design of the terminal.

4.11.3 Flexible switchboard and panel wiring

Flexible switchboard and panel wiring may be used to connect service equipment, provided it is installed in accordance with the manufacturer's specifications.

4.12 Multiple installations

Examples of multiple installations are:

a) multiple residential installations which include a number of single domestic installations; single domestic installations include a flat, unit or duplex unit

b) groups of small shops and/or offices

c) shopping malls

d) factory units

e) combinations of the above.

For large multiple installation developments, contact the electricity distributor and metering coordinator as early as possible to prevent delays for connection of electricity.

4.12.1 Mounting provisions for service equipment

Switchboard panels hinged, fixed or removable shall be non-conductive, in compliance with IEC60893-1.

4.12.2 Service equipment requirements

Adequate space is to be maintained around all service equipment to facilitate its safe operation and maintenance including adequate allowance for heat dissipation.

4.12.3 Labelling

For multiple installations, service equipment and all main switches must be clearly and permanently labelled to indicate occupancy identification in accordance with clause 4.17 for all equipment to be mounted on the panel.

4.13 Sealing of service equipment

Security seals shall not be removed without authorisation/permission from the owner of the seal.

Where seals are broken, the entity that has broken the seal is responsible for arranging the resealing upon completion of work.

All service equipment, unmetered links and paralleling links shall be sealed in an approved manner. Nylon/plastic sealing wire will generally be used.

Seals on a service protection device that are broken shall be re-sealed by an authorised person.

4.14 Low voltage services greater than 100A

The SPD can be a combined SPD/main switch and must be labelled as SPD/MAIN SWITCH.

4.14.1 Design considerations

The submission to the network operator shall include:

a) the proposed load details

b) a single line schematic diagram

c) power factor correction if applicable.

Note: a separate submission to the metering coordinator will be required to assess metering requirements, including the design of the CT enclosure. Refer to the Metering Installation Requirements for further information.

The design will be assessed for tariff requirements.

Note: not all the requirements of this section apply to low voltage switchboards in installations supplied and metered at high voltage. However, it is recommended that the principles of this document be applied to these switchboards.

4.14.2 Prospective short circuit current

The electrical installation shall be capable of withstanding, without damage, the nominated prospective short circuit current.

Switchboards and equipment rated greater than 400A shall be rated for the nominal prospective short circuit current for 1 second. Upon application, the electricity distributor will provide values not specified in these Rules.

4.14.3 Protection grading

Select and arrange the main circuit breakers or fuses so they will interrupt the fault current in the event of a fault on the portion of the installation they protect. They shall interrupt the fault current rapidly enough to ensure the electricity distributor's protection devices do not operate.

The electricity distributor will provide information on the characteristics of the electricity distributor's protection equipment.

WARNING

Where a single customer is supplied direct from a substation, the electricity distributor generally protects its equipment by installing a circuit breaker or fuse in each outgoing LV circuit.

Unless the customer's service protection devices are correctly selected to discriminate with the electricity distributor's device, a fault within the electrical installation may cause the device to operate.

The implications of this are as follows:

Supply to smoke and fire control and emergency evacuation equipment and lifts may be interrupted. It is common for such faults to occur during fires when the need for emergency supply is paramount.

Resetting of 'tripped' equipment can only be carried out by the electricity distributor's specialised staff and this may cause considerable delay to the reconnection of supply. It may also incur a charge.

4.14.4 Connection of neutral links

The multiple earth neutral (MEN) connection shall be located:

a) so it can be readily and safely removed while the supply is connected

b) within the customer's section of the switchboard.

An appropriate notice shall be fixed to the switchboard indicating the location of the MEN connection.

Where a switchboard consists of one assembly and is provided with multiple supplies, the neutral bar and earth bar shall be electrically continuous throughout the assembly.

Where a switchboard consists of more than one assembly, located in the one switch room, and is provided with multiple supplies:

i) a MEN connection shall be provided in each separate assembly

ii) the earthing system of the installation shall be common to all assemblies.

iii) If you install a bus-section coupler:

(1) The MEN connection shall be made on only one assembly;

(2) The common neutral shall join each switchboard neutral bar;

(3) The neutral bars shall have current carrying capacity not less than the underground service / consumers mains neutral conductor;

in case there is feedback through the earth–neutral system.

4.14.4.1 Railway land

Electrical installations on railway land in the 1500V DC electrified rail track area use a modified direct earthing system which incorporates a reticulated insulated earthing conductor. This system requires the neutral and earth to be insulated from each other, hence no MEN connection is permitted, except for the one and only connection for each supply made by the party nominated in ST publications.

Note: in certain circumstances this connection may be located on the consumers main switchboard. Refer to clause 1.17.7.1 and clause 1.17.14.

4.14.5 Earthing

The electrical installation main earth is not normally directly connected to the electricity distributor's earthing system.

Written acceptance from the electricity distributor is necessary before such an arrangement may be carried out.

4.14.5.1 Railway land

Refer to clause 1.17.7.1 and clause 1.17.14 for earthing of electrical installations on railway land in the 1500V DC electrified track area.

4.14.6 Stand-by supply equipment

Main switches and changeover devices to connect a stand-by generating plant shall comply with all requirements of section 8 of these Rules.

Where stand-by supplies exist that are controlled by automatic changeover equipment, the following conditions apply:

a) The main isolator of each stand-by supply shall be able to be locked in the open position.

b) The control circuitry shall be designed to prevent operation of the main isolator, due to the loss of the other supply, when it is locked open.

c) The changeover equipment shall be preceded by a manually operated load break isolator.

4.15 Controlled load for CT metering

The installation and use of a contactor associated with controlled load CT metering is discussed in the Metering Installation Requirements. A contactor shall also comply with the requirements of clause 4.10.2.

Single-phase controlled load connected to a three-phase supply shall be connected to the phase as indicated in tables 2.2 and table 3.2

4.16 Labelling

Install warning labels on a customer's main switchboard in accordance with the following requirements:

a) All warning labels on the main switchboard shall have WHITE lettering, minimum 6mm high, permanently engraved on a RED background.

b) Labels for all main switches shall be readily distinguishable from all other labels, in accordance with AS/NZS 3000. Different colours may be used for identification so they can be operated quickly in an emergency.

c) Provide a schedule for each distribution section within a main switchboard to identify outgoing submains and final subcircuits.

d) Equip each combination fuse-switch (CFS) unit with a label stating the maximum current rating of replacement fuses to be installed. Make sure the ratings for the fuses match:

   i) the current rating of the outgoing submains, or

   ii) the fault current limiting requirements for downstream equipment

   whichever is less.

e) Provide each main switchboard with a permanently engraved label with the following information:

   i) fault rating for 1 second

   ii) the manufacturer's name or trademark

   iii) type, designation or identification number or other means of identification so anyone can get relevant information about it from the manufacturer

   iv) IP rating.

4.16.1 Guide to labelling electrical equipment on switchboards

This clause cannot cover all the labelling requirements in every situation. To establish consistency and improve safety, NSW electricity distributors are providing preferred and acceptable examples in known problem situations.

No reference is made to specific clauses in AS/NZS 3000 as electricity distributors do not intend to indicate precise labelling acceptance criteria.

This clause does not remove responsibility from the customer or their representative in complying with:

a) other Australian Standards

b) requirements of other relevant regulatory authorities

c) other publications if applicable to the situation.

Note: inadequate labelling, or lack of labelling of equipment at the time of inspection, may prevent the connection of electricity.

Avoid temporary labelling – it should not be necessary.

Labelling of equipment needs to be standardised to an acceptable degree so that:

i) authorised persons operating switchgear know which section of the installation the equipment controls

ii) authorised persons working on an installation can do so safely

iii) electrical contractors, equipment suppliers and switchboard manufacturers know what labelling is acceptable.

Wording on labels should be concise, easy to understand, and contain sufficient information to convey the message effectively without ambiguity.

If you use words like 'essential', 'emergency', 'normal' etc, make sure they cannot be confused with words on labels for equipment associated with lifts and fire services.

For example:

(1) 'Essential lighting' would be confused with emergency evacuation lighting (see AS 2293 series: *Emergency escape lighting and exit signs for buildings*).

(2) Some air conditioning equipment may be essential for a manufacturing process, but the labelling of equipment as 'Essential air conditioning' would cause confusion with fire and smoke control equipment.

One example of an acceptable label would be:

Label 1

Air conditioning Motor control cubicle. Basement Do not turn off without consulting supervisor

4.16.2 Examples and explanations of labelling

4.16.2.1 Fault current limiters

Labels 2 to 5 are examples of acceptable labels.

Label 2

Fault current limiters for ..... circuits mounted behind this cover

Label 3

WARNING: Do not re-energise fault current limiters until fault has been cleared

Replace with identically rated fault current limiters

Label 4

WARNING: These fault current limiters are not controlled by a switch

Label 5

WARNING: Use insulated handle to remove and replace these fault current limiters

4.16.2.2 Labelling of Main switches

For labelling main switches, use a different background colour to the background colour used for labels of other equipment.

Use white lettering on a red background for warning labels. Also use white on red for labelling main switches for lifts and fire services and associated equipment. (See *AS 1319:1994 Safety signs for the occupational environment*).

For switchboards rated at 100A or less, the colour of labels for main switches can be the same as the labels for other equipment.

Abbreviations such as DB 7, FIB, EWIS, and MCC2 are unacceptable.

Examples of acceptable labels are:

a) Main switch – Tenant's light and power, Levels 7, 8 and 9
b) Main switch – House services light and power, Levels 1–15
c) Main switch – Motor control panel No. 2, Level 12
d) Main switch – Distribution board, Level 3
e) Main switch – Air conditioning board, Level 14.

4.16.2.3 Switches for fire and smoke control equipment

Examples of acceptable labels are:

a) Main switch – Fire hydrant pump, Level 20
b) Main switch – Fire sprinkler pump, Level 2
c) Main switch – Fire hose reel pump, Levels 7 to 10
d) Main switch – Fire indicator board
e) Main switch – Emergency warning intercommunication system
f) Main switch – Smoke control fans switchboard, Level 9
g) Main switch – Lift 1, High rise, Level 19.

4.16.2.4 Installations in separate buildings

Label 6 is an example of an unacceptable label.

Use internal building numbers wherever possible. Avoid names of companies.

Label 6 – unacceptable

Main switch (location) light, power, air conditioning, lifts and fire services

4.16.2.5 Main switchboard enclosures

Refer to labels 7 and 8 below. If necessary, the label should also include some means of identifying the premises, e.g. 7–19 Phillip Street.

Label 7

Main switchboard electrical services

Label 8

Main electrical switchroom

In large and complex installations, place signs at the fire indicator board and at or next to the tenant's directory board.

Label 9 is an example of this type of sign:

Label 9

Main electrical switchboards located on Levels B2, 10 & 27 Private generation switchboard on Level 28

4.16.2.6 Switchboard equipment

Abbreviated labels such as DB 7 or MCC2 are not acceptable. Labels should indicate the floor or level number or location and, if necessary, the type of load, for example:

a) Light and power, Level 17, north side

b) Air conditioning board, Level 2.

The use of suitable diagrams mounted on or near the switchboard would be acceptable in complex installations where direct labelling would be excessive and confusing. Make a reference on the switchboard to any diagrams.

4.16.2.7 Segregation of supplies

Labels 10–15 shown below are acceptable examples.

Label 10

Main switchboard no. 1
Electricity distributor supply no. 1
circuits 1–18 main switchboard no. 2
is located .....

Label 11

Main switchboard no. 1
Electricity distributor supply no. 1
supplies areas as shown in diagram.
Main switchboard no. 2
is located .....

Label 12

Main switchboard no. 1
Electricity distributor supply no. 1
supplied from substation no. 12345
Main switchboard no. 2
is located .....

Label 13

Distribution board Level 7
supplied from no. 1 main switchboard

Label 14

Electricity distributor supply no. 1
supplies main switchboard no. 1
located on ground floor

Label 15

Electricity distributor supply no. 1
supplies main switchboard no. 1
located on ground floor.

Private generation supply also available,
isolate at generator switchboard on Level 7.

4.16.2.8 Alternative supplies

Display a notice prominently on the main switchboard, distribution board or changeover equipment cubicle in accordance with section 8.

The circumstances to consider are:

a) isolation of the alternative supply to the main switchboard, distribution board or changeover equipment cubicle

b) isolation of an outgoing circuit from the normal supply switchboard

c) isolation of a switchboard remote from the switchboard containing the changeover equipment.

Examples of acceptable labels are:

Label 16

WARNING:
Private generating plant will
automatically be connected to
this switchboard on loss of
electricity distributor supply.
Isolate private generating plant
in lower basement.

Label 17

Main switch, tenant's light and power, Levels 1–
11.
WARNING:
Alternate supply available.
Isolate also at circuit breaker no. 2
on private generating plant,
switchboard on Level 17.

Label 18

Main switch controls circuits 4, 5, 6 & 7.
WARNING:
Alternate supply available to circuit 8.
Isolate also at circuit breaker no. 3
on private generating plant
switchboard on Level 17.

4.16.2.9 Miscellaneous

Isolators, automatic transfer switches, mode selector switches and similar unusual equipment, are usually installed so they are not readily accessible.

Labelling of this equipment on the outside of the switchboard would not normally be necessary.

If labelling is required, it shall not cause confusion. Labelling of this equipment on the inside of the switchboard is necessary to explain the purpose of the equipment.

If an automatic transfer switch is to be used as a main switch, then the associated supervisory control switch will need to be accessible. Label this to indicate it is a main switch, and that it will isolate both the electricity distributor's and the private generation supplies.

Label voltmeter and ammeter selection switches as voltmeter and ammeter selection switches.

4.16.2.10 Circuit breakers – cascade

Where cascade or series connected circuit breakers are installed for current limiting purposes, the following warning label shall be installed adjacent to the circuit breakers.

At upstream circuit breakers:

Label 19

WARNING: All protection devices on this switchboard have been selected to cascade with the downstream circuit breakers. Replace only after consulting manufacturer.

At downstream circuit breakers:

Label 20

WARNING: All protection devices on this switchboard have been selected to cascade with the upstream circuit breakers. Replace only after consulting manufacturer.

5 Special small services

5.1 Introduction

Supplies located in public places, unmetered and of low-voltage (LV) single phase up to 10 amps (A) rating where an accurate assessment of energy usage can be made.

Special arrangements apply for supply to certain small installations, referred to as 'special small services'. These arrangements are restricted to public facilities located in public places. The electricity distributor will provide guidance on the selection of the PCC.

Generally, supply to these small installations does not exceed 230V 10A single phase. Typical small installations include bus stop shelters, traffic lights, small cell telecommunications, public conveniences, floodlights, decorative lighting, direction and locality signs and public telephones, CCTV cameras etc.

Generally, meters are not used in these installations because an accurate assessment can be made of the energy usage.

Note: Should a meter be installed, adequate discrimination between the metering protection device, main switch, final subcircuit protective device and the connection point HRC fuse will not be achievable due to limitations of the HRC fuse size required at the connection point. If this is not acceptable, section 2 shall be complied with unless approved by the electricity distributor.

Supply from the distribution mains allows for 24-hour operation and is not restricted. A time control switch or other controller may be required where the customer wishes to restrict the time of operation.

The electrical installation may be connected to controlled street lighting mains only if all of the following apply:

a) there are no distribution mains available, and

b) operation of the installation is required only at night, and

c) there is adequate capacity in the street light mains to supply the proposed load (consult with the electricity distributor), and

d) an individual controller is installed within the electrical installation, to restrict operation to night-time usage, e.g. a photoelectric cell.

Submit a location sketch of each site to the electricity distributor. It should detail the position of the customer's structure with distances from the electricity distributor's equipment and property lines.

These arrangements do not include supplies to building sites or fetes etc, in public places.

5.2 Connection to the distribution system

5.2.1 Underground supply from overhead mains

Figure 5-1 shows the standard arrangements for an underground electricity supply from overhead distribution mains. The customer shall supply and install an approved connection point termination box on the electricity distributor's distribution pole. The box and conduit are to be mounted on the pole face opposite the traffic flow.

The customer shall provide and arrange for the installation of the service consisting of minimum 6mm^2 stranded copper conductors single-core thermoplastic insulated and sheathed cable.

Where the connection point is not on a distributor's pole, section 2 applies.

A Level 2 ASP, with appropriately registered personnel authorised by the electricity distributor, shall install all distributor pole mounted equipment and connect the service cable to the electricity distributor's overhead distribution mains.

The service shall be installed as follows:

a) Enclose the cable on the pole in flexible plain conduit to AS/NZS 2053.4.

b) Provide enough conduit to reach the cross arm and enable a weather loop to be formed adjacent to the PCC.

c) Provide 1500mm of cable free of conduit at the PCC to enable the connection to the distribution mains.

d) Attach the conduit to the pole above the terminal box using sufficient full (2-hole) galvanised saddles and 40mm long galvanised clouts or screws. Refer to clause 5.2.1.1 where other than timber poles are used.

e) Maximum number of UGOHs on the electricity distributor's pole shall comply with clause 2.10.4 of these Rules.

5.2.1.1 Concrete and steel poles

Where supply is taken from a concrete or steel pole, stainless steel 'band-it' or similar bands shall be used. The bands shall have suitably sized conduit saddles to fix the conduit to the pole.

Equipment mounted on the pole shall also use bands to fix it in place. **Do not drill any holes in concrete or steel poles for fixings.**

5.2.2 Underground supply from underground mains

Figure 5-2, Figure 5-5 and Figure 5-6 show the standard arrangements for supply from the electricity distributor's underground distribution mains. The customer shall supply and install a connection point termination box within a private pit or pillar, as specified in the electricity distributor standards.

The installation of the connection point termination box may be replaced with a submersible inline fuse with a rating not exceeding 20A and submersible neutral connector within the pit. The installation's maximum 10A current limiting device may be located within the electrical installation. The location of the overload protection is to be clearly marked within the pit to ensure ease of location of equipment.

Any alternate proposals to the above are required to be agreed to by the electricity distributor before installation.

Figure 5-3 shows the standard arrangement where supply is taken from the electricity distributor's street lighting standard or pillar.

Do not mount any customer equipment within the electricity distributor's equipment unless the electricity distributor gives permission.

An ASP authorised by the distributor, will connect the underground service cable to the distributor's underground distribution mains. The customer will supply the cable between the

distributor's underground mains and the connection point termination box. The customer shall provide and arrange for the installation of the underground service cable consisting of minimum 6mm^2 stranded copper conductor single-core thermoplastic-insulated and sheathed cable.

Routes greater than 10m shall comply with section 2.

The cables shall be installed in accordance with AS/NZS 3000 and the principles outlined in this section and clause 2.4.

Enough cable is to be provided to connect the underground service cable to the underground distribution mains.

Underground cabling shall be installed in heavy duty UPVC conduit as specified in AS/NZS 3000 for Category A system enclosure, or as approved by the electricity distributor. The underground conduit shall maintain 500mm depth throughout its length.

Orange marker tape, complying with AS/NZS 2648.1 shall be installed approximately 50% depth of cover above all underground electrical conduits.

Underground electrical conduits located in footpaths are to run parallel with or at right-angles to the property line in accordance with Figure 5-2. Refer to section 2.

5.2.3 Overhead service to customer's structure

Where agreed to by the electricity distributor, an overhead service can be installed to a POA on a customer's structure; refer to section 3.

5.3 Customer's structure

For structures to be erected over the electricity distributor's footpath allocation for underground mains, the electricity distributor shall be consulted to obtain their conduit requirements.

Figure 5-2 gives general requirements on the provision and installation of conduits in accordance with this clause.

5.4 Electrical installation

5.4.1 Type of installation

The installation and wiring shall comply with AS/NZS 3000 and this section and may be either a double insulated or earthed installation.

If it is double insulation, all fittings and accessories shall comply with the requirements of double insulation.

Where earthing is required it shall be arranged as a multiple earthed neutral (MEN) system, unless the installation is on railway land; refer to clause 1.17.7.1.

A notice in accordance with the requirements of the Gas and Electricity (Consumer Safety) Regulation 2018 is to be submitted for all work associated with the electrical installation.

5.4.2 Connection point

For OH, the connection point shall be contained within a termination box installed on the electricity distributor's pole.

For UGOH, the connection point shall be on the electricity distributor's pole when installed as a special small service, or in a private pit/pillar or SPD at the metering enclosure when installed as per section 2.

For UG installations, the connection point shall be either a sealed in-line fuse (active) or contained within a termination box (as per 5.4.2.1) when installed as a special small service, or at the SPD at the metering enclosure when installed as per section 2.

The connection point will be the line side of the protection device.

5.4.2.1 Termination box

The terminal box shall meet the following requirements:

a) If the box is in a pillar, it shall be 150mm minimum above ground level.
b) The box, complete with lid and sealing gasket, shall be of suitable size to permit the necessary connections. Consideration of bending radius is also required.
c) The box shall have a minimum rating of IP33 for above ground use, and IP67 for below ground use.
d) Access to a box not installed above 3,000mm, or a box in a pit, shall require use of a tool, and the box shall be suitable to minimise vandal damage.

5.4.2.2 Control and protection

Refer to Figure 5.4 and Figure 5.5. The following shall be contained within a suitable terminal box:

a) a neutral link with MEN
b) a minimum 20A fuse carrier and base
c) a maximum 20A HRC fuse link, and to provide main control and overcurrent protection either:
   i. a double pole maximum 10A overcurrent circuit breaker for double-insulated installations, or
   ii. a single pole maximum 10A overcurrent circuit breaker, or
   iii. a maximum 10A residual current breaker with overcurrent protection (RCBO).

Refer to Figure 5.6. For pit installations only:

a) a maximum 20A sealed in-line fuse (SILF) installed on the active conductor, and
b) an IP67 insulation piercing connector (IPC) on the neutral conductor.

Each device shall be secured to separate side walls of the pit using suitably sized conduit saddles. Cables shall be colour coded as per AS/NZS 3000. Waterproof labels to be installed in a visible location within the pit indicating where the installation is fed from, where the installation is located, who the owner is, and a contact phone number for the owner.

5.4.3 Installation on the electricity distributor's pole

Refer to Figure 5-1. The method of installation on the electricity distributor's pole shall meet the following requirements:

a) The submains or final subcircuit installed between the connection point termination box and the customer's structure shall be installed in flexible plain conduit to AS/NZS 2053.4 from the terminal box to a minimum of 1,000mm from the base of the pole and be suitably protected against mechanical damage.

b) The conduit shall be protected to comply with clause 2.10.2.

c) The connection point termination box is to be maintained by the customer and installed on the pole face opposite the traffic flow, a minimum of 3,000mm and a maximum of 3,800mm above ground.

d) Using sufficient full (2-hole) galvanised saddles and 40mm long galvanised (equivalent or better) clouts or screws to secure the conduit to the timber pole (refer to clause 5.2.1.1 where other than timber poles are used). The conduit shall be installed on the pole face opposite the direction of traffic flow.

e) The customer shall arrange for a Level 2 ASP to install the consumer mains to the connection point within the termination box.

f) The required mechanical protection of the consumer mains between 2,500mm above ground line and 300mm below ground line shall be tubular or 'U' section construction with no side flanges (side securing tabs are permitted) to minimise the surface area of the pole that is covered.

Unless authorised, people are not permitted to work on or near the electricity distributor's assets.

5.4.4 Earthing

The earth electrode may be located:

a) no closer than 1m from the base of the distributor's pole, or

b) in a private pit containing the connection point or in a separate pit, or

c) within or adjacent to the structure being supplied. If within the structure, the connection shall be accessible from an inspection cover.

For electrical installations on railway land, special conditions may apply.

5.4.5 Labelling

Labelling shall be permanent and suitable for its installed location, and at a minimum contain the following information:

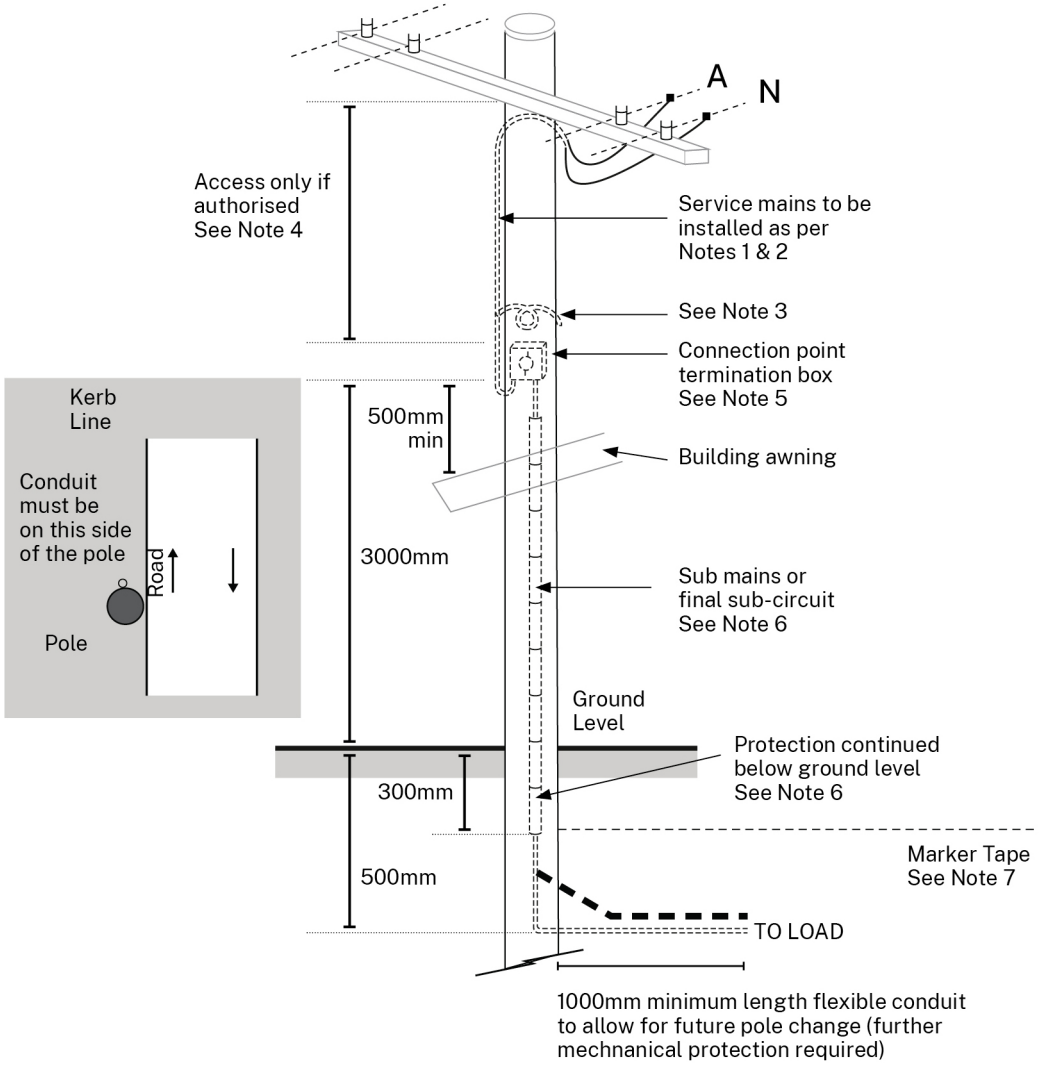
a) at the connection point, include the type (i.e. bus shelter, NBN cabinet, etc), the asset number, and the location of the special small service

b) at the special small service, include the location of the PCC or connection point, and emergency contact phone details, and a map as per clause 2.4.4.

5.4.6 Underground consumer mains

The electrical installation wiring should be installed where possible in the electricity distributor's footway allocation.

Figure 5-1 Typical arrangements for 230V power supply from overhead mains



Note:

1 Install the required length of minimum 20mm flexible plain conduit (conduit to comply with AS/NZS 2053.4) with minimum 6mm^2 single-core double-insulated cables for installation between the connection point termination box and the PCC. Fix and terminate at the connection point termination box.

2 Allow 1500mm of free length of cable without conduit at the electricity distributor's cross arm to connect to the electricity distributor's mains.

3 Only authorised ASPs are permitted to work on or near the electricity distributor's distribution assets.

4 The customer is to provide and maintain an approved connection point termination box. Refer to Figure 5-4. The box may also be located nearby on a wall or structure where supplied by an overhead service main.

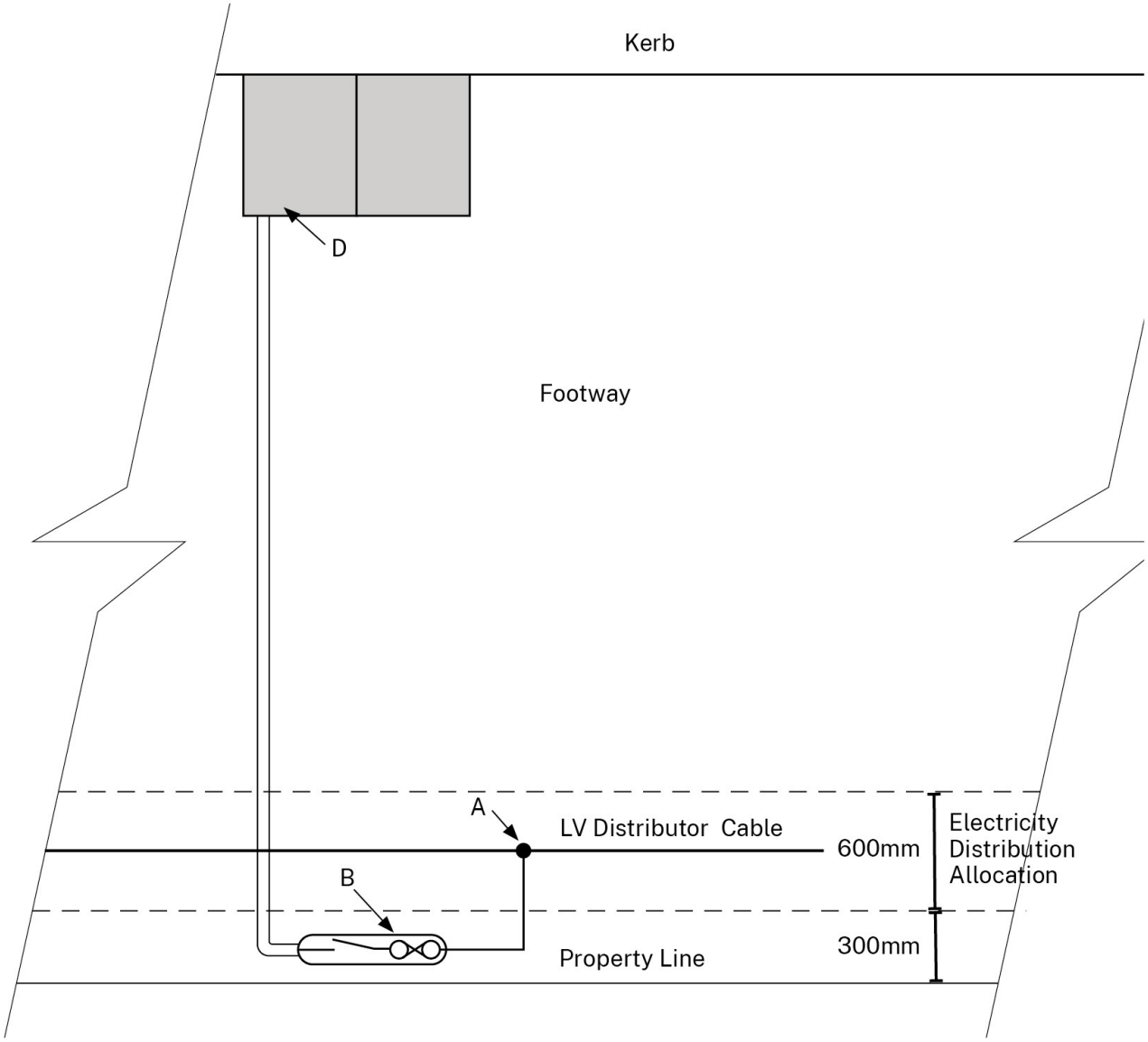
5 Cables to be installed in conduit between the connection point termination box and the customer's structure. The conduit on the pole and within 1,000mm of the base of the pole shall be flexible plain conduit, to AS/NZS 2053.4, or as agreed with the electricity distributor. The conduit is to be suitably protected against mechanical damage:

– up to 2,500mm above the finished ground level, and

– over the underground portion of the flexible plain conduit.

6 Install marker tape approximately 50% depth of cover above the conduit (refer to clause 5.2.2).

Figure 5-2 Typical arrangements for 230V power supply from underground mains



A Refer to the electricity distributor for supply details. New connections to the mains shall be via a distribution pit, pillar or street light column. Existing tee joints may remain after consultation with the electricity distributor.

A–B Minimum 6mm^2 copper 0.6/1kV single-core PVC/XLPE or PVC/PVC cable installed in accordance with the AS/NZS 3000 and clause 5.2.2 (to be kept as short as possible, maximum length is 10m for 6mm^2 cable).

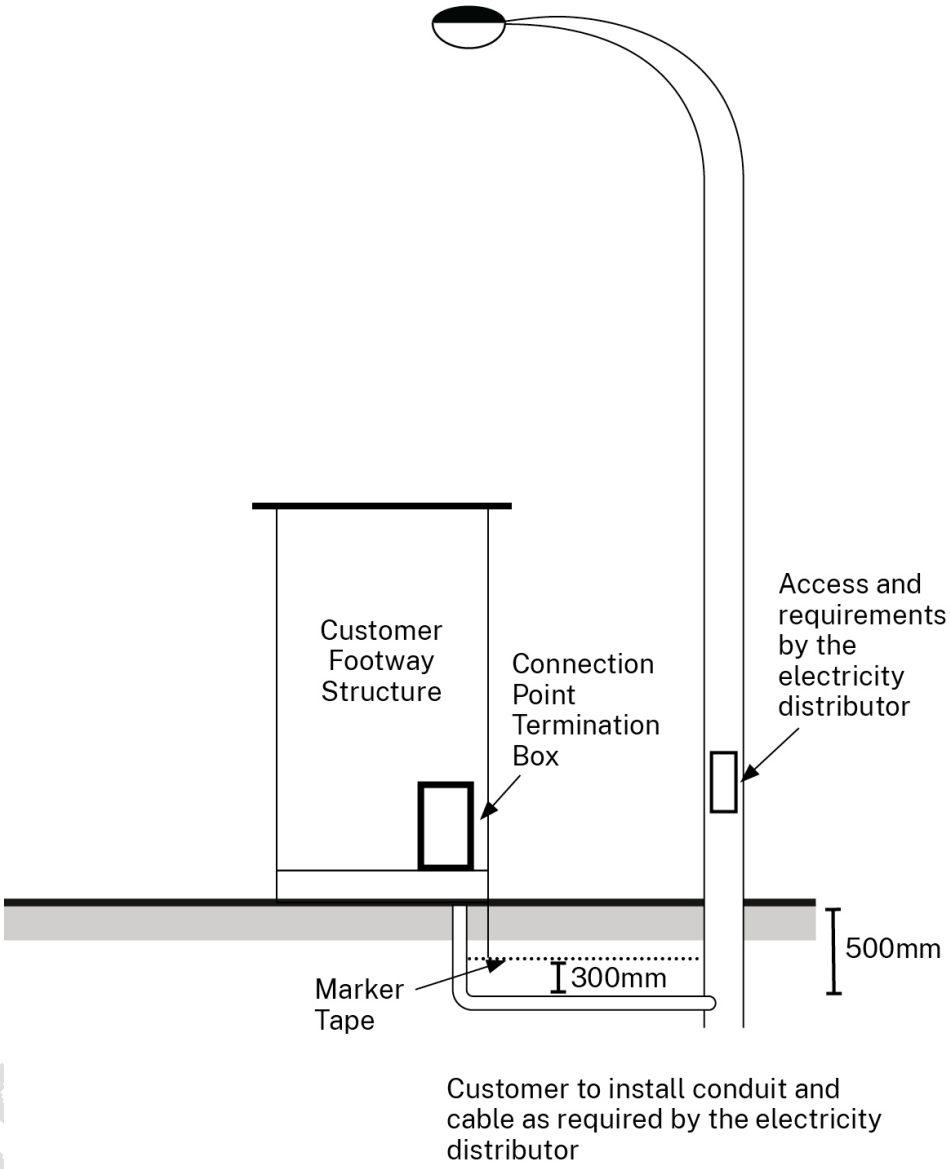
B Approved pit service box supplied and installed by the customer. Refer to Figure 5-5 connection point termination box installed in a pit below ground or Figure 5-3 when installed in a pillar or structure.

B–D Cable installed by customer in accordance with the AS/NZS 3000 and clause 5.2.2.

D Electrical installation.

Note: where the customer's footway structure is built over the electricity distributor's footway allocation, ducts are to be laid beneath the structure in accordance with Figure 5-7 for requirements for ducts under customer's footway structure.

Figure 5-3 Typical arrangements for 230V power supply from underground mains from a steel street lighting standard



Note:

1 Refer to Figure 5-2 for requirements for laying customer's cables in footway.

2 Refer to Figure 5-7 for requirements for ducts under customer's footway structure.

3 Install marker tape (refer to clause 5.2.2).

Figure 5-4 Typical connection point termination box 230V power supply for above ground use (pole mounting illustrated)

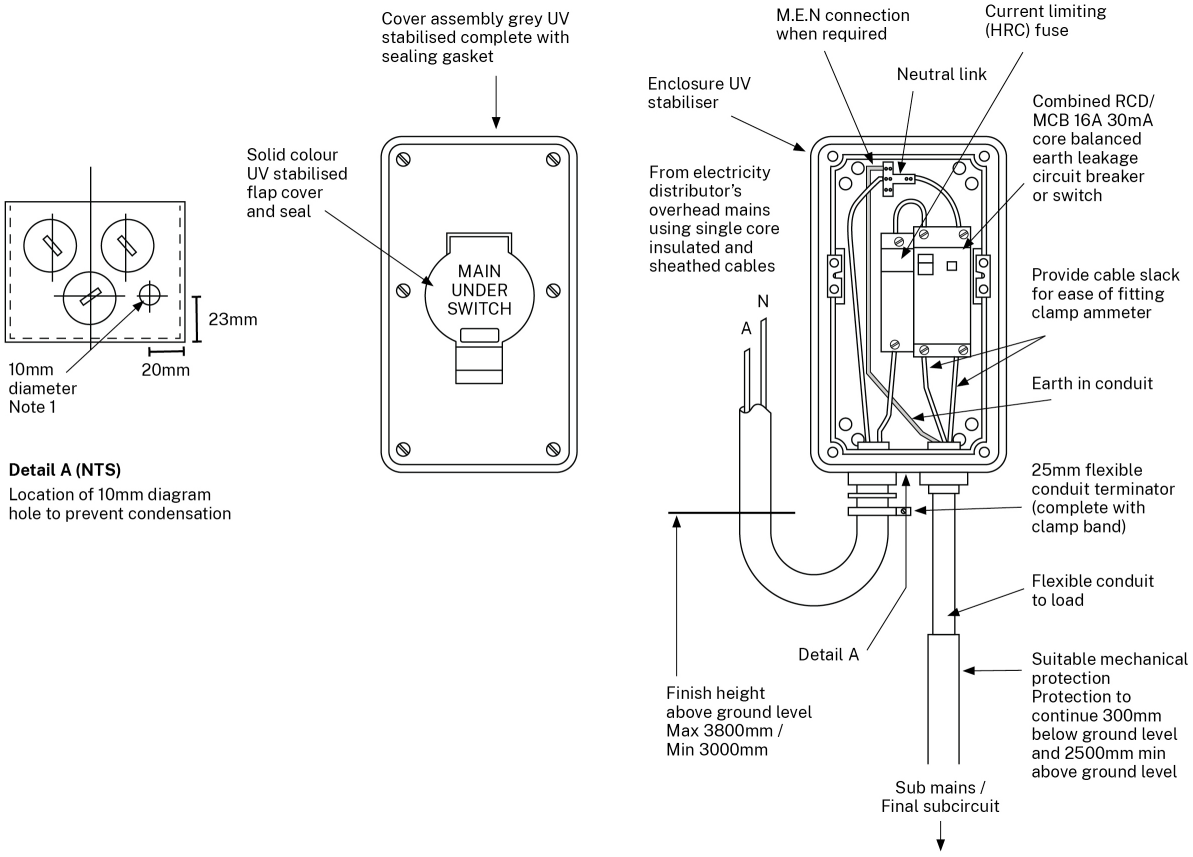
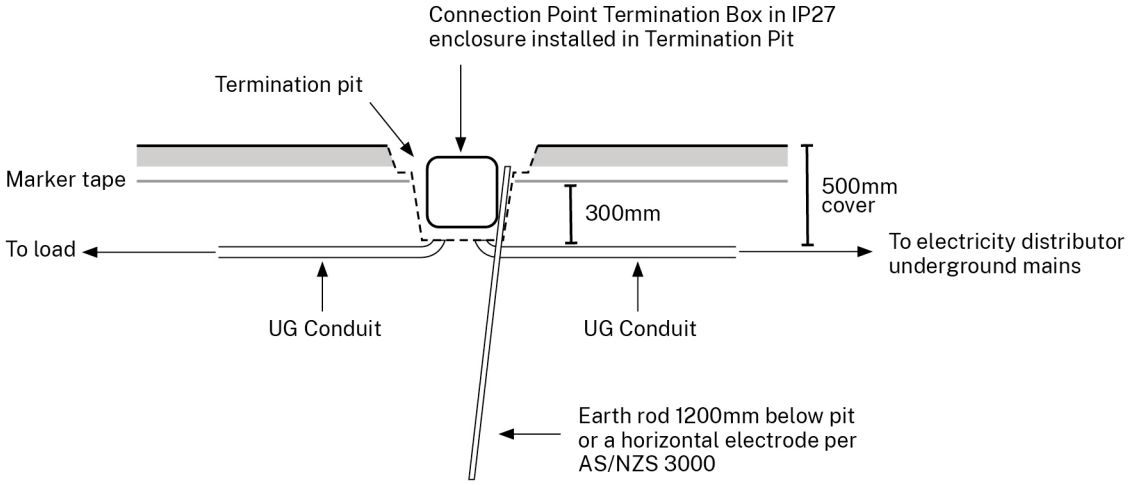
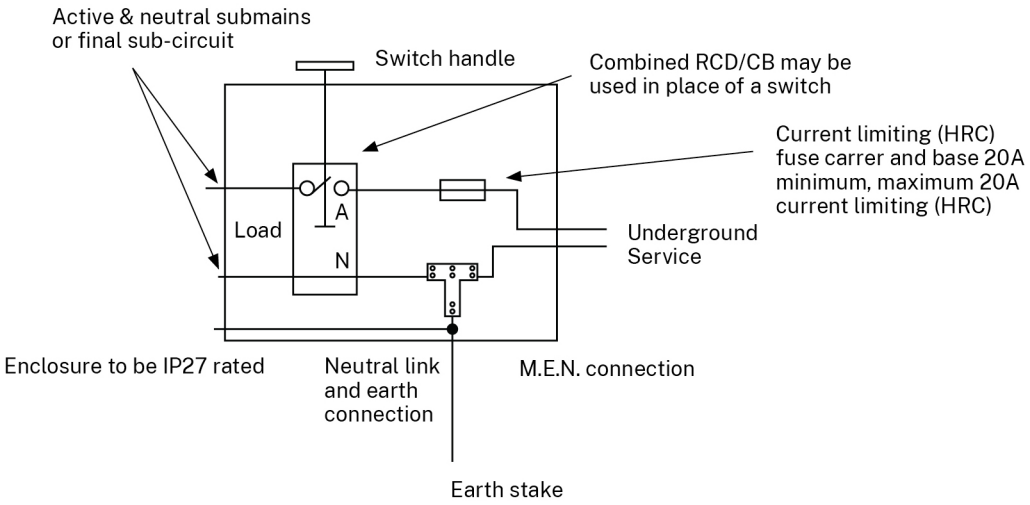


Figure 5-5 Connection point termination box for 230V power supply installed in a pit below ground



GENERAL ARRANGEMENT



CONSUMERS TERMINAL BOX

Components

- Enclosure to be IP27 rated.
- Current limiting (HRC) fuse carrier and base 20A minimum, maximum 20A current limiting (HRC) fuse link.
- Combined RCD/CB may be used in place of a switch.
- Neutral link and earth connection

Figure 5-6 Example of pit using sealed inline fuse and insulation piercing connectors

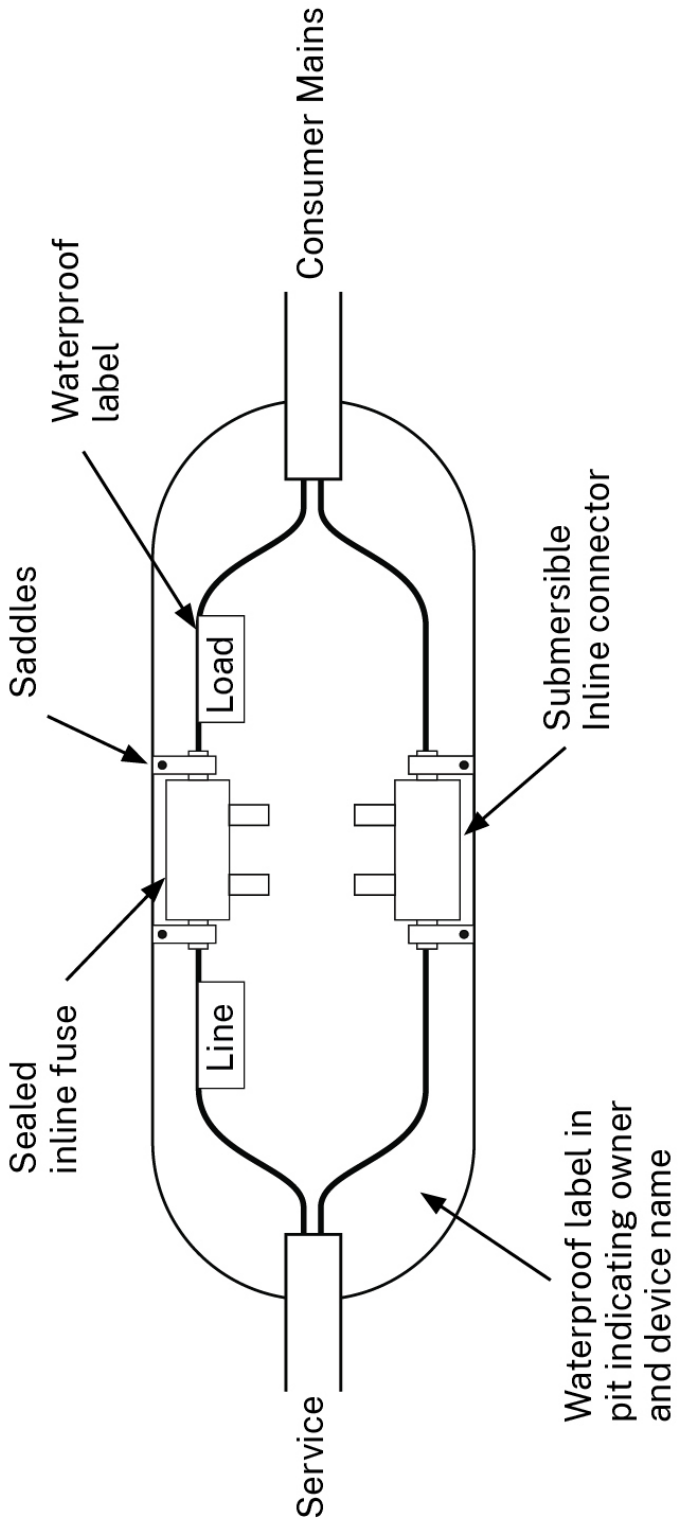
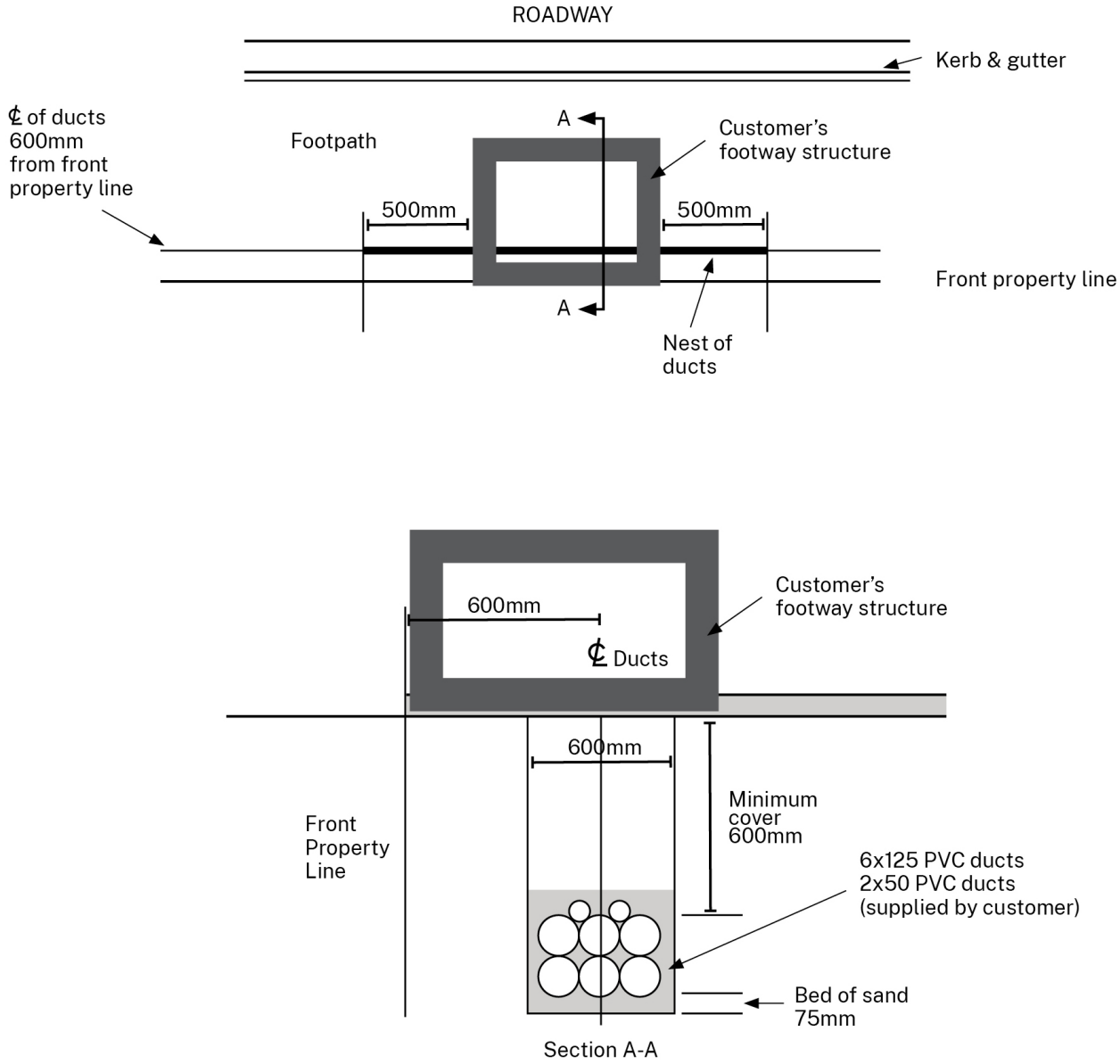


Figure 5-7 Typical installation of ducts under customer's footway structure



Note:

1 Confirm the electricity distributor's requirement and cable location before carrying out any excavation.

2 Ducts to be installed on 75-mm bed of sand.

3 Ducts to be installed in a straight line and at an even grade.

4 End of ducts to have each end plugged with PVC plugs before backfilling.

5 Minimum of 3 working days' notice to be given for work on site.

6 Power factor correction

6.1 Introduction

Industrial and commercial loads require significant amounts of reactive power (kVARs) for the operation of motors, furnaces, electric discharge lighting and the like. The result is a low power factor. The low power factor can be improved by applying capacitors to supply this reactive power.

6.1.1 Power factor correction / capacitor installation

The customer shall maintain the maximum demand power factor of the electrical installation at a value between 0.90 lagging to unity.

The electricity distributor may require metering of the installation, at an appropriate tariff, if the power factor of the supply taken by an electrical installation is such that either:

a) the distribution system is not, or would not be used efficiently, or

b) the supply to another customer is, or would be adversely affected.

The installation of power factor correction equipment, or in the case of the variation of any inductive load, shall not:

i) cause the power factor of the installation to become leading at any time

ii) adversely affect the operation of the electricity distributor's frequency injection load control system.

6.1.2 What is power factor?

Power factor is about the effective use of the electricity distributor's distribution system. It is a measure of how effectively electricity supplied is actual productive power (i.e. light, heat, motive power). Improving power factor could reduce energy costs if it is charged at a tariff incorporating a kVA demand component or a power factor penalty.

The costs of a kVA demand type tariff and a kWh tariff are not the same. There is a difference between the power supplied to a premises **apparent power** (measured in kVA) and the power consumed in electrical equipment **real power** (measured in kW).

This difference is due to electromagnetic fields. **Reactive power** (measured in kVAR) is required to establish electromagnetic fields which allow magnetic coils to operate. These coils are found in fluorescent and mercury vapour lighting, electric motors and many other types of equipment.

6.1.3 Importance of power factor to a business

Improving an installation's power factor can be a significant benefit to a business.

It can achieve this in 2 ways:

a) On an electricity installation using a kVA demand tariff, a higher power factor would reduce the peak kVA demand and save money on the electricity account.

b) If the main switchboard or service / consumers mains are loaded to capacity, an improvement in power factor may provide additional capacity at a lower cost than the replacement of the switchboard or upgrading of the service / consumers mains.

6.1.4 Power factor correction

A higher power factor for the installation can be achieved by reducing the total amount of reactive power required by an electrical installation.

In most cases power factor is best corrected by connecting capacitors at the load terminals, for example, at each motor or each luminaire. However, for economic reasons power factor correction usually takes place at the customer's main switchboard using switchable capacitor banks.

The cost of installing power factor correction capacitors can usually be recovered through reductions in electricity costs.

6.1.5 Cost savings

Significant savings can be achieved by controlling the electrical installation's overall power factor.

As an example, improving a power factor of 0.67 to 0.98 will result in a reduction of about 20% in the total demand charge.

Even with low levels of power factor correction, the savings can be worthwhile.

6.2 Equipment requirements

Power factor correction equipment may be located:

a) in or connected to a distribution board for that part of the installation supplied by that distribution board

b) at the main switchboard for the whole of the installation

c) in individual electric discharge lighting circuits

d) in individual equipment such as induction furnaces, motors, lighting fittings, etc.

The kVAR value of capacitor banks required to obtain a desired power factor for a particular kW load is set out in Table 6-1. Use this table as a guide when designing an installation.

Shunt capacitors shall comply with publications *IEC 60831-1: 2014 Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000V – Part 1: General Performance, testing and rating – Safety requirements – Guide for installation and operation*, as appropriate.

Application for the connection of power factor correction equipment shall be made to the electricity distributor. An application is required for each connection except where fitted to individual items of equipment with low power requirements.

Obtain agreement from the electricity distributor before you commit funds or install the power factor correction equipment.

6.2.1 Capacitor switching steps

In addition to the above requirements, the automatic control capacitors shall be made in steps to not affect the ripple frequency. However, the electricity distributor may consider larger steps in the following circumstances:

a) if the capacitors are switched with equipment as one unit, then there is no limit to the size of capacitors, or

b) in exceptional or special circumstances where switching is not frequent, and either:
   i) the installation is connected to a low impedance supply system (an example would be where the installation is in the proximity of, or directly connected to, an appropriate size of substation)
   ii) other conditions which make sure the supply to other customers is not affected.

6.2.2 Equipment design

The design of the power factor control system to meet the customer's and the electricity distributor's requirements is a complex matter.

Therefore:

a) It is recommended you use a competent energy management consultant.
b) Discuss the detailed aspects of the design of the power factor correction installation with the electricity distributor before it is manufactured.
c) Submit any impedance improvement equipment for approval before connection. Impedance improvement equipment is necessary with power factor correction equipment to reduce the attenuation effect on the electricity distributor's ripple control signal. Refer to clauses 6.6, 6.7 and 6.8.

Table 6-1 Power factor correction, determination of kVARs required

Original power factor	Corrected power factor										
	0.80	0.82	0.84	0.86	0.88	0.90	0.92	0.94	0.96	0.98	1
0.50	0.982	1.034	1.086	1.139	1.192	1.248	1.306	1.369	1.440	1.529	1.732
0.52	0.893	0.945	0.997	1.050	1.103	1.159	1.217	1.280	1.351	1.440	1.643
0.54	0.809	0.861	0.913	0.966	1.019	1.075	1.133	1.196	1.267	1.356	1.559
0.56	0.730	0.782	0.834	0.887	0.940	0.996	1.054	1.117	1.188	1.277	1.480
0.58	0.655	0.707	0.759	0.812	0.865	0.921	0.979	1.042	1.113	1.202	1.405
0.60	0.583	0.635	0.687	0.740	0.793	0.849	0.907	0.970	1.041	1.130	1.333
0.62	0.516	0.568	0.620	0.673	0.726	0.782	0.840	0.903	0.974	1.063	1.266
0.64	0.451	0.503	0.555	0.608	0.661	0.717	0.775	0.838	0.909	0.998	1.201
0.66	0.388	0.440	0.492	0.545	0.598	0.654	0.712	0.775	0.846	0.935	1.138
0.68	0.328	0.380	0.432	0.485	0.538	0.594	0.652	0.715	0.786	0.875	1.078
0.70	0.270	0.322	0.374	0.427	0.480	0.536	0.594	0.657	0.728	0.817	1.020
0.72	0.214	0.266	0.318	0.371	0.424	0.480	0.538	0.601	0.672	0.761	0.964
0.74	0.159	0.211	0.263	0.316	0.369	0.425	0.483	0.546	0.617	0.706	0.909
0.76	0.105	0.157	0.209	0.262	0.315	0.371	0.429	0.492	0.563	0.652	0.855
0.78	0.052	0.104	0.156	0.209	0.262	0.318	0.376	0.439	0.510	0.599	0.802

Original power factor	Corrected power factor										
0.80	0.000	0.052	0.104	0.157	0.210	0.266	0.324	0.387	0.458	0.547	0.750
0.82		0.000	0.052	0.105	0.158	0.214	0.272	0.335	0.406	0.495	0.698
0.84			0.000	0.053	0.106	0.162	0.220	0.283	0.354	0.443	0.646
0.86				0.000	0.053	0.109	0.167	0.230	0.301	0.390	0.593
0.88					0.000	0.056	0.114	0.177	0.248	0.337	0.540
0.90						0.000	0.058	0.121	0.192	0.281	0.484
0.92							0.000	0.063	0.134	0.223	0.426
0.94								0.000	0.071	0.160	0.363
0.96									0.000	0.089	0.292
0.98										0.000	0.203

6.3 Existing installations

Any additional load shall comply with the minimum power factor requirements of clause 6.1.1.

The electricity distributor may also require the entire installation to comply with the minimum power factor requirements of clause 6.1.1.

6.3.1 Power factor problems in non-domestic, multi-tenanted and large installations

In multi-tenanted installations where power factor is poor for the total installation, any additional load may require uprating of the supply facilities.

The premises should have its poor power factor corrected if the power factor of the entire installation is less than 0.9 and power factor correction would cater for the increased load required. The customer will avoid the cost of an uneconomic extension to supply, i.e. additional facilities.

This may be achieved by:

a) installing the power factor correction equipment within the metered house services section of the premises electrical installation

b) if this is not possible because the house services load is small when compared to the total site, the electricity distributor may allow the correction equipment to be connected to the line side of the meters of all customers, i.e. at the unmetered main switchboard. This would be unmetered, and its consumption would need to be estimated.

Do not seal the power factor correction equipment as it would be impracticable for maintenance of fuses, contactors and other equipment.

Label the section with unmetered supply to highlight it. The unmetered section should also be labelled with total power losses at 100% utilisation of the power factor correction equipment at rated voltage.

6.4 Ripple control and harmonic blocking

Ripple control signals are used as a load control system for the switching of water heaters, street lighting and meter equipment. Where it is agreed that power factor correction capacitors are to be installed and the electricity distributor uses ripple control, the customer shall install additional equipment to block the electricity distributor's ripple control signals. The areas where ripple control is used are available from the electricity distributor.

The frequencies used depend on the region within the electricity distributor's area. The frequencies used by each electricity distributor are detailed in Table 6-3.

At audio signal frequencies, capacitors present an impedance of some 10 to 21 times less than at 50Hz. This can result in a significant portion of the signal being absorbed or lost to the system. The effect on the signal voltage of the control system is variable, depending upon the size and number of capacitors and their distribution in the high and low voltage network.

In the worst case, the capacitor impedance may approach or equal the inductive reactance of the distribution transformer(s), to form a series resonance combination and a virtual short-circuit on the ripple system. Avoid this undesirable and unacceptable condition by connecting blocking inductors in the capacitor circuit.

Shunt capacitors used for power factor correction are likely to cause significant loss to the ripple control signal. Their impedance to the frequency shall be increased by connecting either Blocker, Rejector or Stopper Circuits to a value which will prevent interference to the electricity distributor's ripple control system.

The designer of the power factor correction equipment should also be aware that harmonics may either be created by the installation itself or exist on the supply network. These harmonics may harm the capacitors, and the capacitors should be protected by suitable harmonic blocking.

Note: Although electricity distributors permit the use of any methods stipulated in the following clauses it should be emphasised the preferred method is using detuning reactors. (A detuning reactor is a reactor selected to tune the resonant frequency below any likely harmonics.)

It is often difficult to attain the required level of impedance using other methods, and it should be noted that the full costs of re-inspection due to failure to meet impedance levels will be borne by the customer.

In addition, the electricity distributor may, in future, require improved shunt impedance due to the need for powerline carriers. In this event, further blocking would be required of customers using capacitor banks without detuning reactors.

Customers not providing detuning reactors shall install suitable equipment to prevent switching spikes.

The use of power factor correction without detuning reactors greatly increases the risk of damage from harmonics and the incidence of litigation from other customers due to damage. Although detuning reactors will not nullify these risks, they will be significantly reduced.

Typical single-line diagrams representing various arrangements are shown in clauses 6.6, 6.7 and 6.8.

Table 6-1 Ripple frequencies by electricity distributor (as at 1/06/05)

Electricity distributor	Area	Signal frequency (Hz)
Ausgrid	Upper Hunter	492 & 750
	Hunter Valley	1050 & 750
	Hunter other areas	1050
	Central Coast	1050
	Manly/Warringah Mackellar	1050
	St George	492
	Sydney – other areas	750
Endeavour Energy	Thirroul to Kiama	750
	Kandos area	396
	Nowra	283
	Western Sydney	1050

Electricity distributor	Area	Signal frequency (Hz)
Essential Energy	The distributor should be contacted for information concerning signal frequencies throughout their area.	

6.4.1 Blocking system

The customer is responsible for the design of blocking systems. Blocking should be effective under all required conditions, including where sequential steps of capacitor switching are employed.

6.4.2 System harmonic blocking

This equipment will be installed in a power system environment where natural harmonics of 50Hz exist in varying magnitudes depending on location and time of day. In general, the magnitude of the harmonics tends to diminish as the number increases; the 3rd and 5th tend to be 'strong' while the 17th and 19th are 'weak'. Signal frequencies in common use are positioned in the upper region of this frequency spectrum.

In many electricity distributor's systems, significant levels of 650Hz (i.e. 13th harmonic) are present at some locations and steps are taken in 750Hz installations to minimise the harmful effects of 650Hz.

The series resonance frequencies required are therefore designed to both increase the impedance of shunt capacitors at the signal frequency and avoid introducing low impedance sinks to system harmonics which may overload equipment.

The required tuning frequency should not be close to any harmonic frequency and still provide a sufficient increase in impedance at the signal frequency.

6.4.3 Low frequency ripple systems

Experience in the industry shows that any effects due to capacitance will be negligible for a ripple frequency less than 400Hz. However, sufficient space for the installation of harmonic filters should be provided. Nevertheless, each individual application shall still be checked and verified by the customer.

6.4.4 Ripple control blocking

Although the design of the blocking systems is the responsibility of the customer, in general there are 3 types of circuit commonly used to increase the impedance of shunt connected capacitors at the signal frequency. These are known as blocker, rejecter and stopper circuits. Refer to clauses 6.6, 6.7 and 6.8.

Only the blocker circuit, which acts as a general low-pass filter, is not frequency specific. The rejecter and stopper circuits use parallel resonance and are tuned to a specific frequency.

6.5 Labelling

The power factor equipment shall have a nameplate securely fixed to it in an accessible position. The label shall include the following information:

a) maker's name

b) type, serial number (rejecter coils and stopper circuits only)

c) system voltage rating

d) rated 50Hz current

e) rated capacitor value (inductors only).

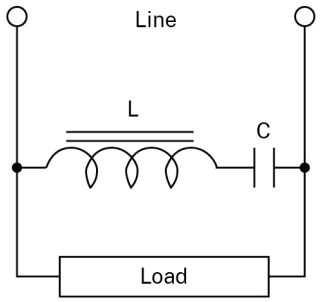
The complete equipment assembly should also be labelled for:

i) series resonant frequency (series inductors and rejecter coils only)

ii) parallel resonant frequency (rejecter coils and stopper circuits only).

6.6 Blocker circuits

Figure 6-2 Blocker circuit



An inductor L in series with the capacitor bank C can be used to increase the signal frequency impedance of single or 3-phase capacitors. This is commonly used in individual discharge lighting fittings.

Choose the inductance of the series inductor (also called a blocking inductor) so the series resonant frequency does not coincide with a strong harmonic of the mains frequency (e.g. 5th harmonic, 250Hz and 7th harmonic, 350Hz). The series resonance frequency is fixed by the inductance of the inductor and the capacitance of the shunt capacitor to be blocked.

The required value of tuned frequency shall be at least 50% below the ripple frequency ± 5%. For example, in a system where a 750 Hz ripple frequency is used, a value of 190 Hz or 320 Hz ensures that harmonic currents and resultant overvoltages on the capacitor are minimised, at the same time providing adequate blocking to the signal frequencies.

The whole installation should present a predominantly inductive impedance within ± 10% of the ripple frequency.

Successful blocking of the harmonics depends on accurate values of inductance and capacitance.

Note: the inductance value should not vary, with up to 200% of the inductors current. There may be considerable difference between the nameplate value and the actual value of capacitance.

Series or blocking inductor circuits are a cost-effective and satisfactory method of raising the impedance to signal frequencies, particularly where the capacitor is a single unit, such as in a fluorescent lighting installation.

6.6.1 Series resonant frequency

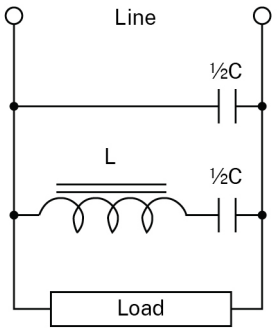
Inductors shall be designed so when they are connected in series with the actual capacitor(s) they will be used with, the series resonant frequency of the combination will be at least 50%

below the ripple frequency within ± 5%. The voltage of the superimposed frequency is 2% of the mains voltage.

Note: the operating conditions of the combination can combine to cause a considerable increase in the RMS current through the capacitor over its normal 50Hz current as determined by the mains voltage and reactance. The voltage rating of the capacitor shall be such that it can withstand these conditions in compliance with *IEC 60831-1: 2014*.

6.7 Rejecter circuits

Figure 6-3 Rejecter circuit



Rejector circuits are used where the capacitor installation can be divided into 2 approximately equal banks. This is often the most cost-effective method for fixed capacitor banks up to 450kVARs. To tune the circuit, on-site adjustment is required.

For large correction currents, and where the shunt capacitor bank can be split into 2 equal sections, the inductor is placed in series with one half of the bank. The inductor then only carries half of the 50Hz correction current. These are called rejecter circuits. They are suitable for fixed capacitor banks up to 450kVAR.

Tune the parallel combination of one half of the capacitor bank and one inductor with the other half of the capacitor bank to parallel resonance at the signal frequency. This offers a high impedance to the control signal.

Tune the inductor on site by air gap adjustment to achieve the required rejection of harmonics and signal frequency.

6.7.1 Signal frequency impedance

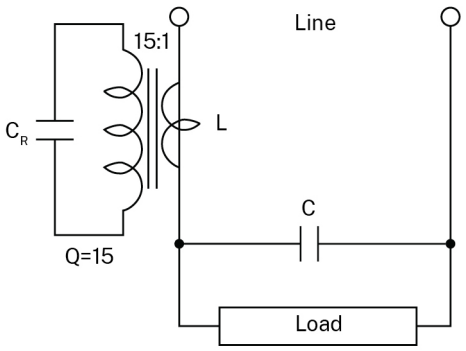
The overall impedance of the capacitor installation with rejecter coils installed shall not be less than 75% of the 50Hz reactance of the capacitors within the frequency range used by the electricity distributor in that location, + 1% - 2%. This shall be measured with a signal voltage equal to 2% of the 50Hz mains voltage across the terminals of the input capacitor(s).

6.7.2 Series resonant frequency

The series resonant frequency of the inductor and the capacitor(s) on the side of the inductor remote from the supply shall not be less than 500Hz.

6.8 Stopper circuits

Figure 6-4 Stopper circuit



Stopper circuits are used for installations with stepped banks of shunt capacitors or where capacitors are located at various sites throughout the installation. They are particularly suitable for automatically controlled systems.

Stopper circuits consist of a self-contained inductor/capacitor unit in series with either the capacitor bank or the line feeding the capacitor bank and the load. Tune the elements to parallel resonance for the signal frequency to be blocked. A series impedance of about 10 times the impedance of the inductor or tuning capacitance alone will be the result.

6.8.1 Signal frequency impedance

The impedance of the stopper circuit alone within the range used by the distributor in that location, + 1% - 2% shall not be less than 75% of the impedance of the capacitor alone at 50Hz. A stopper circuit carrying load current in addition to capacitor charging current shall not be less than 120% of the 50Hz impedance of an equivalent load determined by the current rating. The impedance of this equivalent load shall be determined by dividing the mains voltage by the rated current of the stopper circuit.

In the case of switched or variable capacitor banks, the 50Hz impedance shall be the maximum possible capacitance connected at any time. Further, the overall impedance of the stopper circuit and capacitor in any switched position of capacitance shall not be less than 50% of the 50Hz impedance of the maximum possible capacitance connected at any time.

The impedance at the electricity distributor's ripple frequency shall be measured at rated 50Hz current and with a signal voltage applied equal to 2% of the mains voltage.

6.8.2 Series resonant frequency

The series resonant frequency of the stopper and capacitor combination shall be at least 25% below the ripple signal frequency and at a minimal even harmonic of 50Hz, e.g. 10th harmonic. In the case of switched or variable capacitors, the series resonant frequency with the maximum capacitance connected shall not be within 10% of the ripple signal frequency.

Note: this clause does not apply to stopper circuits carrying load current in addition to capacitor charging current.

For transformer coupled stopper circuits, with 1.3 times the rated 50Hz current flowing in the primary winding, the temperature rise of the secondary winding after 4 hours in still air, measured by the winding resistance method, shall not exceed 50°C.

6.9 Power factor correction equipment installation

Power factor correction equipment is sometimes added after the initial switchboard installation. The equipment is often in a separate cubicle, wired back to the main switchboard. Most of the cable requirements below will not apply for the few instances where the correction equipment is part of the main switchboard.

Where the power factor correction equipment is installed as part of the main switchboard, then the provisions of AS/NZS 3000 apply.

6.9.1 Electrical and mechanical protection of supply conductors

Normally a main switchboard is located in its own dedicated switch room or an allocated area of a plant room or floor. If there is a lack of space in this switch room or switchboard area, the correction equipment may be located remote from the switchboard. In this instance, the interconnecting cables should have electrical protection and isolation devices located on the main switchboard.

The cabling should be clamped in accordance with AS/NZS 3000, to withstand the forces due to fault current. Each individual cable shall be adequate to carry the fault current if the cables between the switchboard and the power factor correction cubicle are paralleled and the cables are not protected (where the correction equipment is located in the switch room). To achieve this, each cable's current rating shall be no less than 25% of the setting of the upstream protection.

6.9.2 Isolation of equipment

Isolation of the correction equipment shall be via a fault make, capacitive load break switch. It is not acceptable to use a fuse link or the power factor controller to operate capacitor contactors to provide isolation. Each consecutive stage of correction will have a time delay before its introduction, so the power factor controller will not provide instantaneous isolation. A circuit breaker or combined switch fuse (CFS unit) is acceptable isolation if it is suitable for switching capacitive currents.

The isolation and protection equipment shall be rated for a fault level of 25kA. The electricity distributor may nominate a higher fault level if:

a) the customer is situated close to the substation supply, or

b) the substation supplying the customer has multiple transformers in parallel.

Labelling of the protection and isolation devices on the main switchboard should show the identity and location of the power factor correction equipment.

6.9.3 Clearances around equipment

Maintain adequate clearances where the power factor correction equipment is installed. If metering equipment is installed nearby, it shall still have the minimum clearances nominated. If the metering location is a problem, it is often more cost effective to relocate the metering than to find an alternative location for the power factor correction equipment.

6.9.4 Frequency rejection equipment

In ripple signal areas, the equipment shall be designed for the ripple frequency or have ripple frequency rejection fitted. Frequency rejection is necessary because the capacitors would otherwise appear as a low impedance to the ripple signal. The equipment shall also be labelled with the designed rejection frequency.

Electricity distributor inspectors will check this frequency matches the ripple frequency of the area in which the equipment is installed. Frequency rejection is necessary to limit the current spread of poor signal sectors within ripple areas. The equipment supplier should test the supply for harmonic content to establish whether harmonic rejection is required to protect the power factor correction equipment. This significantly increases the cost of the correction equipment and need only be installed where necessary.

6.9.5 Oil-filled capacitors

If oil-filled capacitors are used, they should be manufactured in accordance with IEC 60871-1. Other capacitors are manufactured to IEC 60831-1. If the supplier has used oil-filled capacitors with a flashpoint of less than 250°C and with total oil volume of greater than 50L, then the capacitor housing or mounting area should have adequate drainage installed, to prevent the spread of oil as specified in AS/NZS 3000.

6.9.6 Labelling of equipment

The correction equipment should be labelled as specified in clause 6.5.

6.9.7 Power factor monitoring

The current transformer (CT) used to monitor the installation's power factor should be mounted where it will accurately reflect the power factor detected by the revenue metering. Mounting the power factor correction CT close to the revenue CTs is acceptable, provided it does not interfere with the removal of the revenue CT. The CT should be on the line side of the where the power factor correction unit is connected to the installation. The electricity distributor shall approve the location.

6.9.8 The Power Factor Controller

One power factor correction controller is often installed for two or more services. In these situations, the power factor correction controller should make sure that no one service has a leading power factor. If the controller fails, it should give the installation a lagging power factor.

7 High-voltage electrical installations

7.1 Introduction

This section outlines the procedures and requirements for the supply of electricity at voltages higher than 1,000V AC.

This section is to be considered in conjunction with section 1 of these Rules, the high-voltage electrical installations section of AS/NZS 3000, *AS 2067:2016 Substations and high voltage installations exceeding 1 kV a.c.*, the electricity distributor's high-voltage requirements and safety management systems, and applicable Australian or other approved standards.

Inquiries on high-voltage supply and installations should be directed to the electricity distributor.

7.2 General information

Supply of electricity will depend on:

a) availability

b) system constraints.

Customers who take supply at high voltage shall bear the costs associated with:

i) transformer energy losses

ii) the purchase, installation, operation, testing and maintenance of high-voltage equipment

iii) spare equipment

iv) insurance, interest and depreciation

v) compliance with the electricity distributor's safety management system.

Customers shall also bear the cost of fees, deposits, charges or capital contributions which may be required by the electricity distributor, subject to the determinations of the Australian Energy Regulator.

7.3 Submission of proposal

Where the electricity distributor has agreed in principle to supply a new high-voltage installation, alter or add to an existing high-voltage installation, the proponent shall lodge a detailed proposal and include the following key points:

a) the date at which supply is required

b) whether temporary or permanent supply is required; if temporary, for how long supply is required

c) a locality plan of the property

d) the proposed system voltage

e) a schematic diagram of the proposed electrical installation

f) loading details including load characteristics and duty cycles of equipment

g) protection and control details

h) the fault level gradients throughout the installation

i) policy for people to be authorised to accept operating agreements with the electricity distributor.

Considerable planning time may be necessary for the electricity distributor to consider augmentation and/or an extension to the existing distribution system to accommodate the proposed high-voltage installation. This is particularly so where the proposed load is relatively large or located in a remote and un-reticulated area.

Potential customers for high-voltage installations are advised not to purchase or install any high-voltage equipment before the design and construction programs have been accepted by both parties.

7.4 Customer high-voltage installation

7.4.1 Connection point

The high-voltage installation (HVI) commences at the connection point, which is the point agreed between the customer and the electricity distributor.

7.4.2 Compliance

The HVI and equipment shall comply with the requirements of:

a) the HV electrical installations section of AS/NZS 3000

b) AS 2067

c) these Rules

d) the distributor's HV requirements

e) the electricity distributor's safety management system

f) applicable Australian or other approved standards.

7.4.2.1 High-voltage installation safety management plan

Each HVI customer shall have a high-voltage installation safety management plan (ISMP). This plan shall consider the compliance requirements of these Rules, agreed operating protocols with the electricity distributor, applicable legislation, and other relevant codes, guides and standards.

Electricity distributors may require HVI customers to provide evidence of an effectively implemented ISMP which takes into account assessment of worker and public safety and bushfire risk. The electricity distributor's regulatory electricity network safety management system (ENSMS) obligations include consideration of the risk posed by aerial consumers mains connected to its network. The HVI customer may be required to provide evidence in the form of an appropriate independent audit, certificate of compliance or statement of compliance.

7.4.2.2 Bushfire precautions

High-voltage installations may represent particular hazards in relation to bushfire risk such as bare overhead lines, earthing systems, expulsion fuses and other protection devices, etc. For further pertinent information refer to clauses 1.16.5, 3.1.1 and 3.3.1.4 of these rules and the relevant clauses of AS/NZS 3000.

7.4.3 Supply voltage

The electricity distributor will nominate the supply voltage during negotiations. Consult with the electricity distributor for its likely range of voltage conditions and install suitable equipment accordingly.

Transformers should have tappings similar to those specified for the electricity distributor's transformers. These tappings enable the electrical installation's voltage level to mirror those available on the supply system.

Momentary voltage dips and spikes may occur:

a) Line conditioning equipment' shall be installed for supply to voltage-sensitive equipment.
b) Make sure that, when they are used, the over/under voltage relays are designed to avoid unnecessary operation.

7.4.4 Fault levels

AS/NZS 3000 states the electricity installation shall be designed so it 'is capable of performing satisfactorily under fault conditions'. The short-circuit current which may occur in the installation depends on:

a) the prospective fault level at the connection point
b) any contribution which may be made by large rotating electrical plant connected within the installation
c) impedances within the installation.

The effect of the short-circuit current shall be considered in the installation design. The electricity distributor will advise in writing of the maximum prospective fault level on the distribution system at the connection point, under normal operating conditions.

The fault level will be used to determine minimum equipment fault ratings. The fault level given is generally higher than will exist initially to provide for system development.

Unless otherwise advised, install equipment that meets the following minimum fault levels:

i) 11kV nominal supply voltage: 250MVA
ii) other voltages: refer to the electricity distributor.

The electricity distributor will also advise you of the initial fault level at the PCC so you can calculate the protection relay settings and anticipated voltage fluctuations.

The design submission shall include details of fault levels assigned throughout the installation.

7.4.5 Consumers mains

Select the size and type of cable (and the terminations) in consultation with the electricity distributor.

Cable selection should consider the possibility of future load growth and be adequate for the maximum prospective fault level.

7.4.6 Protection and control of incoming supplies

The customer shall include protection devices in each incoming supply, as well as the control device required by AS/NZS 3000.

Protection devices shall ensure discrimination with the electricity distributor's protection devices in the event of a fault on any part of your installation. Include the relevant details of your proposed main protection devices in the design submission.

Where batteries are used to operate the incoming supply circuit breaker's trip mechanism, the battery shall be provided with:

a) automatic charging equipment

b) a battery-condition indicator

c) an under voltage alarm.

Refer to Attachment B which sets out the typical details the electricity distributor requires.

7.4.7 Testing and inspection

The customer shall arrange and pay for the testing (to the electricity distributor's satisfaction) of all high-voltage equipment:

a) within a new installation

b) involved in the repair, alteration or addition to an existing installation.

The testing shall be completed before the electricity distributor may permit the connection of the installation, or any part of it, to their supply.

The customer shall provide the electricity distributor with copies of all test reports, indicating the equipment has passed the required tests.

The electricity distributor may inspect the installation for compliance with the requirements of AS/NZS 3000 and relevant standards.

The person responsible for carrying out the work is required to submit the installation particulars on the relevant notification of electrical work form.

7.4.8 Operation of the customer's high-voltage installation

The customer is responsible for the operation of the high-voltage installation, including any switching of the customer's equipment.

The prospective high-voltage installation customer shall establish and document effective operational procedures as part of their high-voltage installation safety management plan.

The customer shall maintain records of either:

a) electrically qualified staff, or

b) employees of an electrical contractor

verified as competent[1] and authorised by the HVI responsible person to operate the high-voltage installation and enter into operating agreements with the electricity distributor.

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[1] Competent:

- Operators must be trained and verified as competent for the specific installation, procedures, tools and apparatus they are expected to use, and any procedures required by the electricity distributor to enter into an operating agreement.
- Testing and proving HV electrical equipment to be de-energised is considered **energised electrical work**.

The customer shall provide the required safety and operating equipment for people working on the electrical installation.

Attachment A of this publication shall be read in conjunction with this standard.

7.4.9 Maintenance

The customer shall maintain the high voltage installation to ensure the electrical equipment is always in sound operating condition. It shall be maintained to safely perform the functions for which it is designed.

In addition to the equipment manufacturer's guidance and specifications for maintenance of the equipment, the following publications are relevant in this regard:

a) SafeWork NSW Code of Practice – Managing the Risk of Plant in the Workplace

b) SafeWork NSW Code of Practice – Managing Electrical Risks in the Workplace

c) applicable Australian Standards

d) Electricity Supply (Safety and Network Management) Regulation 2014.

Safe access shall be provided before working on any part of the high-voltage installation.

The installation shall be effectively earthed at suitable points during work on or near exposed conductors.

The customer shall provide suitable direct earthing equipment or use equipment with built-in earthing facilities.

In general, the principles of *ENA Doc 003-2021 National Guidelines for Safe Access to Electrical and Mechanical Apparatus* should be applied to HV installations.

7.4.10 Power factor correction

The customer shall maintain the maximum demand power factor at all metering points as per the connection agreement or at a value between 0.9 lagging to unity (customers supplied at a voltage ≥ 50kV refer to the *National Electricity Rules*). You should allow for power factor correction equipment in the initial design.

Attachment A – Schedule of minimum operating procedures and safety equipment – HV electrical installations

Customers taking supply at high voltage shall employ electrically qualified and trained staff or electrical contractors. Customers shall establish operating procedures and provide safety equipment to ensure the safe performance of all work on the installation.

Operating procedures shall meet the conditions listed below:

1. The high-voltage installation (HVI) responsible person shall have a documented set of electrical safety Rules covering all aspects of operating the high-voltage installation. The safety Rules should achieve the principles and practices documented in *ENA Doc 003-2021*

As such the associated provisions of the Work Health and Safety Regulation 2017, Part 4.7, Division 4 apply.

This includes the definition in that regulation of competent person for such work as '…a person who is authorised under the *Home Building Act 1989* to do electrical wiring work' unless an exemption is granted by SafeWork NSW.

National Guidelines for Safe Access to Electrical and Mechanical Apparatus in addition to ensuring that safe switching practices and procedures are applied.

2. The HVI responsible person shall provide all persons engaged in work on, or operation of, the high-voltage electrical installation with a copy of the electrical safety Rules and training in rescue and resuscitation procedures.
3. The HVI responsible person shall prominently and permanently display the installation's high-voltage system operating diagram in each high-voltage electrical substation.
4. The HVI responsible person shall provide, maintain and cause operators to be trained in the use of:

a) testing equipment to prove that high-voltage mains and apparatus are de-energised
b) high-voltage earthing equipment designed to facilitate the earthing of all types of high-voltage equipment within the installation
c) insulating mats, screens and other similar equipment necessary for the safe operation of the high-voltage installation.

5. The HVI responsible person shall provide appropriately coloured tape barriers and stands to display access permits clearly identifying isolated, proven de-energised, and earthed sections of the high-voltage installation on which work can safely be performed.
6. The HVI responsible person shall provide labelled storage facilities as close as practicable to the point of use for the equipment described in items 4 and 5.
7. The HVI responsible person shall display a safety poster prominently and permanently in each high-voltage station within the installation. The poster shall outline resuscitation methods.
8. The HVI responsible person shall provide 'access permit forms' to facilitate the monitoring of all persons accessing isolated sections of the electrical installation, to perform work and to ensure all such persons are clear before re-energising of the isolated section of the installation.
9. The HVI responsible person shall ensure that only persons qualified, trained and competent in the operation of the installation perform switching within the high-voltage installation, test to prove de-energised, apply earths, and issue access permits authorising persons to work on isolated and earthed sections of the installation.
10. If the HVI responsible person requires isolation of the electricity distributor's high-voltage supply (or supplies), the electricity distributor will require completion of an 'operating agreement'. This agreement shall be between the authorised operator and the electricity distributor.

Attachment B – Protection details required for new or altered HV electrical installations

The electricity distributor will assess the proposed protection scheme(s). The customer shall provide the following detailed information:

1. single-line diagram of the high-voltage installation, including main transformers winding configurations, e.g. 33kV Delta-11kV Star.

2. loading details, e.g. maximum expected load, load characteristics, duty cycles, large motor starting details, etc.
3. where the incoming protection device is a fuse:

a) rated current of fuse
b) rated breaking current of fuse
c) make and type of fuse
d) current-time characteristic curves

4. where the incoming protection device is a circuit breaker:

a) a control and protection schematic diagram of the incoming circuit breaker(s)
b) make, type, rated load current and rated fault MVA or rated breaking current of incoming circuit breaker(s)
c) details of protection relays used, including:
    i) make and type
    ii) setting range
    iii) characteristic curves
    iv) thermal ratings of input circuit
    v) tripping and control supply details
d) protection current transformer details including:
    i) make and type
    ii) primary current rating
    iii) secondary current rating
    iv) CT class
    v) short-time rating
    vi) length and size of secondary circuit wiring
    vii) proposed location

Note: CTs which use primary tappings for ratio changes are not acceptable. CTs located within a transformer tank or bushings are not acceptable.

5. protection details of the next line of protection within the installation, so a realistic grading can be achieved
6. voltage transformer details including:

a) make and type
b) primary voltage rating
c) secondary voltage rating(s)
d) category of performance
e) rated burden
f) accuracy class
g) rated voltage factor and rated duration

7. estimated date when protection is to be commissioned.

8 Alternative sources of supply

8.1 Introduction

All privately owned generating installations (whether stand-by or parallel generation) connected to the distribution system shall comply with all statutory and regulatory requirements, including but not limited to:

a) AS/NZS 3000

b) relevant Australian Standards

c) these Rules

d) the electricity distributor's customer connection contract

e) the National Electricity Rules.

The electricity distributor may disconnect generating equipment from their distribution system if:

i) the equipment is dangerous to the electricity distributor's staff or representatives

ii) the continued operation of the equipment is dangerous to the integrity of the electricity distributor's distribution system

iii) the equipment adversely affects other customers.

All enquiries regarding alternative sources of supply shall be directed to the electricity distributor.

8.2 Costs

Subject to the relevant determinations of the Australian Energy Regulator and/or provisions of the National Electricity Law, the customer may be required to pay for all costs incurred by the electricity distributor resulting from the installation of private generating plant. These may include the provision of equipment to:

a) record the operation of the plant

b) control and protect the electricity distributor's distribution system.

The customer should not spend any money on the proposed generating plant or its installation until:

i) the conditions under which the electricity distributor agrees to the connection and intended use of the plant have been received, or

ii) the electricity distributor's conditions of use and connection have been received.

8.2.1 Private generation

8.2.1.1 Standby generation

Where the customer installs an alternative source of electrical supply, e.g. a standby generator, the proposed arrangements shall be approved by the electricity distributor. Approval shall be

given for facilities to connect the alternative source of supply to the electrical installation normally supplied from the distribution system.

Where the electricity distributor agrees to the installation of facilities to enable an installation to be disconnected from the distribution system and connected to the alternative source, the systems shall comply with the electricity distributor's requirements. They shall prevent the electricity distributor's service equipment and distribution system from being energised by the alternative source.

A notice shall be fixed to the main switchboard and other affected switchboards to show:

a) that the alternative supply facilities exist

b) which section(s) of the installation they can supply

c) their point of control

d) the conditions under which they may be operated.

8.2.1.2 Parallel generation

Application shall be made to the electricity distributor for the installation of facilities which enable the connection of a privately owned generation plant to its distribution system.

Installations incorporating interconnectable (parallel) generation shall comply with the electricity distributor's requirements.

A customer requiring interconnectable (parallel) generation will be required to comply with specific terms and conditions which may be incorporated in the customer connection contract.

The cost of designing, installing, operating and maintaining the private generating equipment is the customer's responsibility. Parallel operation of the generating equipment cannot commence until the electricity distributor gives written approval. The electricity distributor will advise of the conditions applicable.

For large (over 75kW) installations, the electricity distributor may require approval and inspection of the installation before the generator is connected to the network. A test operation may be necessary.

8.3 Stand-by generating plant – general

For the purpose of this section, the terms stand-by generating plant or stand-by generator mean private generating equipment installed to supply or partly supply an electrical installation which is normally supplied from the electricity distributor's distribution system.

8.3.1 Conditions of use

Stand-by generating equipment shall be used only under the conditions agreed to by the electricity distributor.

In general, stand-by generating equipment shall not be used to operate in parallel with the electricity distributor's distribution system unless it complies with the requirements of clause 8.4 or clause 8.5.

Applications to connect generating systems intended to operate in parallel with the distribution system will be individually assessed. Connection of these systems shall be approved by the electricity distributor and meet the requirements of clauses 8.4, 8.5 and 8.6.

Systems which limit power output in accordance with voltage rise will be considered.

Inquiries or proposals for generation of electricity into the network shall be directed to the electricity distributor.

8.3.2 Spacing for conductors

Conductors shall be suitably spaced from all the other conductors of the installation, to limit the damage to the customer's electrical installation if an internal generator fault occurs.

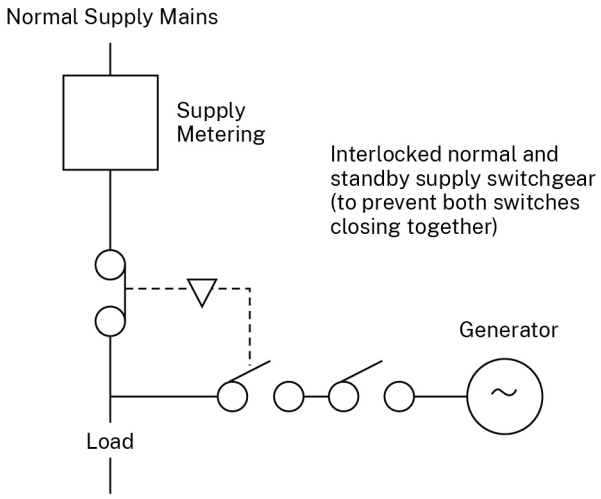
8.3.3 Changeover equipment for non-parallel operation

The connection of the stand-by plant to the electrical installation should normally be made on the load side of metering equipment. This is so the meter will not meter the generated energy. However, this may be unavoidable where an installation has multiple customer metering. Typical arrangements are shown in Figure 8-1 and Figure 8-2.

Switchgear to facilitate manual or automatic changeover in the event of interruption to the electricity supply should be located on or adjacent to the switchboard controlling that part of the electrical installation to be supplied from the private generating plant.

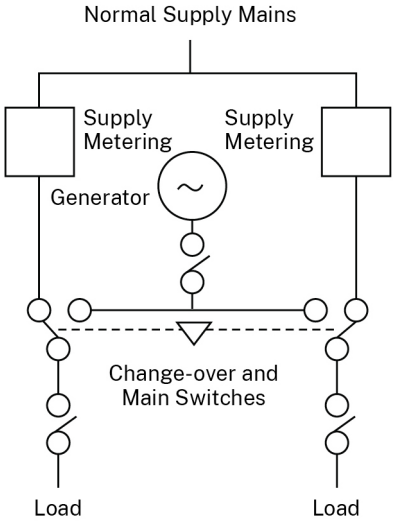
If automatic changeover uses contactors or circuit breakers, arrange them so opening any switch that controls that part of the installation is safe. Do not create a situation where the opening of any switch controlling that part of the electrical installation intended to be supplied from the stand-by generating plant could be unsafe. Contactors or circuit breakers for automatic changeover shall meet the requirements of *AS/NZS 3010: 2017 Electrical Installations – Generating Sets*. Provide a switch to isolate the stand-by generating plant from the installation.

Figure 8-1 Suitably interlocked switches



Phase connections shown only, i.e. break before make type, where there is a definite period when both switches are open. This interlocking may be electrical and/or mechanical (with fail-safe non-parallel state) or by keying. Refer to AS/NZS 3010.

Figure 8-2 Changeover switches



Phase connections shown only. Refer to AS/NZS 3010 for methods of connecting and switching neutral conductors.

8.3.4 Switching the neutral

8.3.4.1 Principles

The switching of the generator neutral may be required to avoid multiple MEN connections.

The normal supply neutral shall not be switched.

Correct sizing of the earth and neutral conductors for a permanently connected generator set is essential as these conductors form the loop that carries the earth fault currents. Refer to Table 8-1 for correct sizing of these conductors.

Table 8-1 Neutral and earthing conductors

Size of active conductors	Minimum size of connecting conductors
Not larger than 120mm² copper or 185mm² aluminium	Not smaller than half the largest active conductor, and in any case, not smaller than 25mm² copper or 35mm² aluminium.
Exceeding 120mm² copper or 185mm² aluminium	Not smaller than one quarter of the largest active conductor and in any case not less than 70mm² copper or 95mm² aluminium.

Note: the minimum size of connecting conductors may be reduced from 25mm² copper and 35mm² aluminium to 10mm² copper and 16mm² aluminium respectively for generating units up to and including 5kVA.

8.3.5 Multiple generators

The customer shall discuss the method of interconnection with the electricity distributor if multiple generators are to be connected in parallel.

The methods for interconnection will vary with the size of the site and whether all the generators are to be connected at the same switchboard. Larger sites may have generation at multiple locations, whereas smaller sites may have their generators located at the one position. Refer to AS/NZS 3010 for various changeover requirements.

The harmonic current produced by the generator will flow through the neutral under normal operating conditions. Where dissimilar generators are operated in parallel, steps shall be taken to limit the circulating current in the neutral connection between the generators. The circulating current shall be considered when determining the size of the neutral conductor.

8.4 Requirements for stand-by generator synchronise close transfer trip

Generator synchronise close transfer trip (SCTT) allows transfer to generator supply without complete disconnection of the load.

Customers who wish to use SCTT operation with their stand-by generation shall provide a letter to electricity distributor stating the operating conditions of the generator. The operating conditions shall specify the generator will be used as a stand-by supply and will run in parallel with the electricity distributor's supply system only for extended periods if the conditions of clause 8.5 are met.

The customer shall also provide the electricity distributor with the following details of the equipment:

a) site electrical drawings

b) the protection settings of circuit breaker transfer switches and interlocking arrangements

c) earthing provisions

d) the proposed installation date

e) the size of the generator.

Note: all sources of supply, at the time of synchronisation, shall be considered when designing the fault capacity of the system.

8.4.1 SCTT operating procedure

The time for operating in parallel with the distribution system during the disconnection or reconnection function of the SCTT for any occurrence should not be longer than 1 second for each operation. The short transfer period eliminates the need for protection against reverse power flow and vector shift.

The period for disconnection includes:

a) closing the generator isolating device to the distribution system once generator and mains supply are synchronised

b) isolation from the distribution system and transfer of the load to the generator.

The period for reconnection includes:

i) transferring the load from the generator to the distribution system once generator and mains supply are synchronised

ii) disconnecting the generator.

8.4.2 Additional protection

Apart from the protection requirements in AS/NZS 3010, the only additional protection required is a check synchronisation relay which shall be provided to monitor manual synchronisation where used.

Switchboards shall be labelled to AS/NZS 3010.

An indicator on the main switchboard shall clearly show the generator and electricity distributor's supply system status.

The electricity distributor will approve and inspect the installation before the generator is commissioned. A test operation may be necessary.

When it is necessary for the electricity distributor's system operator to be informed of a stand-by generator run period, a minimum of one hours' notice is desirable, advising of the starting time and duration before commencing each run period. The customer representative shall provide a contact number and be available for the duration of the run period.

The customer shall provide details of the maintenance schedule of the generator protection devices if requested. The customer shall keep records; the records shall be available upon request.

8.5 Requirements for generator parallel operation

This clause covers the use of a generator for extended parallel operation.

Customers shall provide a statement of the operating condition of the generator. This will specify the generator may be run in parallel with the electricity distributor's supply system for extended periods as agreed with the electricity distributor.

The customer shall provide the electricity distributor with the following details of the equipment:

a) site electrical drawings
b) the protection settings of circuit breaker transfer switches and interlocking arrangements
c) earthing provisions
d) the proposed installation date
e) the size of the generator.

From 1 December 2019, the customer shall also provide technical data on all installed generation sources under 30MW that are not registered generators with AEMO, including batteries, to the AEMO Distributed Energy Resource Register (DER Register). This shall be done in accordance with the distributor's relevant model standing offer for connection services, and a receipt of record confirmation obtained from AEMO within 20 days of commissioning the generation source. For further information see DER Register portal on the AEMO website.

8.5.1 Operating procedure

The procedure for operating in parallel with the electricity distributor's distribution system for any occurrence will include:

a) closing the generator isolating device to the distribution system once in synchronism
b) increasing the generator load to the desired level
c) running for the period arranged
d) decreasing the generator load and isolating the generator from the distribution system.

8.5.2 Additional protection

The minimum interconnection protection requirements to allow parallel operation are:

a) over- and undervoltage protection relays with appropriate time delays (undervoltage protection to prevent generator output being transferred to the electricity distributor's distribution system in the event of low or no supply system voltage)

b) manually initiated, fully automatic synchronising equipment

c) overcurrent and earth fault protection. The protection setting shall be suitable for the rating of the machine, the method of earthing, and the current capability of the affected circuits.

d) A supervised battery supply for relays and tripping.

Note: settings on these devices should be approved by the electricity distributor before the generator being used in parallel mode.

Devices shall also be provided to protect the generator from abnormal operating conditions. Devices shall include (as a minimum) protection against:

i) reverse power (failure of prime mover)

ii) loss of excitation (pole slipping)

iii) loss of mains (anti-islanding).

Further protection may be installed as required by the generator, manufacturer or consultant. Typical examples are:

(1) negative phase sequence

(2) rotor earth fault

(3) differential protection

(4) thermal overload.

Switchboards shall be labelled as per clause 8.7.

An indicator on the main switchboard shall clearly show the generator and electricity distributor's supply system status.

The electricity distributor will approve and inspect the installation before the generator is commissioned. A test operation may be necessary.

When it is necessary for the electricity distributor's system operator to be informed of a stand-by generator run period, a minimum of one hours' notice is desirable advising of the starting time and duration before commencing each run period. The customer representative shall provide a contact number and be available for the duration of the run period.

If the paralleling adversely affects the quality of supply to other customers, the operation of the generator shall be corrected before any further parallel operation.

The customer shall provide details of the maintenance schedule of the generator protection devices if requested. The customer shall keep records; the records shall be available upon request.

Manual synchronisation is prohibited, unless monitored by a check synchronisation relay.

8.6 Small-scale parallel customer generation (via inverters)

8.6.1 Introduction

This clause outlines installation requirements for small-scale generation facilities on premises of customers connected to the distribution system (grid) via an inverter. The generation source is most commonly solar photovoltaic (PV), but these requirements are applicable to other sources such as battery storage systems.

The generation source shall remain isolated from the distribution system until appropriate metering has been installed.

From 1 December 2019, the customer shall provide technical data on all installed generation sources under 30MW that are not registered generators with AEMO, including batteries, to the AEMO Distributed Energy Resource Register (DER Register). This shall be done in accordance with the distributor's relevant model standing offer for connection services, and a receipt of record confirmation obtained from AEMO within 20 days of commissioning the generation source. For further information see DER Register portal on the AEMO website.

8.6.1.1 System capacity rating

The rating shall be determined by the inverter capacity rating.

8.6.1.2 Applicability

This Clause covers single and three phase generators rated at 10kW per phase maximum, larger generators will require special negotiation and approval by the electricity distributor.

8.6.1.3 Voltage rise

The combined impedance of the service and electrical installation wiring shall be low enough to ensure the generation system can operate effectively and export to the PCC without excessive voltage rise within the customer's installation or the distribution system. This shall be calculated before installation. See clause 1.12.3.4, Figure 8-3 and Table 8-2.

8.6.1.4 System voltage limit

If the 10-minute average voltage at the main switchboard (measured with reference to *AS 61000.3.100:2011 Electromagnetic compatibility (EMC) limits – Steady state voltage limits in public electricity systems*) exceeds 253V with no load or generation connected, the electricity distributor should be contacted.

8.6.2 Responsibilities

The customer is responsible for the design, installation and maintenance of private generation facilities. The installation shall comply with all relevant Australian Standards, including but not limited to:

a) AS/NZS 3000

b) AS/NZS 4777 series – Grid connection of energy systems via inverters

c) AS/NZS 5033:2021 Installation and safety requirements for photovoltaic (PV) arrays

d) AS/NZS 5139:2019 Electrical Installations – Safety of battery systems for use with power conversion equipment

e) Energy Networks Australia (ENA) guides to PV/inverter energy systems

f) these Rules

g) requirements of the electricity distributor.

8.6.3 Export limiting systems

The installer or distributor may propose an export limited system to avoid upgrades of the service cable or the distribution network.

Zero export systems may also be proposed in order to expedite the approval process, or assist where solar penetration rates are high. All whole current export limiting devices shall be installed on the load side of the main switch.

8.6.4 Approvals documentation

The inverter and protection equipment shall be approved in writing by the electricity distributor before connection. The electricity distributor will advise its requirements when it has received an application for connection. The customer shall provide all appropriate documentation at the time of application for connection, including:

a) comprehensive and accurate single-line diagram of the alternating current (AC) side of the inverter, showing the PCC, including any standby generation connection upstream of the inverter energy system

b) full description of all protection equipment proposed to be installed, including test results. The electricity distributor may also require ongoing periodic verification tests.

Systems incorporating battery storage shall indicate this in the application and on the single-line diagram.

Generating systems with a rating greater than 5kW shall not be connected to single phase unless given approval by the electricity distributor. Refer to clause 8.6.8.

The application for connection and relevant CCEW shall include full details of the inverter rating and certificate of suitability certification number.

8.6.4.1 Information required for systems greater than 5kW urban and 3kW non-urban

In addition to the requirements of clause 8.6.4, applications for systems with a rating greater than 5kW in urban areas or 3kW in non-urban areas shall submit details of the voltage rise calculations for each of the 3 components of the generating system that indicate the system will operate correctly and not cause any adverse effects on the customer's installation. (Where there is one or more existing inverter energy system, these shall be included in the calculations.)

The 3 components are the:

a) service

b) consumers mains, and

c) conductors between the main switchboard and the inverter terminals.

See clause 1.12.3.4 and clause 8.6.1.2, Figure 8-3 and Table 8-3 for further details.

8.6.5 Metering Installation Requirements

This information can be found in the Metering Installation Requirements. A metering installation compliant with the *National Electricity Rules* shall be installed before energisation. Refer to the metering provider for details.

8.6.6 Construction permits

The customer shall obtain any authorisation or permits required for the connection and operation of the generating equipment and interconnection facilities. This may include local government rezoning or building permits.

8.6.7 Islanding

The customer shall prevent the situation where, intentionally or unintentionally, inverters maintain a supply to the distribution system after the distribution system supply has been de-energised. Loss of grid supply may be unplanned (blackout) or planned (for work on the street mains).

Supply to the grid from islanded installations creates serious safety issues, quality of supply problems for other customers, and the possibility of equipment damage.

Installations may be designed to continue to operate with supply either from storage such as batteries or from alternative energy sources. The protection equipment associated with the generation source shall be designed, installed and tested to ensure that correct islanding of the installation occurs.

8.6.8 Multi-phase generating systems

Generating systems with a rating of greater than 5kW shall not be connected to single-phase supply unless given distributor approval.

Small-scale generating systems that are connected across multiple phases can be connected via the following methods:

8.6.8.1 Three-phase connection via an integrated 3-phase inverter

This is the preferred method as it allows all 3 phases to be controlled by a single control circuit and allows for a balanced 3-phase power output.

8.6.8.2 Multiple single-phase inverters

The use of 2 or more single-phase inverters across multiple phases is permitted provided all other requirements of clause 8.6 are met.

Where 1 or 2 single-phase generation systems are to be connected to a multiphase supply, one generator shall be connected to the phase listed in Table 2-2 or Table 3-2. The other generator/s are to be on another phase.

Note: this is to reduce the out-of-balance loading to a minimum.

8.6.8.3 Voltage rise

Regardless of the connection method applied above, the voltage rise for a multiphase embedded generation system shall be calculated based on the maximum current imbalance permitted by the inverter control systems and shall meet the requirements of clause 8.6.1.3

8.6.8.4 Single-phase supply conversion to multiphase

Where supply is required to be converted to multiphase it shall be converted to 3-phase unless approval is given by the distributor to convert to 2-phase.

8.6.9 Power factor setting

Inverters may alter network voltage levels by varying the output power factor (PF) e.g. an inverter set as 'lagging' will absorb VARs and may minimise network voltage rise. Conversely, an inverter set as 'leading' will generate VARs and may provoke network voltage rise.

Applications for both 'static' and 'dynamic' PF control systems will be considered for their suitability for the proposed location.

8.6.10 DC isolation

An appropriately rated double pole DC isolation device shall be provided either close to or internal to the inverter, to isolate the DC source from the inverter and operate simultaneously in both positive and negative legs of the DC supply.

The isolation device shall not be polarity sensitive, as per AS/NZS 5033.

8.6.11 Generator connection arrangement

The generation system shall be connected to a dedicated circuit.

It is preferable for the generation system to directly connect to the main switchboard to simplify future metering arrangements. If this is not practicable, the nearest distribution board may be used to connect the generation system, and all upstream switchboards labelled.

8.6.12 Switching requirements

The following installation main switches shall be of the lockable or sealable form for safe isolation:

a) the installation main switch(s) on the main switchboard

b) the generator supply main switch; refer to clause 8.6.14.

8.6.13 Reconnection procedure

As per AS/NZS 4777.2:2020

8.6.14 Generator supply main switch

The generator supply main switch shall be located on the switchboard at which the generation source is connected.

8.6.15 Shut-down procedure

Labelling describing the correct shut-down procedure in accordance with the relevant Australian Standard shall be provided.

8.6.16 Shared energy (including storage)

Non-embedded networks cannot share energy across installations having separate NMIs without the approval of the electricity distributor. The electricity distributor may approve the installation of a shared energy system, provided all the following conditions are satisfied:

a) The installation is for multi-occupancy building(s), with one connection point to the distribution network, one management entity responsible for the building(s) and system(s), and located on a single legal land parcel.

b) The system(s) is for the benefit of the NMIs in the building(s) only.

c) Energy transfer shall not occur between NMIs on the load side of metering. Refer to clause 1.17.14.

d) Energy transfer to the distribution network shall be approved by the electricity distributor.

e) Ongoing safety, operation and maintenance activities shall not compromise the electricity distributor's connection services obligations at each NMI of the building(s).

f) The system(s) shall not damage, cause quality of supply issues or effect the distribution network or other electrical installation(s) outside of the system(s).

g) Additional unshared systems shall comply with (c), (d), (e) and (f).

h) Bi-directional metering shall be installed on all participating NMIs before the systems(s) are commissioned.

Note: 'unshared' means a system connected to one NMI which feeds that NMI only and is not shared with any other NMI.

Table 8-2 Examples of cable lengths for 1% voltage rise for various inverter configurations

Inverter configuration		**Single phase**	**Three phase**	**Three phase**
Inverter rating (kW)		5	5	10
Conductor current (A)		21.7	7.2	14.5
Cable conductor size (mm²)	**Conductor material**	**Maximum route length (m)**	**Maximum route length (m)**	**Maximum route length (m)**
6	Cu	14	85	42
10	Cu	24	143	71
16	Cu	38	227	113
25	Cu	59	357	179
35	Cu	82	491	246
50	Cu	109	659	329
95	Cu	204	1232	616
25	Al	36	216	108
95	Al	132	794	397

Voltage rise is calculated using current (I) x cable length (L) / ampere metre (Am) per % voltage drop (Vd); (Am per % Vd).

A 5 kW IES produces 21.74 A at full rated output.

Table 8-3 Example of calculating voltage rise

	Cable size	Cable length	Am per %Vd	Voltage rise calc	%	Result
Service mains	6 mm^2 Cu	13	306	21.74 x 13 / 306 =	0.92	0.92
Consumer mains	6 mm^2 Cu	20	306	21.74 x 20 / 306 =	1.42	
MSB to IES	6 mm^2 Cu	10	306	21.74 x 10 / 306 =	0.71	2.13 fail
						3.05 fail

This example fails both the 2% rule for installation wiring and the 3% maximum rule.

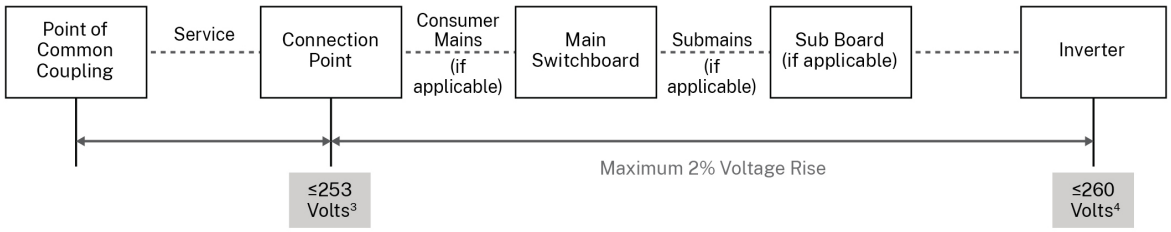
	Cable size	Cable length	Am per %Vd	Voltage rise calc	%	Result
Service mains	6 mm^2 Cu	13	306	21.74 x 13 / 306 =	0.92	0.92
Consumer mains	6 mm^2 Cu	20	306	21.74 x 20 / 306 =	1.42	
MSB to IES	10 mm^2 Cu	10	818	21.74 x 10 / 306 =	0.27	1.69 pass
						2.61 pass

Increasing the cable size from the MSB to the IES reduces the voltage rise.

Reducing the cable length from the IES to the MSB would also reduce the voltage rise.

AS/NZS 3000 Table C8 contains Am per %Vd for common cable sizes. Other cable sizes can be calculated using *AS/NZS 3008.1.1:2017 Electrical installations – Selection of cables, Cables for alternating voltages up to and including 0.6/1 kV – Typical Australian installation conditions*.

Figure 8-3 Voltage rise limits for installations with embedded generation



Notes:

1 See clause 1.12.3.4.

2 Requirements for voltage rise from the connection point are based on the full rated output of the inverter.

3 See AS 60038 Table 1.

4 Overvoltage anti-islanding protection applies (AS/NZS 4777.2).

5 Existing Rules apply for voltage drop due to customer loads (AS/NZS 3000).

6 Based on nominal voltage of 230 V.

8.7 Labelling

All labelling shall comply with the relevant Australian Standards.

Service and Installation Rules of NSW

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