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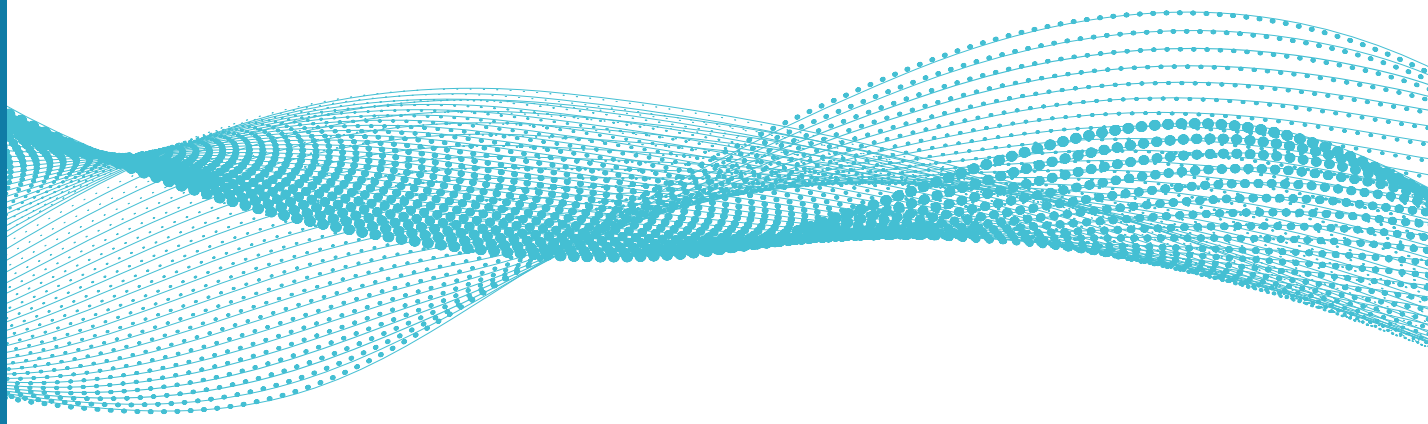
AS/NZS 3001.2:2022

AUSTRALIAN/NEW ZEALAND STANDARD

Electrical installations – Connectable electrical installations and supply arrangements

Part 2: Connectable electrical installations

Superseding AS/NZS 3001:2008



AS/NZS 3001.2:2022

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This joint Australian/New Zealand standard was prepared by Joint Technical Committee EL-001, Wiring Rules. It was approved on behalf of the Council of Standards Australia on 2 November 2022 and by the New Zealand Standards Approval Board on 5 October 2022.

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Australian Energy Council
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Consumers' Federation of Australia
Electrical Regulatory Authorities Council
Electrical Safety New Zealand
Electrical Workers Registration Board
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Australian/New Zealand Standard

Electrical installations – Connectable electrical installations and supply arrangements

Part 2: Connectable electrical installations

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-001, Wiring Rules, to supersede AS/NZS 3001:2008, *Electrical installations—Transportable structures and vehicles including their site supplies*.

The objective of this Standard is to provide the requirements for electrical installations associated with connectable electrical installations, including their alterations and repairs. It includes provisions for the connection of electric power to various types of connectable electrical installations, including relocatable units, recreational vehicles, and non-recreational vehicles.

AS/NZS 3001:2008 will also remain current for 12 months after the date of publication of this Standard for the requirements covered in this Standard only. After this time it will be superseded by AS/NZS 3001.1:2022 and AS/NZS 3001.2:2022. Regulatory authorities that reference this Standard in regulation may apply these requirements at a different time. Users of this Standard should consult with these authorities to confirm their requirements.

This Standard forms Part 2 of the AS/NZS 3001 series as follows:

AS/NZS 3001.1, *Electrical installations — Connectable electrical installations and supply arrangements, Part 1: Site supplies for connectable electrical installations*

AS/NZS 3001.2, *Electrical installations — Connectable electrical installations and supply arrangements, Part 2: Connectable electrical installations* (this Standard)

The preparation of this Standard was undertaken following requests from industry for a comprehensive set of requirements applicable to connectable electrical installations with minimal reference to AS/NZS 3000.

This Standard does not attempt to include every installation method, but contains installation methods which are considered by industry to be the most commonly used for connectable electrical installations that are consistent with AS/NZS 3000.

The general principles and requirements of AS/NZS 3000 apply for the application of this Standard.

This Standard has been divided into separate sections for specific types of connectable electrical installations, reducing the need for the reader to refer to other sections of the Standard.

The major changes in this edition are as follows:

(a) AS/NZS 3001 has been divided into two parts. Part 2 specifies requirements for electrical installations in connectable electrical installations.

(b) Section 1 provides the scope, inclusions and exclusions of this Standard. The definitions, as well as the alterations and repairs clauses have been expanded.

(c) Section 2 provides external supply connection and onboard supply installation requirements applicable to a connectable electrical installation.

(d) Section 3 provides the installation requirements for relocatable units.

(e) Section 4 provides the installation requirements for recreational vehicles and non-recreational vehicles.

(f) Section 5 provides the installation requirements for extra-low voltage wiring systems and equipment in all connectable electrical installations.

(g) Section 6 provides verification requirements in all connectable electrical installations.

(h) The issuing of Warrants of Electrical Fitness has been amended for New Zealand, see Appendix D.

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(i) Appendix E has been added, covering additional New Zealand requirements for the issue of Warrants of Electrical Fitness for imported connectable electrical installations.

All figures have been updated and new figures included for clarity.

The following sections are applicable to each type of connectable electrical installation:

(i) Relocatable units — Sections 1, 2, 3, 5 and 6.

(ii) Recreational vehicles and non-recreational vehicles — Sections 1, 2, 4, 5 and 6.

This Standard may be applied through legislative requirement, from a date to be set by the relevant regulatory authority. If work on an installation was commenced before publication of this edition, refer to the relevant regulatory authority or electricity distributor regarding permission for the installation to be completed under AS/NZS 3001:2008 as applicable.

Differences between requirements in Australia and New Zealand are as follows:

This Standard applies to new connectable electrical installations.

In Australia: AS

(A) 15 A, three-pin, flat-pin plugs complying with AS/NZS 3112 are the type most commonly used for single-phase supply to connectable electrical installations. Round-pin plugs and socket-outlets complying with AS/NZS 3123 may be used.

(B) It is required that all protection devices and switching devices connected to the wiring of connectable electrical installations operate in all live (active and neutral) conductors, unless a polarity sensing device is installed on the input supply to the connectable electrical installation(s).

In New Zealand: NZ

(1) For single-phase supply, supply lead plugs complying with IEC 60309-2 are the norm for all types of connectable electrical installation, however other types may be used.

(2) A diminishing number of older caravans are fitted with a neutral-earth connection. If supplied from a source that is protected by RCD, the RCD will trip. Supply must instead be obtained from a source not protected by RCD, e.g. an older service pillar in a caravan park. It is expected that such issues will become less frequent as older caravans are upgraded in accordance with this edition.

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

See Introduction for information on how to interpret and use this Standard.

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Introduction

Application of typefaces

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

(a) Normal print indicates requirements that form the main part of a clause. It also indicates deemed to comply methods that satisfy the requirements. Normal print is used in the appendices to present informative material for guidance only.

(b) *Italic print indicates exceptions or variations to requirements. Exceptions generally give specific examples where the requirements do not apply or where they are varied for certain applications. They may contain requirements. Examples are also presented in italic text.*

(c) Reduced size normal print indicates Notes which give explanations and advice.

NOTE They are preceded by the word "NOTE" in the manner used in previous editions.

(d) **Bold print indicates WARNINGS.**

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

National requirements

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

(i) Applicable in Australia only. AS

(ii) Applicable in New Zealand only NZ

Deemed to comply

The term "deemed to comply" means that a requirement can be met by following a specified Standard or method.

So, where an installation is carried out in accordance with the specified Standard or method, the installation is "deemed to comply" with the requirements of this Standard.

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

Notes

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

Cross-references

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

Typical figures

Figures labelled as "typical" show one method of complying with the requirements set by the clause(s) that refers to them. Other arrangements are not precluded, provided they comply with the relevant clause(s). Figures do not necessarily illustrate all requirements that may apply.

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Provision for revision

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

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Australian/New Zealand Standard

Electrical installations — Connectable electrical installations and supply arrangements

Part 2: Connectable electrical installations

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Section 1 Scope and general

1.1 Scope

1.1.1 General

This Standard sets out the requirements for connectable electrical installations used for the purposes of accommodation, habitation or other residential, commercial or recreational uses that are intended for connection to external low voltage a.c. (see Clause 1.4.28) supply systems by either —

(a) a detachable supply lead; or

(b) a supply lead directly connected to the connectable electrical installation.

A connectable electrical installation (see Clause 1.4.8) may comprise a number of types of low voltage supplies, however where a connectable electrical installation has the facility to connect to an external supply (see Clause 1.4.23.2), it is required to comply with this Standard.

This Standard also sets out requirements and provides guidance for the installation of extra-low voltage (see Clause 1.4.28) systems installed within connectable electrical installations that are intended for detachable connection to external low voltage a.c. supply systems.

For the purposes of this Standard, the term “connectable electrical installation” includes vehicles and units with or without wheels that can readily be moved from one site to another, either under their own motive power or by some other means.

The particular requirements of this Standard replace, modify or are additional to the general requirements of AS/NZS 3000 for the electrical wiring of connectable electrical installations.

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

In addition, guidance is provided so that the electrical installation functions correctly for the purpose intended.

1.1.2 Inclusions

1.1.2.1 Relocatable units

Relocatable units (see Clause 1.4.19) including, but not limited to:

(a) Homes.

(b) Cabins/huts.

(c) Site offices.

(d) Cloakrooms.

(e) Meeting offices.

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(f) Dormitories.

(g) Canteens.

(h) First aid rooms.

(i) Toilet facilities.

(j) Washroom facilities.

(k) Other facilities.

(l) Tents for accommodation.

(m) Rigid and non-rigid annexes.

See Figure 1.1 for further information.

1.1.2.2 Recreational vehicles

Recreational vehicles (see Clause 1.4.18) including, but not limited to:

(a) Caravans.

(b) Camper vans.

(c) Motor homes.

(d) Camper trailers.

(e) Pop top caravans.

(f) Tent trailers.

(g) Fifth wheel caravans.

(h) Slide on campers.

(i) Converted buses or trailers.

See Figure 1.1 for further information.

1.1.2.3 Non-recreational vehicles

Non-recreational vehicles (see Clause 1.4.15) including, but not limited to:

(a) Horse floats.

(b) Semi-trailers.

(c) Livestock or car transporters.

(d) Vehicles such as food and drink vending vans and trailers.

(e) Educational display caravans and trailers, mobile classrooms.

(f) Television outside broadcast vans.

(g) Mobile stages.

(h) Display units e.g. mobile electronic score boards and advertising signs, mobile traffic information signs.

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(i) Hybrid, any towable or self-propelled vehicle that does not fit specifically into any of the above categories.

(j) Other vehicles such as emergency vehicles that have an external low voltage connection.

(k) In New Zealand, mobile medical connectable installations complying with the requirements of this Standard. NZ

NOTE Further requirements for mobile medical connectable installations can be found in NZS 6115.

See Figure 1.1 for further information.

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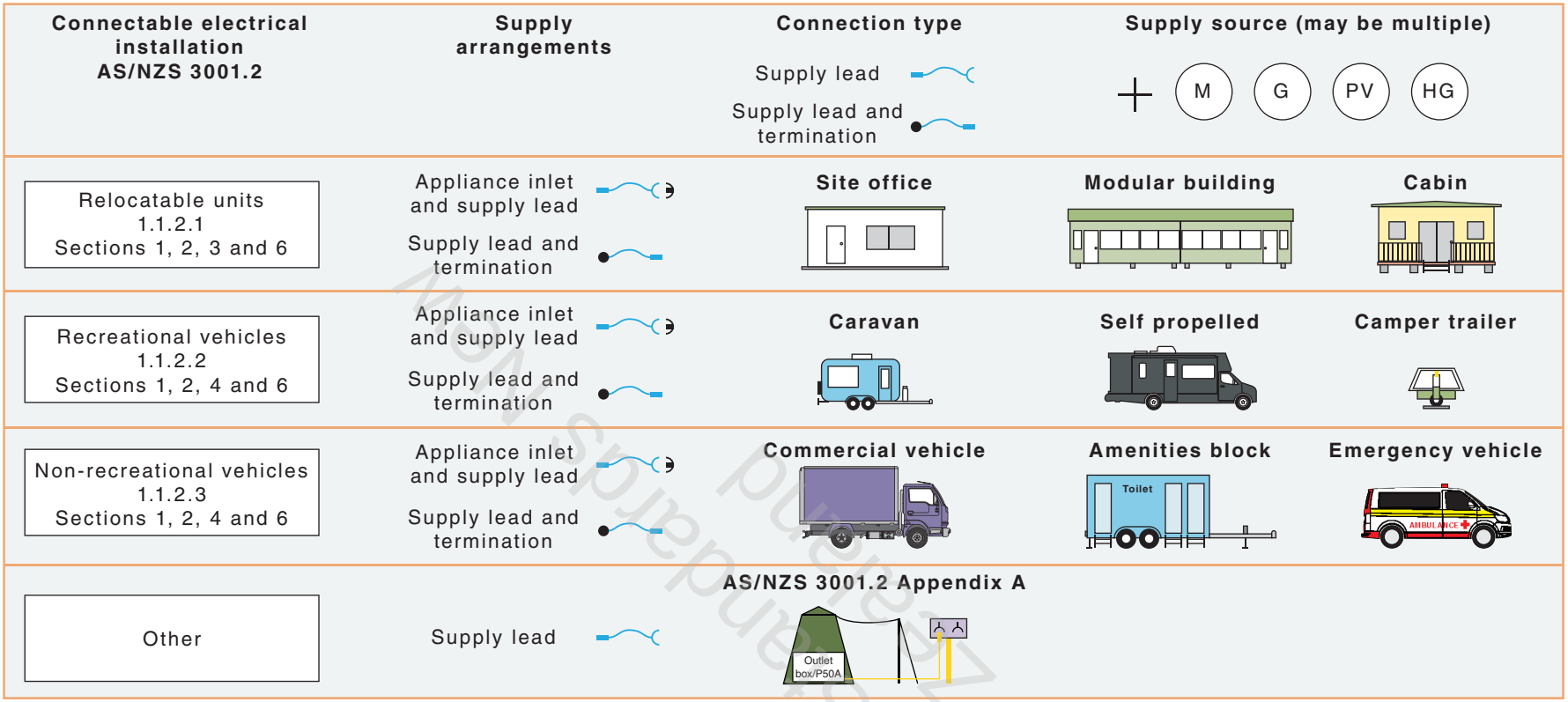


Figure 1.1 — Typical inclusions to this Standard

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Non-standards user

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1.1.3 Exclusions

This Standard does not apply to connectable electrical installations that are immobilized or fixed in position and directly connected by installation wiring, and where the ability for relocation is not intended to be maintained. These structures are subject to the requirements of AS/NZS 3000.

Examples include but are not limited to the following:

(a) Vehicles, recreational vehicles and non-recreational vehicles that are rendered immobile, e.g. tramcars, buses, etc.

(b) Relocatable units, e.g. homes, huts, construction sheds and tents.

In addition, this Standard does not apply to the following:

(i) Vehicles forming part of an amusement ride or device. These vehicles may be subject to the requirements of AS 3533.

(ii) Structures for the provision of entertainment that do not contain an electrical installation e.g. circus and carnival tents and temporary vending stalls. These structures are subject to the requirements of AS/NZS 3002.

(iii) Boats.

(iv) Other vehicles such as emergency vehicles that do not have an external low voltage connection. In the case of these vehicles, this Standard may be used as a guide.

(v) Non-recreational vehicle fitted with a permanently attached supply lead or inlet plug for the connection of a single item of electrical equipment, such as the following:

(A) Trailed concrete mixer.

(B) Single on board battery charger, only.

(C) Mobile elevated work platform (MEWP) battery charger only.

(D) Mobile battery powered equipment charger.

(E) Message boards and portable traffic advisory systems.

This Standard does not cover requirements for the following:

(1) Re-generative drive/braking systems.

(2) Battery charging while moving.

(3) Enhanced protection arrangements that may be subject to design and original equipment manufacturer's requirements.

This Standard does not apply to automotive wiring systems, electrical fittings, and electrical wiring whose primary function relates to propulsion or roadworthiness of a vehicle.

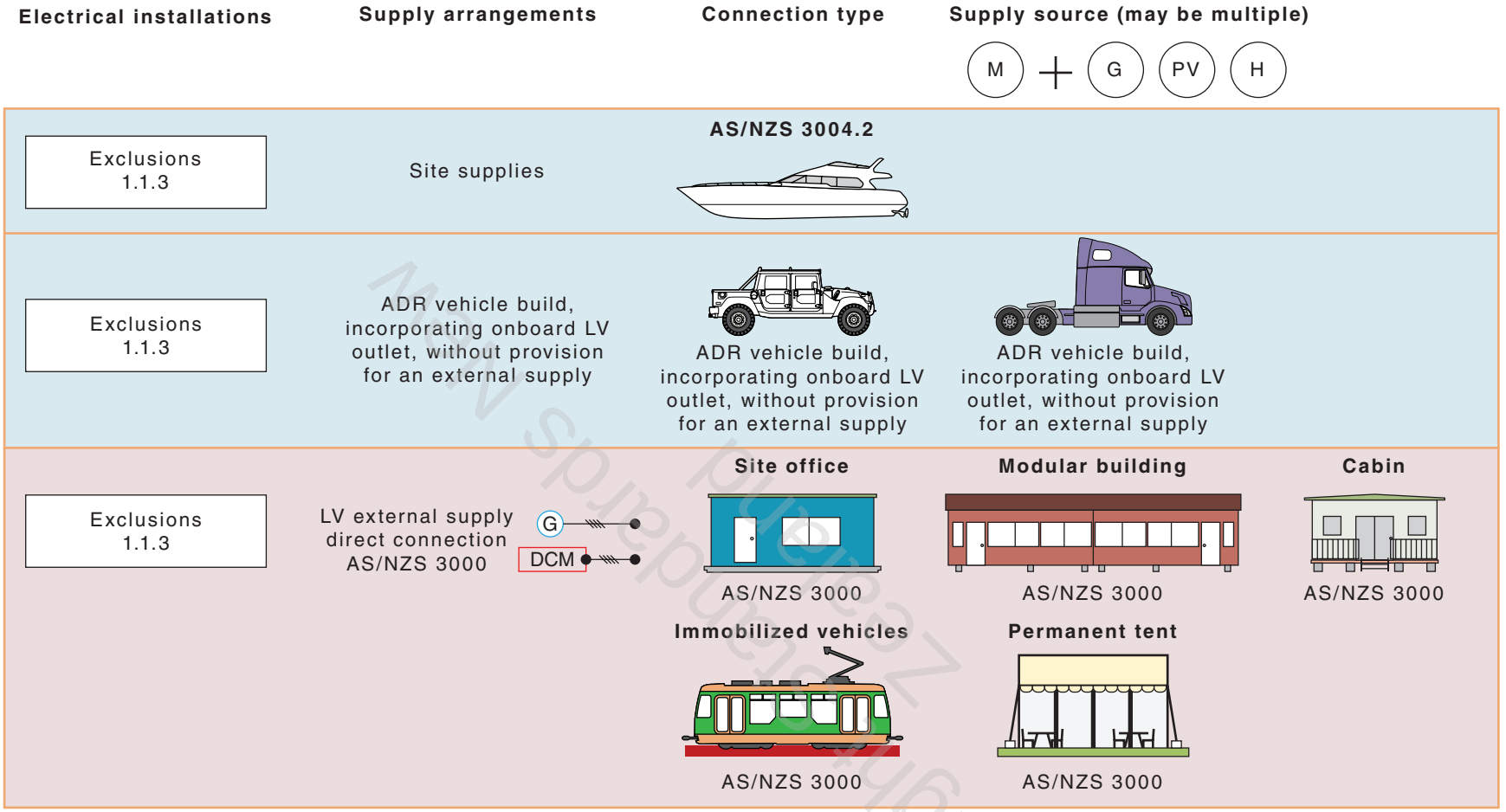
See Figure 1.2 for further information.

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Key

- M — Normal supply
- G — Motor generator
- PV — Photovoltaic
- HG — Hybrid generator incorporating one or more technologies
- G — Direct connect generator supply
- DCM — Direct connect normal supply
- Fixed wiring system
- ADR — Australian design rules

Figure 1.2 — Typical exclusions to this Standard

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1.2 Application

The particular requirements of this Standard replace, modify, or are additional to the general requirements of AS/NZS 3000 for the electrical wiring of connectable electrical installations.

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

1.3 Normative references

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

NOTE Documents for informative purposes are listed in the Bibliography.

AS 60529, *Degrees of protection provided by enclosures (IP Code)*

AS 62040.1, *Uninterruptible power systems (UPS), Part 1: Safety requirements (IEC 62040-1:2017 (ED 2.0), MOD)*

AS IEC 62619, *Secondary cells and batteries containing alkaline or other non-acid electrolytes— Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

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

AS/NZS 3001.1, *Electrical installations — Connectable electrical installations and supply arrangements, Part 1: Site supplies for connectable electrical installations*

AS/NZS 3010, *Electrical installations—Generating sets*

AS/NZS 3112, *Approval and test specification—Plugs and socket-outlets*

AS/NZS 3120, *Approval and test specification—Cord extension sockets*

AS/NZS 3123, *Approval and test specification—Plugs, socket-outlets and couplers for general industrial application*

AS/NZS 3131, *Approval and test specification—Plugs and socket-outlets for stationary appliances*

AS/NZS 3190, *Approval and test specification—Residual current devices (current operated earth-leakage devices)*

AS/NZS 3191, *Electric flexible cords*

AS/NZS 3760, *In-service safety inspection and testing of electrical equipment and RCDs*

AS/NZS 4417 (all parts), *Regulatory compliance mark for electrical and electronic equipment*

AS/NZS 4509 (all parts), *Stand-alone power systems*

AS/NZS 4763, *Safety of portable inverters*

AS/NZS 4777 (all parts), *Grid connection of energy systems via inverters*

AS/NZS 5000.1, *Electric cables—Polymeric insulated, Part 1: For working voltages up to and including 0.6/1 (1.2) kV*

AS/NZS 5000.2, *Electric cables—Polymeric insulated, Part 2: For working voltages up to and including 450/750V*

AS/NZS 5033, *Installation and safety requirements for photovoltaic (PV) arrays*

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AS/NZS 5139, *Electrical installations — Safety of battery systems for use with power conversion equipment*

AS/NZS 5601.2, *Gas installations, Part 2: LP Gas installations in caravans and boats for non-propulsive purposes*

AS/NZS 5761, *In-service safety inspection and testing—Second-hand equipment prior to sale*

AS/NZS 60335.1, *Household and similar electrical appliances — Safety, Part 1: General requirements (IEC 60335-1 Ed 5.2, MOD)*

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

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

AS/NZS 61558.2.6, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V, Part 2.6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers (IEC 61558-2-6 Ed 2, MOD)*

NZS 6115, *Electrical installations—Mobile medical facilities*

IEC 60309-2, *Plugs, socket-outlets and couplers for industrial purposes, Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

IEC 60364-7-717, *Low voltage electrical installations — Part 7-717: Requirements for special installations or locations — mobile or transportable units*

IEC 60364-7-721, *Low-voltage electrical installations — Part 7-721: Requirements for special installations or locations — Electrical installations in caravans and motor caravans*

1.4 Terms and definitions

For the purposes of this Standard, the terms and definitions in AS/NZS 3000 and those below apply. Where an additional term is defined in a particular section or clause, the term takes the meaning defined in that section or clause.

1.4.1
accessible
capable of being reached for inspection, maintenance or repairs but does not include the destructive dismantling of structural components

1.4.2
accessible, readily
capable of being reached quickly and without climbing over or removing obstructions, or using a movable ladder, and in any case not more than 2 m above the ground, floor or platform

1.4.3
annex
attachment to a connectable electrical installation used as an extension of the area. It may be rigid or non-rigid

1.4.4
appliance inlet
inlet plug
accessory, having pins designed to engage with the contacts of a cord extension socket, integrated or incorporated into equipment or intended to be fixed to it

Note 1 to entry: Inlet plugs were previously specified in AS/NZS 60320.1 as Group 3 appliance inlets.

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1.4.5
battery
unit consisting of one or more rechargeable electrical energy storage cells connected in series, parallel, or series parallel arrangement

Note 1 to entry: See Figure 1.3 for examples of batteries.

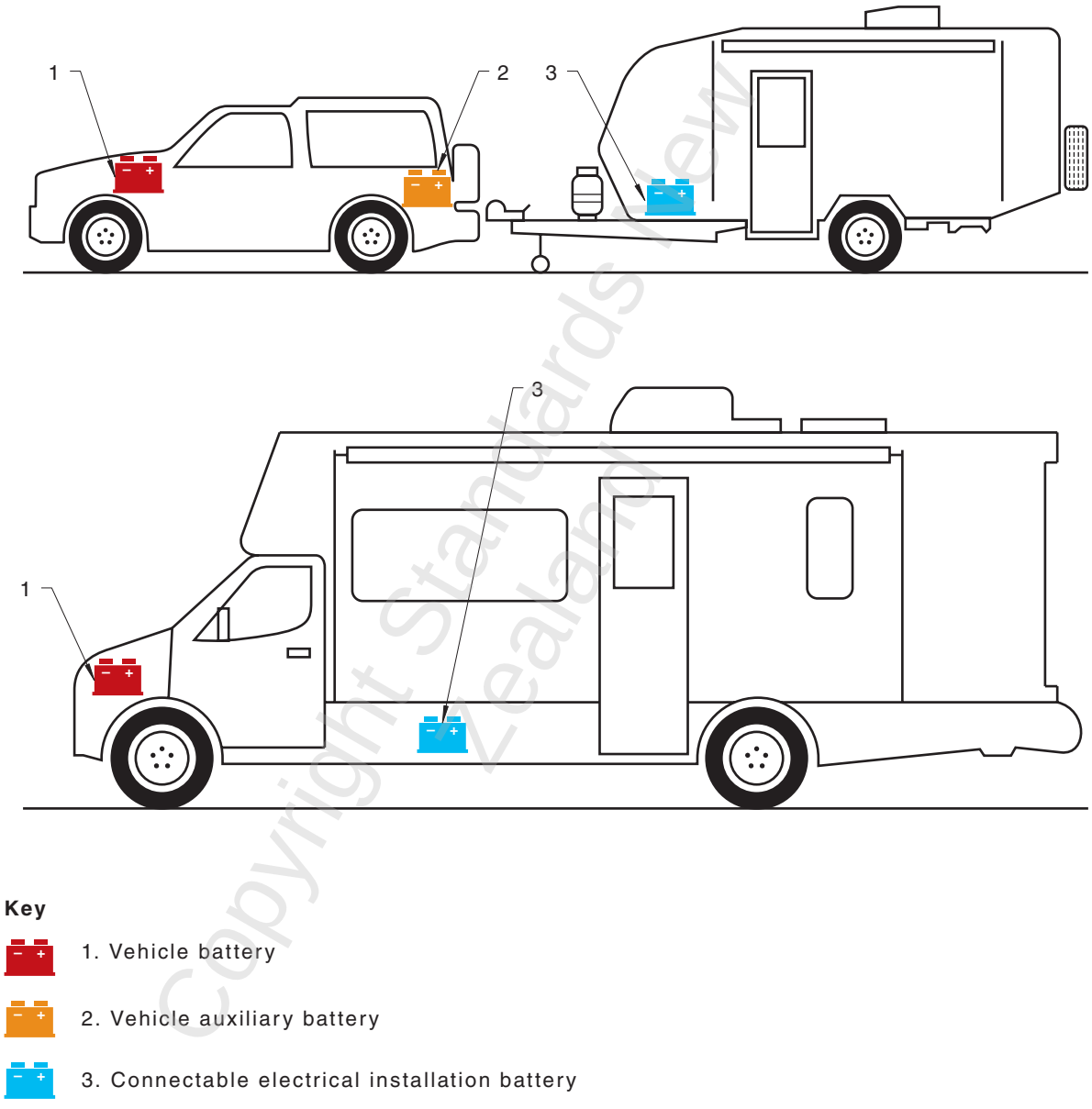


Figure 1.3 — Typical examples of battery types

1.4.5.1
connectable electrical installation battery
battery with the primary purpose of supplying circuits not related to either the propulsion of the vehicle or supply to equipment intended for compliance with vehicle/road transport requirements

Note 1 to entry: A connectable electrical installation battery may be charged by the charging system for the vehicle battery and may also have other charging facilities.

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Note 2 to entry: A connectable electrical installation may be referred to as a house battery, general light and power battery or service battery.

1.4.5.2
vehicle battery
battery with the primary purpose of starting a vehicle engine

Note 1 to entry: A vehicle battery may also supply other circuits; including recreational vehicle and non-recreational vehicle circuits.

Note 2 to entry: This Standard sets no requirements for vehicle batteries.

1.4.5.3
vehicle auxiliary battery
battery that is connected in parallel with the vehicle battery

Note 1 to entry: A vehicle auxiliary battery may be charged by the charging system for the vehicle battery and may also have other charging facilities.

Note 2 to entry: A battery that is connected in parallel with the vehicle battery is deemed to be a vehicle battery.

Note 3 to entry: This Standard sets no requirements for vehicle auxiliary batteries.

1.4.6
caravan park
camping ground
area of land —

(a) that is used, or intended to be used, to site two or more connectable electrical installations; and

(b) on which fittings are installed to supply electricity to those connectable electrical installations

1.4.7
competent person
person who has acquired, through training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the required task correctly

1.4.8
connectable electrical installation
electrical installation of a *non-recreational vehicle* (1.4.14), a *recreational vehicle* (1.4.17) or a *relocatable unit* (1.4.18) that is designed, intended for, or capable of, connection to an external power supply that operates at low voltage by *detachable connection* (1.4.11)

1.4.9
cylinder
container for the storage of LP Gas that has a capacity of more than 120 mL but not more than 500 L, and does not include an aerosol container

Note 1 to entry: Capacity is often referred to as “water capacity” and is the total internal volume i.e. 25 L water capacity is approximately 10 kg nominal LP Gas capacity.

1.4.10
cylinder enclosure
cylinder compartment
enclosed area or a partitioned space primarily used for the installing of a gas cylinder, pressure regulator and other associated equipment, or for the storing of a gas cylinder

1.4.11
detachable connection
electrical connection of a connectable electrical installation to a low voltage electrical installation by means of a plug and socket-outlet, or socket and *appliance inlet* (1.4.4)

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1.4.12
hazardous area
region surrounding an LP Gas cylinder(s) that is regulated so that the adverse effects of any gas leakage are reduced

Note 1 to entry: A hazardous area should include an administrative control in the form of a label indicating the cylinders should be isolated when not in use or when the vehicle is in transit.

Note 2 to entry: Figure 4.5 shows an example of a hazardous area for LP Gas cylinders on the draw bar of a domestic caravan.

1.4.13
may
indicates the existence of an option

1.4.14
non-recreational vehicle
1 trailer designed to be towed by a road vehicle that has the provision for, or is intended for connection to a low voltage supply from an external source that is not deemed to be a *recreational vehicle* (1.4.17)

2 self-propelled vehicle with the same features

EXAMPLE Cars, trucks and trailers, including: horse floats; semi-trailers; livestock or car transporters; vehicles such as food and drink vending vans and trailers; educational display caravans and trailers, mobile classrooms; television outside broadcast vans; mobile stages; display units e.g. mobile electronic score boards and advertising signs, mobile traffic information signs; or any towable, self-propelled or hybrid vehicle that does not fit specifically into any of the above categories.

1.4.15
outlet box
portable power distribution unit supplied via an attached or detachable flexible lead and fitted with one or more socket-outlets, which incorporates overcurrent protection, residual current protection and may also incorporate cord reeling or coiling arrangements

1.4.16
power conversion equipment
PCE
electrical device converting one kind of electrical power from a voltage or current source into another kind of electrical power with respect to voltage, current and frequency

Note 1 to entry: Examples include d.c./a.c. inverters, d.c./d.c. converters, charge controllers, etc.

1.4.17
recreational vehicle
1 trailer designed to be towed by a road vehicle, often used for living and accommodation, and has the provision for, or is intended for connection to a low voltage supply from an external source

2 self-propelled vehicle with the same features

EXAMPLE Camper vans; motor homes; camper trailers; caravans; pop top caravans; tent trailers; fifth wheel caravans; slide on campers; converted buses or trailers for the use of accommodation or recreational purposes; any towable, self-propelled or hybrid vehicle intended for use as accommodation or for recreational purposes that does not fit specifically into any of the above categories; or *vehicles* (1.4.26).

Note 1 to entry: Vehicles such as mobile site offices and similar, that are not used for living accommodation or recreational purposes, are not deemed to be recreational vehicles, see *vehicles* (1.4.26).

1.4.18
relocatable unit
unit designed for human occupation that may be relocated from one site to another and has the provision for, or is intended for connection to a low voltage supply from an external source

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EXAMPLE Relocatable site offices, cloakrooms, meeting offices, dormitories, canteens, toilets, workshops, site huts or other facilities.

1.4.19
shall
indicates a statement is mandatory

1.4.20
should
indicates a recommendation

1.4.21
site
area in a *caravan park* (1.4.6), *camping ground* (1.4.6) or other location intended for the placement of one or more *connectable electrical installations* (1.4.8) under the control of one occupier

1.4.22
supply
1.4.22.1
alternative supply
supply system intended to maintain the functioning of an electrical installation or a part or parts thereof, in case of interruption of the normal supply

1.4.22.2
external supply
low voltage 230/400 V 50 Hz external source of supply from which the connectable electrical installation is supplied

Note 1 to entry: Does not include internal or onboard low voltage supply facilities.

1.4.22.3
normal supply
source of supply that the electrical installation is supplied from under normal conditions of operation

Note 1 to entry: The normal supply is usually from a distribution network but may instead be from a generation system.

1.4.23
supply lead
socket-outlet and plug arrangement, or a lead permanently connected to the connectable electrical installation, used to connect connectable electrical installation to the site supply

1.4.24
switchboard
assembly of a circuit protective device or devices, with or without switchgear, instruments, or connecting devices, suitably arranged and mounted for distribution to, and protection of, one or more submains or final subcircuits, or a combination of both

1.4.25
tent
portable shelter or dwelling with non-rigid walls

1.4.26
vehicle
means for transporting people, animals or goods, specifically on land

EXAMPLE Cars, trucks and trailers including: non-recreational vehicles (1.4.14), recreational vehicles (1.4.17), mobile offices, break facilities and similar, or rail vehicles (rolling stock).

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1.4.27
voltage
differences of potential typically existing between conductors or between conductors and earth, as follows:

(a) *Extra-low voltage (ELV)* — not exceeding 50 V a.c. or 120 V ripple-free d.c.

(b) *Protected extra-low voltage (PELV)* — an extra-low voltage system that is not electrically separated from earth, but that otherwise satisfies all the requirements for SELV.

(c) *Separated extra-low voltage (SELV)* — an extra-low voltage system that is electrically separated from earth and from other systems in such a way that a single fault cannot give rise to the risk of electric shock.

(d) *Low voltage (LV)* — exceeding extra-low voltage, but not exceeding 1 000 V a.c. or 1 500 V d.c.

(e) *High voltage (HV)* — exceeding low voltage.

1.4.28
wiring systems
assembly made up of one or more conductors, cables or busbars and the parts that secure their fixing and, if necessary, their mechanical protection

1.5 Alterations and repairs

1.5.1 Alterations

1.5.1.1 General

Alterations to electrical installations in connectable electrical installations shall comply with AS/NZS 3000, except as varied herein, and with the additional requirements of this Standard.

Alterations to connectable electrical installations shall not cause any portion of the original electrical installation, or electrical equipment connected thereto, to —

(a) carry currents or sustain voltages in excess of those permitted by this Standard; or

(b) be used in any manner that is not in accordance with this Standard.

1.5.1.2 New Zealand

In New Zealand, when any alteration is made to the LV electrical installation of the recreational vehicle, any neutral-earth link shall be removed. Also, the following shall be installed if not already in place: NZ

(a) Overcurrent protection for each external supply, in accordance with Clause 4.5.3.1; and

(b) RCD protection for all final subcircuits, in accordance with Clause 4.5.4.

Alterations include:

(i) Removal of a neutral-earth link or connection.

(ii) Installation of a new final subcircuit.

(iii) Extension of an existing final subcircuit.

(iv) Removal of an in-line RCD from the supply lead.

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Where a neutral-earth link is removed, the incoming earth conductor of the external supply shall be disconnected from the neutral bar (or equivalent) and reconnected to the earth bar (or equivalent).

NOTE Transferring the connection point of the incoming protective earthing conductor is necessary to ensure that all items required to be earthed remain connected to the earth pin of the supply lead.

1.5.2 Repairs

1.5.2.1 General

Repairs to existing electrical installations in connectable electrical installations or parts thereof may be effected using methods, fixtures and fittings that were acceptable when that part of the electrical installation was originally installed or with methods, fixtures and fittings currently available as a direct replacement, provided that the methods satisfy the fundamental safety principles of AS/NZS 3000.

1.5.2.2 Switchboard replacement

In New Zealand, when a switchboard is replaced, any neutral-earth link shall be removed. Also, the following shall be installed if not already in place: NZ

(a) Overcurrent protection for each external supply, in accordance with Clause 4.5.3.1; and

(b) RCD protection for all final subcircuits, in accordance with Clause 4.5.4.

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Section 2 Electrical supplies for connectable electrical installations

2.1 General

This section specifies the minimum requirements for the connection of external electrical supplies to connectable electrical installations, that is relocatable units, recreational vehicles and non-recreational vehicles, that have the ability to be connected to an external source of low voltage a.c. electricity supply, by the use of a detachable connection.

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

In addition, guidance is provided so that the electrical installation functions correctly for the purpose intended.

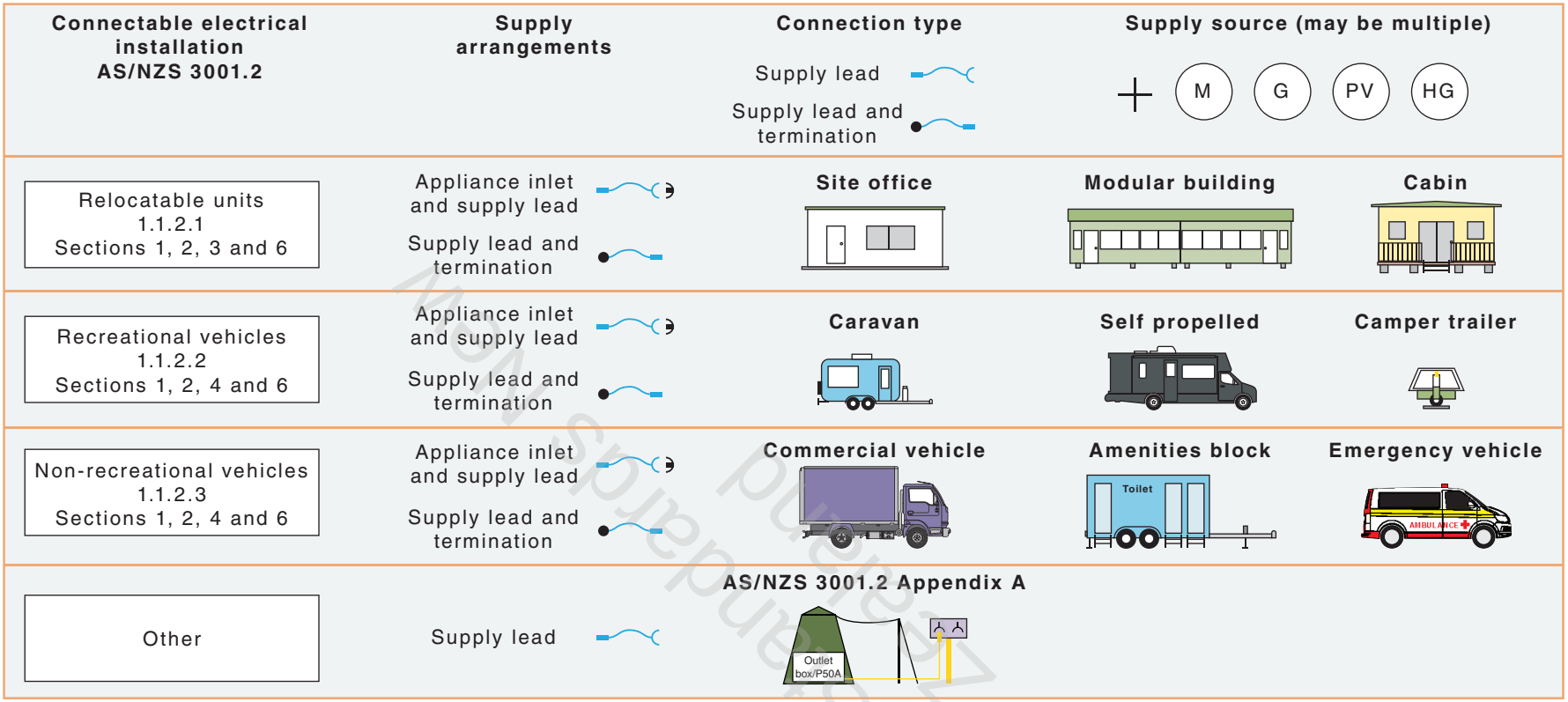
See Figure 2.1 for typical connectable electrical installations.

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Key

M — Normal supply

G — Generator

PV — Photovoltaic

HG — Hybrid generator incorporating one or more technologies

Connectable electrical installation — Supply lead terminated on structure

Connectable electrical installation — Inlet plug

Plug
Socket
Supply lead

Termination
Inlet plug/Appliance inlet

Figure 2.1 — Typical connectable electrical installations

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2.2 Supply systems

The low voltage electrical supply for any connectable electrical installation shall be installed in accordance with:

(a) AS/NZS 3000; and

(b) the additional or modified requirements of AS/NZS 3001.1; and

(c) other applicable Standards including:

(i) AS/NZS 4509.

(ii) AS/NZS 3010.

(iii) AS/NZS 5033.

(iv) AS/NZS 4777.

(v) AS/NZS 4763.

(vi) AS/NZS 5139.

See Figures 2.2 and 2.3 for typical supply arrangements.

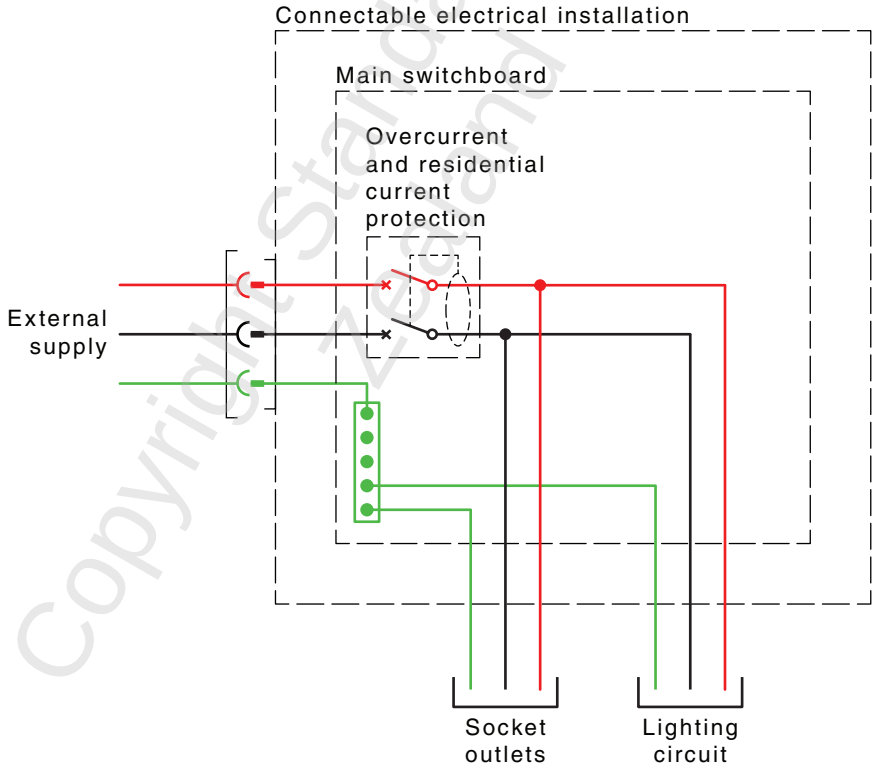
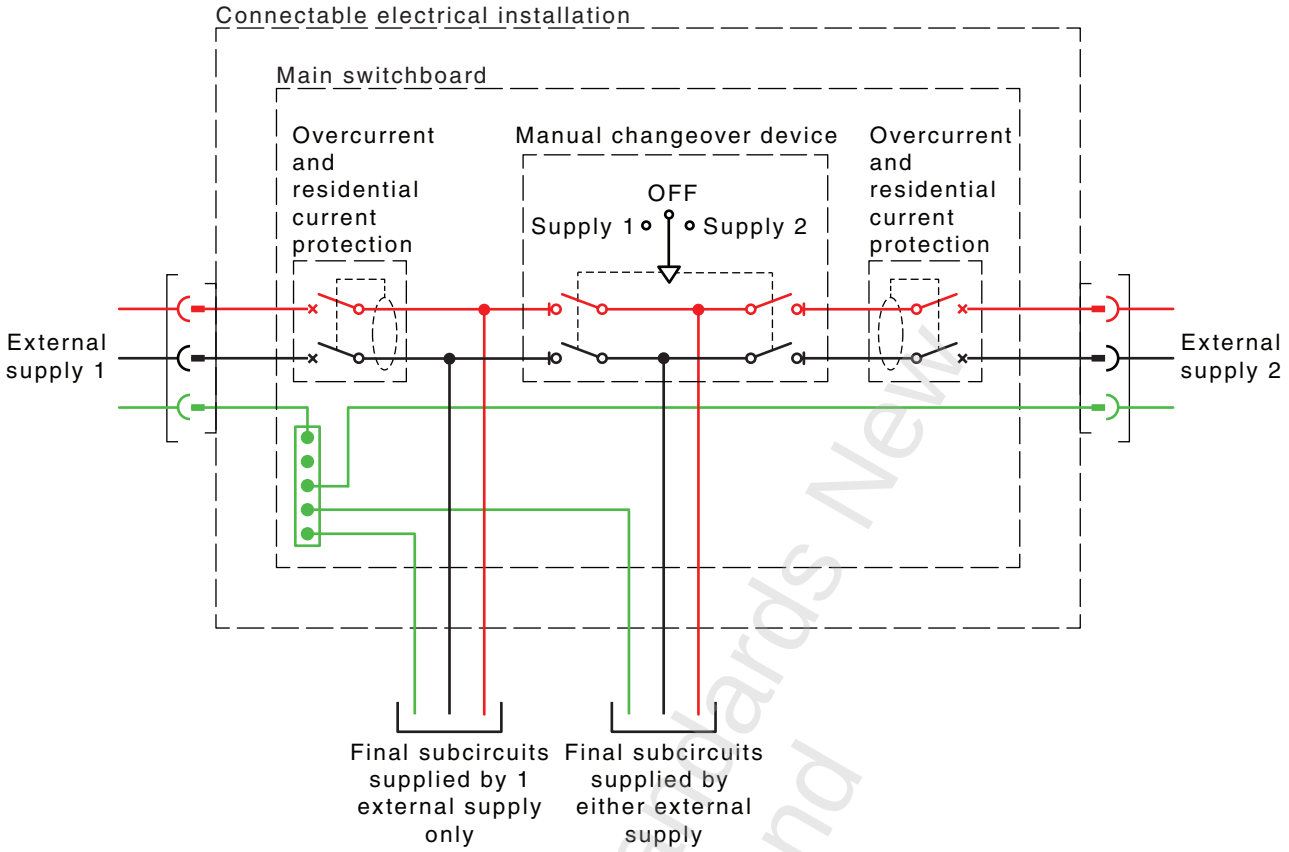


Figure 2.2 — Typical connectable electrical installation with one external supply

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NOTE 1 External supply 1 and external supply 2 may be from any one or combination of the following:

(a) Normal supply (caravan park pillar or socket-outlet at an installation); and/or

(b) motor generator supply; and/or

(c) inverter supply (renewable energy or battery energy storage system).

NOTE 2 External supplies should incorporate a neutral-earth connection.

Figure 2.3 — Typical connectable electrical installation with two external supply arrangements including manual changeover device

2.3 Generation

2.3.1 Generating sets (motor generator set)

Where an external generator is used to supply a connectable electrical installation, it shall comply with the safety requirements specified in AS/NZS 3010 for an isolated generator or for a generator protected by an RCD.

The generator set shall provide internal overcurrent protection as detailed in AS/NZS 3010.

2.3.2 Inverters

Where an external inverter is used to supply a connectable electrical installation, it shall comply with the safety requirements specified in AS/NZS 4763 for an isolated inverter, EPB (equipotentially bonded) inverter or for an inverter protected by an RCD.

The inverter shall provide internal overcurrent protection as detailed in AS/NZS 4763.

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2.4 Provision for connection to electrical supply

2.4.1 General

The connectable electrical installation shall be configured for connection to the external supply in accordance with one or more of the methods specified in Clauses 2.4.3 and 2.4.4.

2.4.2 Direct connection

Connections to supply by installation wiring, as shown in Figure 2.4, are excluded from this Standard.

Where the supply to a connectable electrical installation is connected by means of fixed (installation) wiring, the requirements of AS/NZS 3000 apply.

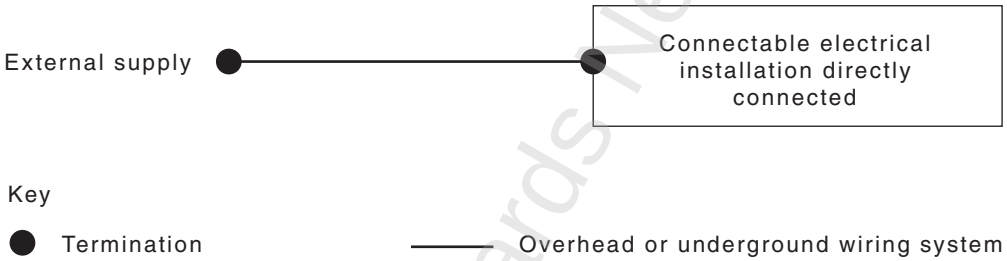


Figure 2.4 — A connectable electrical installation directly connected to electricity supply

2.4.3 Permanent connection of the supply lead

Where the supply lead is permanently connected to the connectable electrical installation, the connection shall be made at a permanent connection point mounted on or in the connectable electrical installation. See Figure 2.5.

The permanent connection point shall be either —

(a) the line terminals of one of the overcurrent protection devices; or

(b) a permanent connecting facility which is connected to the line terminals of the overcurrent protection device. It shall have the following minimum degree of protection:

(i) Mounted internally — IP2X.

(ii) Mounted externally — IP34.

In addition, the supply lead shall —

(A) comply with the applicable requirements of Clause 2.5; and

(B) be securely anchored at its point of termination to relieve strain from the terminals; and

(C) be provided with a suitable means for storage when not in use; and

(D) be constructed of double insulated or reinforced insulation.

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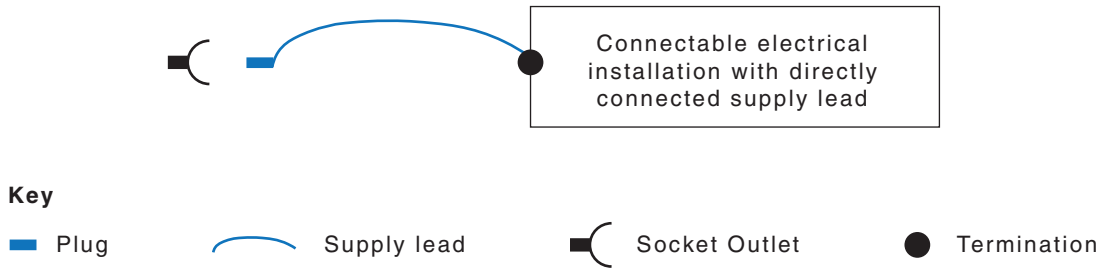


Figure 2.5 — Connectable electrical installation with supply lead directly connected

2.4.4 Detachable connection of the supply lead

Where the supply lead is connected to the connectable electrical installation by means of a detachable connection, the connectable electrical installation shall be fitted with one or more inlet plugs complying with —

(a) AS/NZS 3112; or

(b) AS/NZS 3123; or

(c) IEC 60309-2.

See Figure 2.6 for an example of a connectable electrical installation with inlet plug.

NOTE 1 The choice of the type of inlet plugs should be made following consideration of the conditions of use likely to apply in the area, state or country where it is anticipated that the connectable electrical installation is to be used. This should include the requirements of the relevant regulatory authorities.

Each inlet plug shall —

(i) be mounted and fixed in a readily accessible position and in such a manner as to be mechanically protected against any risk of damage that may reasonably be anticipated; and

(ii) comply with AS 60529 with a minimum degree of protection of IP34, both with and without a cord extension socket inserted; and

(iii) be provided with a mechanical means of relieving the strain on the supply lead connector.

NOTE 2 A bracket and insulator, a hook and thimble, or a non-perishable guy rope tensioner are suitable ways of meeting this requirement.

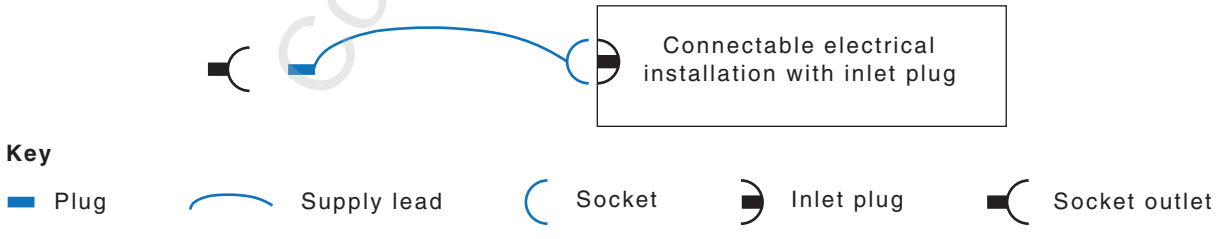


Figure 2.6 — Connectable electrical installation with inlet plug

2.4.5 Multiple connections

Where facilities for the connection of more than one supply lead to the connectable electrical installation are provided, the installation shall be arranged such that there are no interconnections between the live (active and neutral) conductors of different supplies or between the pins of different inlets.

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For multiple connection earthing requirements, see the following clauses for the applicable requirements:

(a) Clause 3.9 for relocatable structures.

(b) Clause 4.11 for recreational vehicles and non-recreational vehicles.

2.5 Supply lead

2.5.1 General

A supply lead used to connect a connectable electrical installation, or the electrical equipment in a tent or non-rigid annexe, to a site supply shall be in one length and comply with Clauses 2.5.2 and 2.5.3.

NOTE 1 See Appendix A for information on electrical supply to tents and non-rigid annexes.

NOTE 2 In New Zealand, the requirement for supply leads to be in one length does not preclude the use of an adaptor, provided it has a suitable IP rating and includes an overcurrent device to limit the current to the rating of the adaptor's plug. NZ

2.5.2 Technical details

The supply lead shall consist of the following:

(a) A flexible cord or cable complying with AS/NZS 3191, AS/NZS 5000.1 or AS/NZS 5000.2.

(b) A plug that (except where a plug of another rating or configuration, or both, is chosen for special purposes) complies with —

(i) AS/NZS 3112 with a minimum rating of 15 A; or

(ii) In Australia, AS/NZS 3123 with a minimum rating of 20 A.

(iii) In New Zealand, IEC 60309-2 with a minimum rating of 16 A.

Exception: When connecting a connectable electrical installation to a 10 A socket-outlet complying with AS/NZS 3112, the plug may have a 10 A rating, provided that the lead includes a device to limit the current to maximum 10.a.

(c) A cord extension socket or coupler complying with —

(i) AS/NZS 3120 with a minimum rating of 15 A; or

(ii) AS/NZS 3123 with a minimum rating of 20 A; or

(iii) IEC 60309-2 with a minimum rating of 16 A.

Exception: Clause 2.5.2(c) is not applicable to supply leads permanently connected to connectable electrical installations.

The choice of plug, cord and socket types and their ratings shall be dictated by:

(A) The current ratings of the elements to be connected; and

(B) the relevant conditions of use; and

(C) local conditions.

NOTE Local regulatory authorities may have alternative requirements for choice of plug, cord and socket type.

All parts of the supply lead shall have a minimum ingress protection rating of IP34, in accordance with AS 60529.

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2.5.3 Length

Supply leads used in caravan parks shall be not less than 10 m long. This is to reduce the risk of series joins in detachable supply leads. In other applications, no minimum length is specified.

In all cases, the length shall not exceed the relevant figure specified in Table 2.1 for the applicable conductor cross-sectional area.

Table 2.1 — Maximum lengths of supply leads

Single-phase			3 Phase		
Cable size mm^2	CB rating	Length of lead m	Cable size mm^2	CB rating	Length of lead m
1.5	16	15	1.5	16	15
2.5	16	25	2.5	16	25
2.5	20	20	2.5	20	20
4	20	30	4	20	35
4	25	25	4	25	30
6	32	30	6	32	30
10	50	30	10	50	35
16	63	40	16	63	45
25	80	50	25	63	70
35	100	55	25	80	55
—	—	—	35	100	65
—	—	—	35	125	50
—	—	—	50	125	70

NOTE 1 The minimum length of 10 m is specified for use in caravan parks for the benefit of park designers when they are designing site layouts.

NOTE 2 Values calculated in Table 2.1 are based upon voltage drop considerations and the overload characteristics of the protection devices.

2.5.4 Coiled leads

Where a reel, drum, storage box or similar is provided for the purpose of coiling the supply lead, a prominent notice should be fixed on or near the device to warn that the supply lead should not be connected to the supply while it is in coiled or reeled configuration.

2.6 External source of supply

2.6.1 Limitation of incoming supply current

Every external supply shall be protected against overload by an overcurrent device on, or within, the connectable electrical installation to which the supply is connected. The rating of this device shall not exceed the rating of the supply lead or supply lead fittings, whichever is the smaller. See Figure 2.7.

A 16 A miniature circuit breaker (MCB) may be used as overcurrent protection for a 15 A three-pin flat-pin fitting to AS/NZS 3112 in a recreational vehicle.

In Australia, the overcurrent protection device for connectable electrical installations shall operate in all live (active and neutral) conductors. AS

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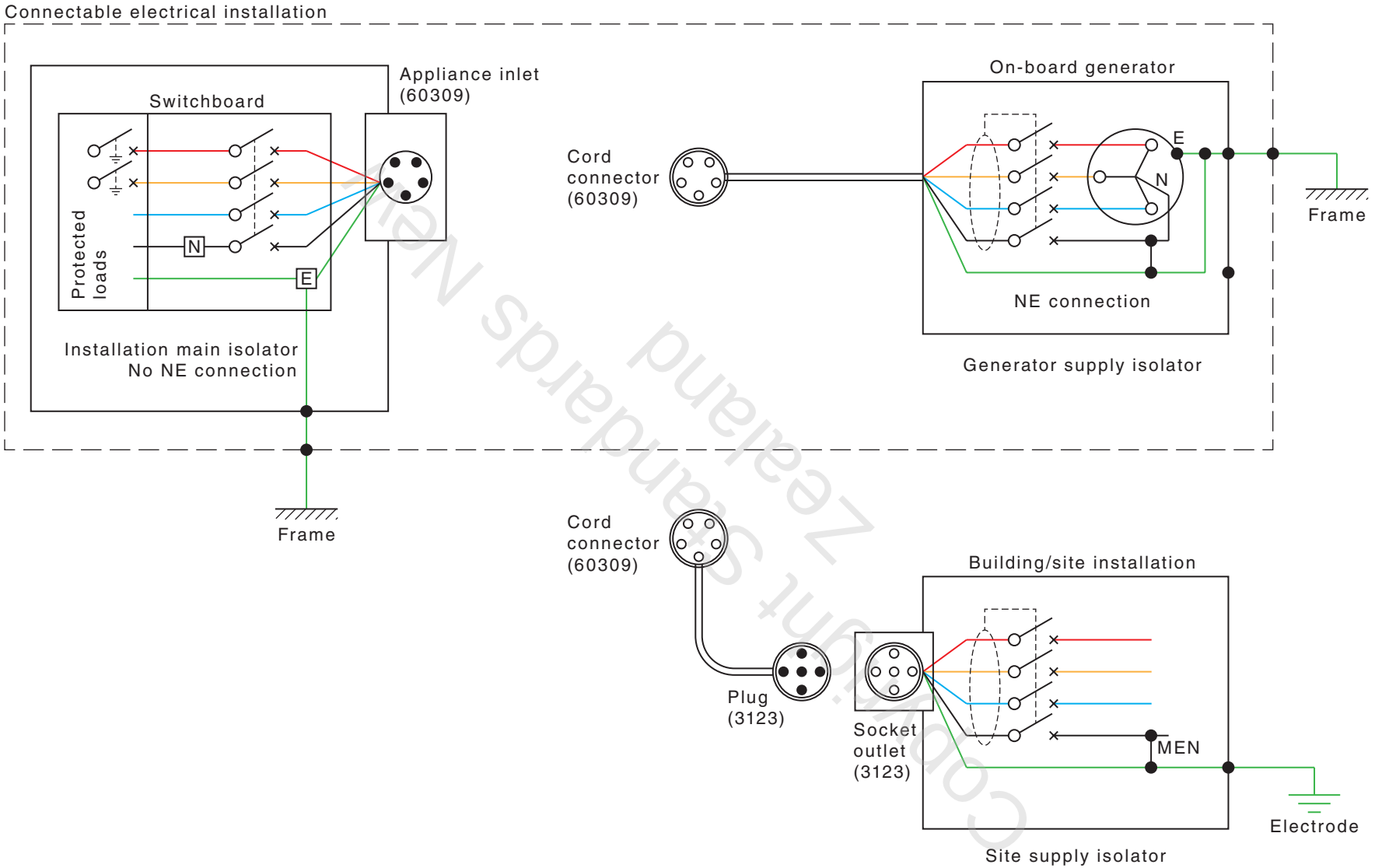


Figure 2.7 — Example of a typical connectable electrical installation with one external supply and one onboard supply where only one supply can be connected for use

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2.6.2 Earthing

The protective earthing conductors associated with any external supply to any connectable electrical installation shall be directly connected to the earthing conductor of every other external supply.

Where internal supplies exist, see Clauses 2.7.4 and 2.7.5 for requirements on earthing arrangements.

2.6.3 Phase sequence sensors

2.6.3.1 Multi-phase installations

In multi-phase electrical installations, provision shall be made for the ability to check the phase sequence of any external supply, and to match the supply phase sequence with the connectable electrical installation phase sequence.

Exception: This requirement does not apply where all multi-phase equipment within the connectable electrical installation is such that safety is not adversely affected by incorrect phase rotation.

NOTE A combined phase sequence sensor and transposition sensor may be used to satisfy this requirement.

2.6.3.2 Location

Phase sequence sensors shall be installed between the input inlet plug (appliance inlet) and the switchboard located in the connectable electrical installation.

Where installed, the phase sequence indicators shall be visible.

2.6.4 Protection against incorrect polarity

2.6.4.1 General

For every single-phase external supply, protection against transposition of the active and neutral conductors of the supply shall be by one of the following methods:

(a) transposition sensor; or

(b) onboard isolating transformer or electricity converter with a polarized output; or

(c) protective devices and switching devices in a connectable electrical installation shall operate in all live (active and neutral) conductors in accordance with Sections 3, 4 and 5.

See Sections 3 and 4 regarding switching of all live conductors.

2.6.4.2 Transposition sensor

NOTE 1 A transposition sensor is commonly referred to as a reverse polarity sensor.

The transposition sensor shall be either —

(a) an interlocking device with visual indication such that any supply cannot be connected if the polarity is incorrect; or

(b) an automatic correction device with visual indication that matches the polarity of the external supply to the polarity of the connectable electrical installation.

Transposition sensors shall be installed between the input inlet plug (appliance inlet) and the switchboard located in the connectable electrical installation.

NOTE 2 A combined transposition sensor and phase sequence sensor may be used to satisfy this requirement.

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2.7 Multiple sources of supply

2.7.1 General

A connectable electrical installation may have multiple sources of supply, either external or internal at low voltage or extra-low voltage.

Parts of the electrical installation within the connectable electrical installation may be supplied either —

(a) as independent installations, each supplied from only a single source; or

(b) from multiple sources, provided that each source is at the same voltage and frequency, in accordance with Clause 2.7.7.

Each supply shall comply with the relevant provisions of this section. In addition to the following requirements:

(i) External low voltage supplies shall comply with Clauses 2.4 to 2.6.

(ii) Internal low voltage supplies shall comply with Clause 2.7.2.

(iii) All extra-low voltage supplies shall comply with Section 5.

(iv) Interconnections between supplies shall comply with Clause 2.7.7.

(v) DC systems shall operate at extra-low voltage and comply with Section 5.

For the purposes of this Standard, power conversion equipment (PCE), such as inverters and battery chargers are regarded as a delineation point between separate systems operating at different voltage and frequency. See Figures 2.10, 2.11 and 2.12.

NOTE The input of an inverter is regarded as an extra-low voltage d.c. load and the output is regarded as a low voltage a.c. source.

Each supply shall be connected to the connectable electrical installation at a switchboard.

Exception: This requirement does not apply to extra-low voltage supplies intended solely for charging of batteries.

2.7.2 Onboard supplies

2.7.2.1 General

Onboard supplies for a connectable electrical installation are supplies that are dedicated to and are located within the connectable electrical installation.

NOTE Sources of internal low voltage supplies may include motor-driven generating sets or inverters.

2.7.2.2 Internal/onboard low voltage supplies

Internal/onboard supplies for a connectable electrical installation shall be provided by either —

(a) an RCD protected supply; or

(b) an isolated supply.

Sources shall comply with the relevant safety requirements of —

(i) AS/NZS 4763 for an inverter; and

(ii) AS/NZS 3010 for a generator.

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The source shall provide short circuit protection in accordance with AS/NZS 3000.

See Figures 2.8 and 2.9 for typical onboard supply wiring diagrams.

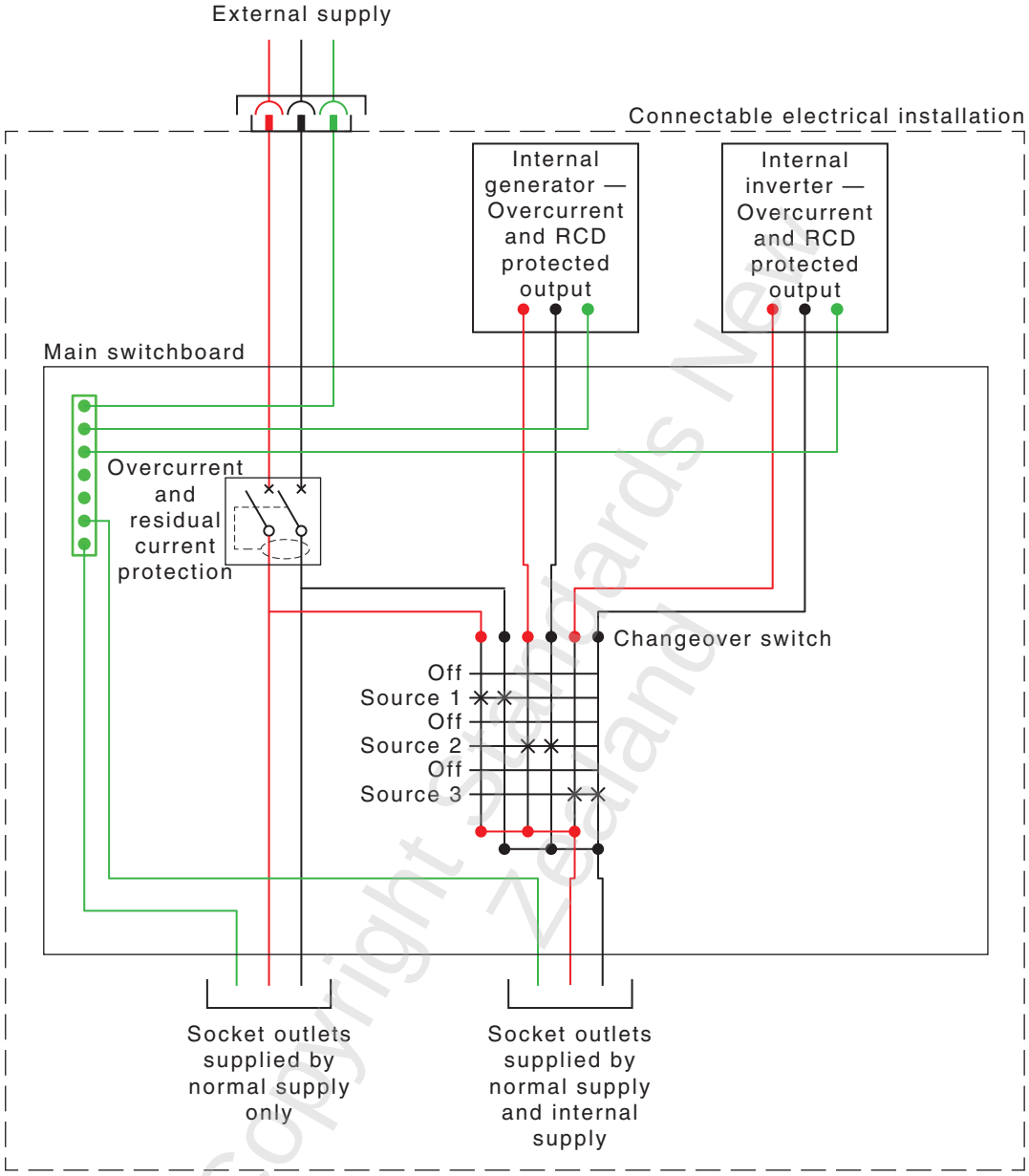
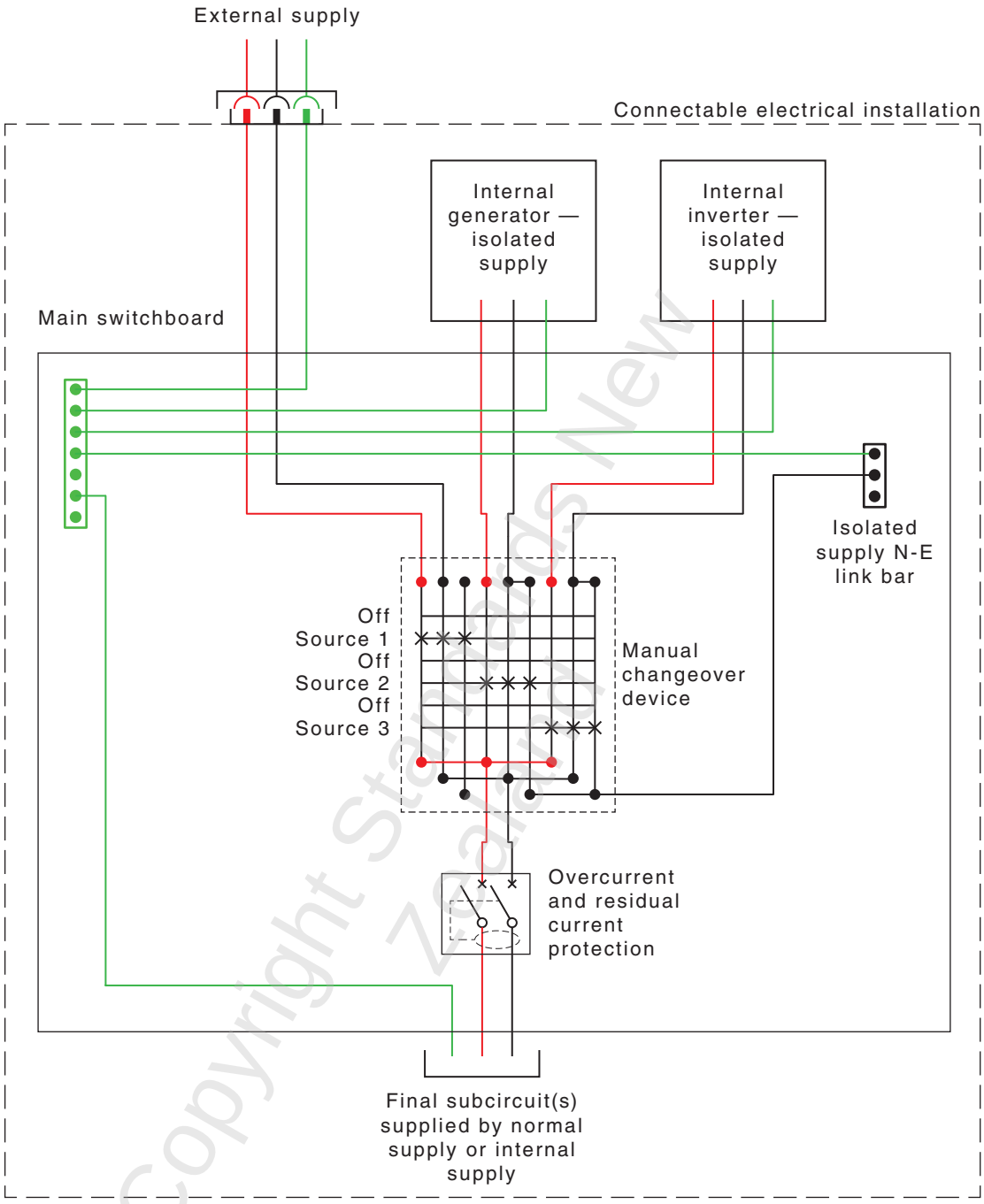


Figure 2.8 — Typical connectable electrical installation with one external supply and two onboard RCD protected supplies including manual changeover device

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NOTE 1 Isolated supply neutral-earth link bar optional.

NOTE 2 Isolated supply switched neutral tails connected between the main switch (changeover device) and neutral-earth link bar may be directly connected to the earth bar.

Figure 2.9 — Typical connectable electrical installation with one external supply and two internal supply arrangements including manual changeover device

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2.7.2.3 Inverter/inverter charger units

2.7.2.3.1 General

Inverter charger units charge batteries when the normal power supply is available and provide a 230 V a.c. power supply when the normal supply or supplementary supply (i.e. generator) is not available. An inverter charger takes d.c. power from a battery or d.c. source and converts it to 230 V a.c.

See Figures 2.10, 2.11 and 2.12 for typical inverter charger connection diagrams.

2.7.2.3.2 Inverters and inverter charger requirements

Inverters and inverter chargers shall —

(a) have separate terminals for the a.c. input and the a.c. output, which are isolated from each other and from the d.c. battery input terminals; and

NOTE 1 Where common or linked a.c. terminals are used, it is not possible to avoid back-feeding of the circuit providing normal supply to the unit.

NOTE 2 Relays or electronic switching may not provide the required isolation between a.c. input and output, see Clause 2.7.7.2.

(b) have short circuit and overload protection on the low voltage output of the inverter charger unit in accordance with AS/NZS 3000; and

(c) be non-rotating power inverters; and

(d) be designed to operate up to an ambient temperature of 50 °C and withstand an ambient temperature of 70 °C without damage; and

(e) be automatically controlled; and

(f) provide isolation of the a.c. output from the d.c. supply circuit; and

(g) have controls which are readily accessible.

2.7.2.3.3 Final sub-circuits supplied by inverter and inverter charger units

Final sub circuit(s) supplied by an inverter and by inverter charger units shall not be supplied by any other source.

Inverters and inverter charger units with internal socket-outlets shall be —

(a) an isolated output type; or

(b) the output shall be protected by an RCD device.

A visible indicator shall be provided at the a.c. switchboard indicating the inverter and inverter charger is active online or in standby mode together with a warning label to indicate that the electrical system includes an inverter.

Exception: Where the connectable electrical installation switchboard is installed externally, the visible indicator shall be placed in a prominent position within the connectable electrical installation e.g. above a door.

An example of a warning label is as follows:

WARNING — DANGEROUS VOLTAGE

THIS UNIT IS EQUIPPED WITH A POWER INVERTER

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TO AVOID SERIOUS INJURY OR DEATH FROM ELECTRICAL SHOCK DISCONNECT ALL A.C. EXTERNAL POWER SUPPLY(S) AND DC. BATTERY POWER TO INVERTER BEFORE OPENING PANEL OR SERVICING ELECTRICAL SYSTEMS

2.7.2.3.4 Inverter and inverter charger installation location

Inverters and inverter chargers shall be permanently installed.

Inverters and inverter chargers shall not be permanently installed in any of the following locations:

(a) near sources of heat such as engine exhaust pipes; or

(b) below fuel lines; or

(c) within battery enclosures, see Section 5.

2.7.2.3.5 Inverter and inverter charger nameplate information requirements

All inverters shall include the following information:

(a) input voltage and current; and

(b) continuous output current at rated voltage; and

(c) nominal output voltage and frequency; and

(d) surge capability and duration.

All inverter-chargers shall include the following information:

(i) input voltage, current and frequency; and

(ii) nominal output voltage and current; and

(iii) d.c. output voltage at float or shut off, if applicable; and

(iv) continuous output current at nominal battery voltage at 25 °C; and

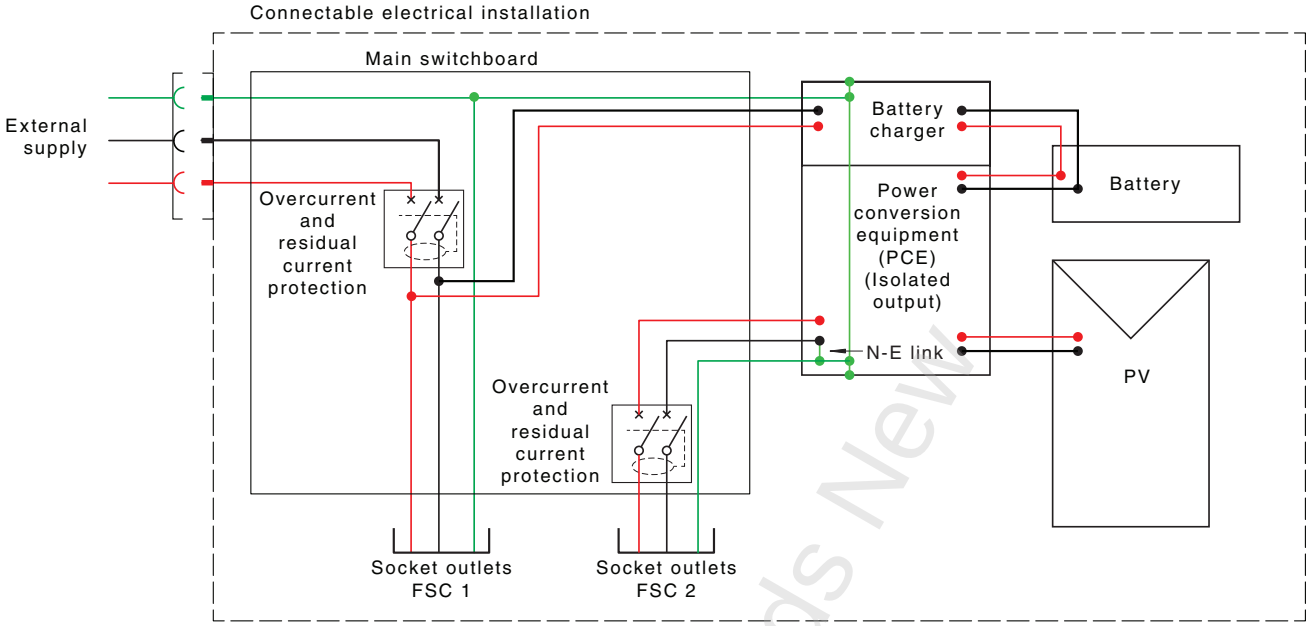
(v) battery type.

NOTE For further guidance, refer to ISO 13297, AS/NZS 4763, AS/NZS 60335.2.29, AS/NZS 60335.1.

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NOTE 1 See Clauses 2.7.7 and 2.7.8 for power conversion equipment (PCE) requirements.

NOTE 2 See Clause 2.7.7.5 for neutral-earth connection requirements in PCE.

Figure 2.10 (A) — Typical arrangement for a connectable electrical installation including inverter charger supply

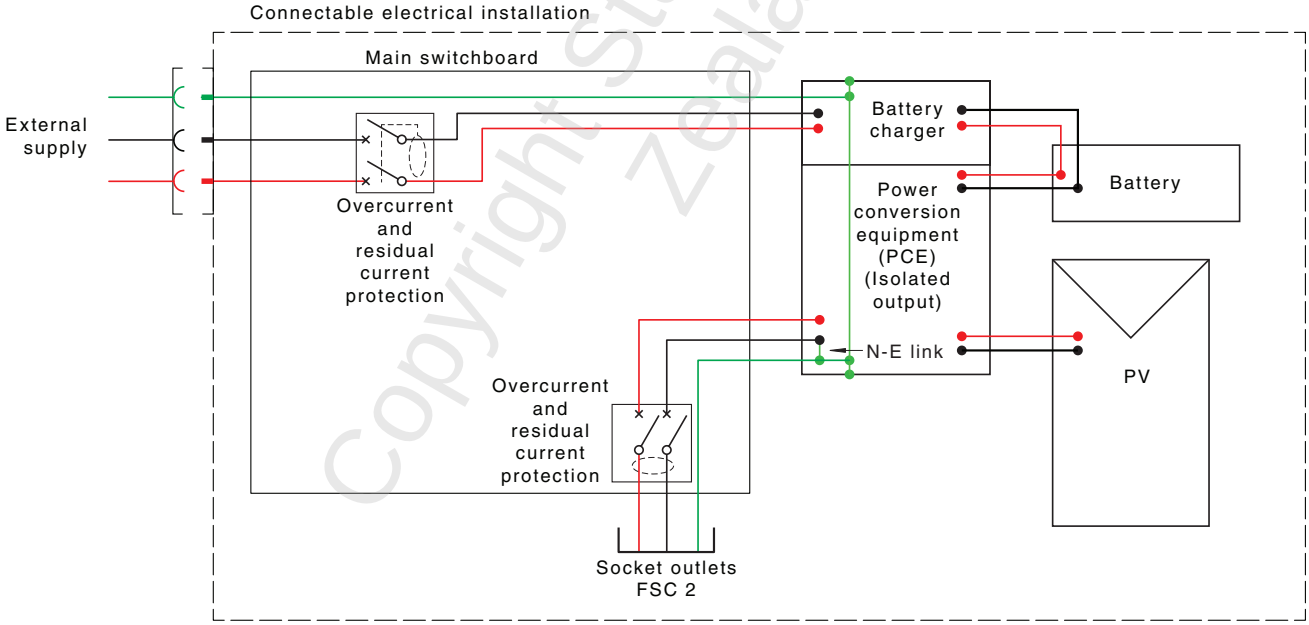
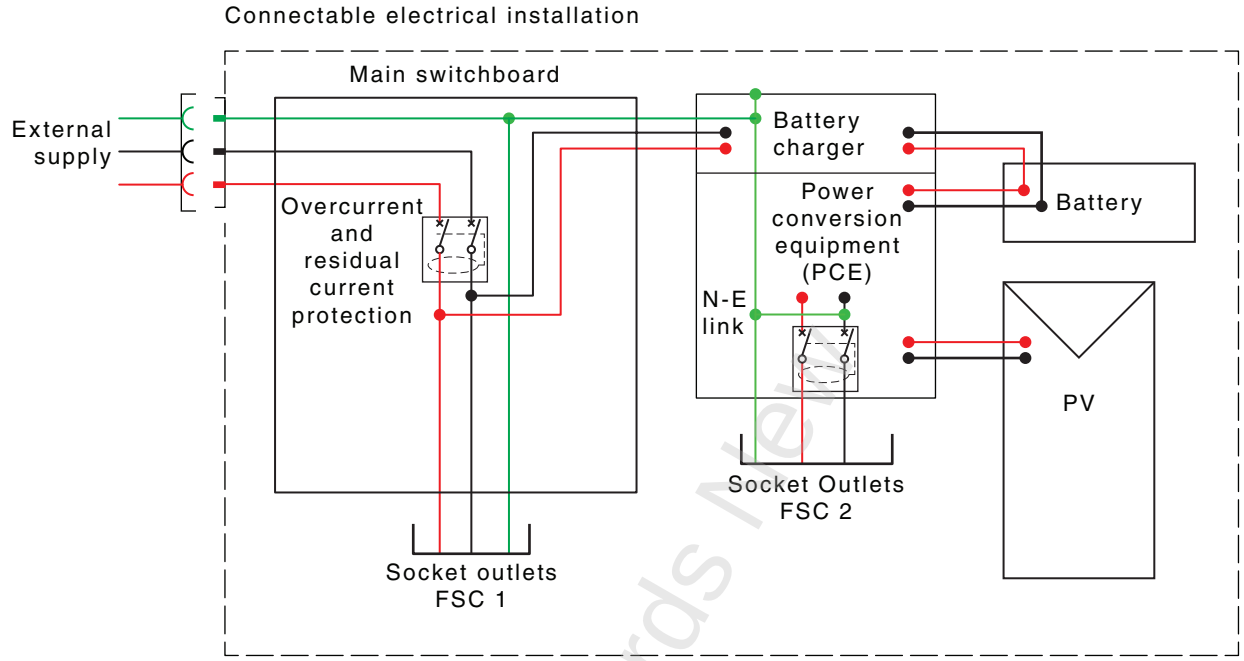


Figure 2.10 (B) — Typical arrangement for a connectable electrical installation including inverter charger supply

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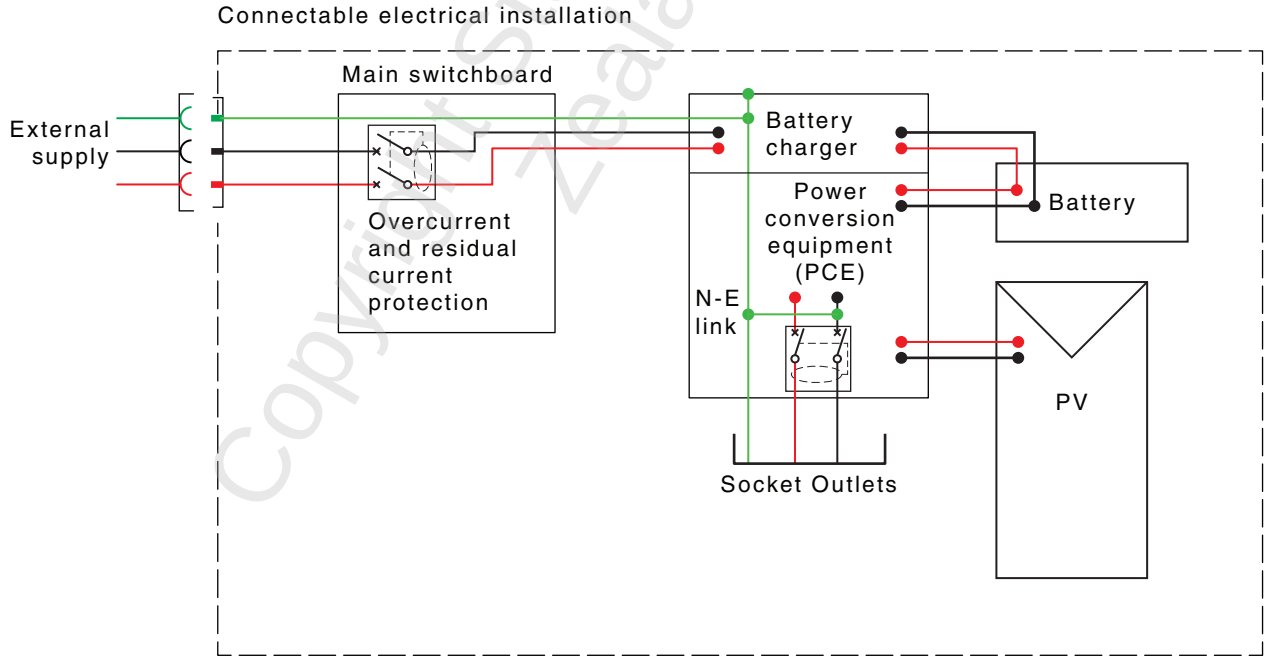
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NOTE 1 See Clauses 2.7.7 and 2.7.8 for PCE requirements.

NOTE 2 See Clause 2.7.7.5 for neutral-earth connection requirements in PCE.

Figure 2.11 — Typical arrangements for connectable electrical installation onboard supplies



NOTE 1 The PCE contains an automatic changeover device. Refer to the manufacturer's installation instructions.

NOTE 2 See Clauses 2.7.7 and 2.7.8 for PCE requirements.

NOTE 3 See Clause 2.7.7.5 for neutral-earth connection requirements in PCE.

Figure 2.12 — Typical arrangements for connectable electrical installation with external supply and RCD protected circuit to power conversion equipment (PCE)

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2.7.2.4 Onboard uninterruptible power supplies

2.7.2.4.1 General

An uninterruptible power supply (UPS) system may be used to provide an alternative supply for all or part of a low voltage installation in a connectable electrical installation, provided all the following conditions are met:

(a) The UPS shall comply with AS 62040.1; and

NOTE 1 AS 62040.1 requires UPS equipment to be designed and tested to prevent back-feeding into the a.c. input connection when the input a.c. supply is absent, and the UPS is producing an a.c. output.

(b) the UPS shall be installed in accordance with AS/NZS 3000 and the UPS manufacturer's instructions; and

(c) the circuit(s) supplied by the UPS shall not be able to be supplied by any other source; and

(d) the circuits supplied by the UPS shall be provided with RCD protection; and

NOTE 2 The RCD needs to be suitable for the output waveform under earth fault conditions. This may require use of Type B or Type F RCD.

(e) a transformerless UPS shall not be used to supply fixed wired circuits. Transformerless UPSs may be used only for direct supply to equipment, where the supply input and load output are connected by a detachable connection.

Typical arrangements for a UPS system are shown in Figure 2.13.

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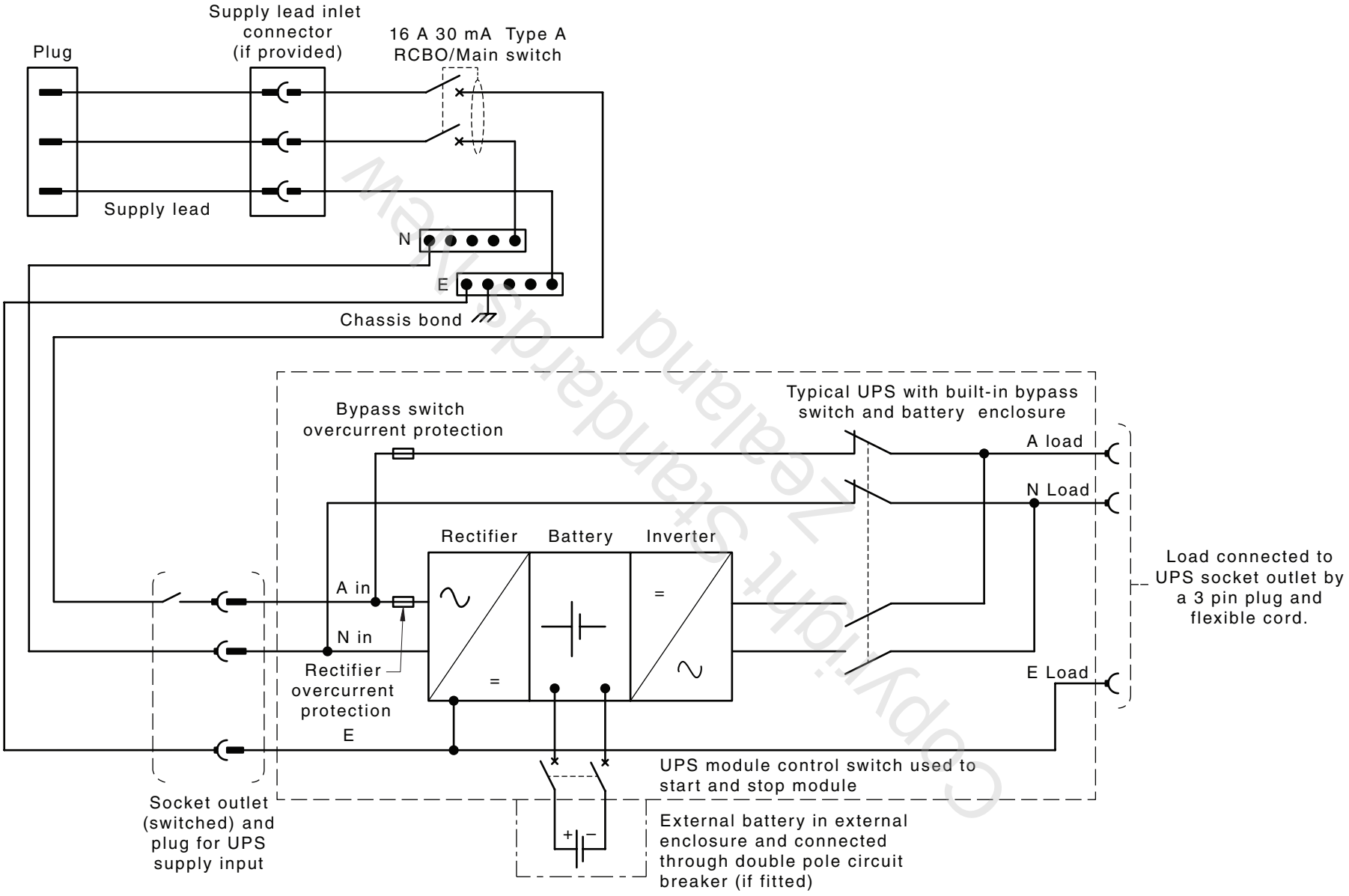


Figure 2.13 — Typical connection of transformerless UPS in conjunction with a supply in a connectable installation

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2.7.2.4.2 External UPS batteries

The UPS internal battery may be replaced or supplemented by use of external batteries, provided all the following conditions are met:

(a) The external battery shall be connected only to the UPS. The battery terminals shall be fully enclosed or screened to achieve ingress protection rating, in accordance with AS 60529, of IP2X; and

NOTE 1 For transformerless inverters, some fault conditions may result in the a.c. output being connected to the d.c. input, creating a risk of electric shock.

(b) the UPS external battery shall be located in a compartment sealed from the interior and ventilated to the exterior of the connectable electrical installation (see Section 5); and

(c) the UPS external battery output shall be provided with an isolating switch operating in both positive and negative conductors. The isolating switch shall be located in an accessible position; and

(d) the UPS external battery wiring shall be provided with short circuit protection located as close as practicable to, but not within, the battery compartment. If a circuit breaker is used, it shall be a non-polarized type.

NOTE 2 Consult the UPS manufacturer's information for details of the maximum limit of battery capacity able to be provided.

A UPS supplied by detachable connection shall be used only to supply equipment that is connected to the UPS by detachable connection. A UPS connected as an internal/onboard source of supply shall not be used to supply the inlet plug specified in Clause 2.4.

A detachable UPS used as an onboard supply shall comply with AS 62040.1.

2.7.3 Connection to installation

The output of the internal supply source shall be connected to the fixed wiring of the connectable electrical installation at the switchboard.

The wiring between the supply source and switchboard shall be provided with fault protection and short circuit protection in accordance with AS/NZS 3000.

NOTE Typical small inverters and generating sets may not be capable of delivering sufficient current to provide protection by operation of an overcurrent device, in which case alternative methods are permitted.

2.7.4 Earthing of supply source equipment

The exposed conductive parts of the supply source equipment shall be connected to the connectable electrical installation earthing system by means of a protective earthing conductor. These parts shall not depend solely on the equipment being fastened to the frame of the structure.

The connection of the source equipment protective earthing conductor to the installation's earthing system shall be made at the switchboard supplied by the source.

2.7.5 Supply source connections to earthing system

The neutral conductor of the output of any low voltage supply source shall be connected to the earthing system of the connectable electrical installation in accordance with one of the following:

(a) *Isolated supplies:* Where the electricity supply source is obtained from an isolated onboard generator or isolated inverter or EPB inverter, the neutral connection of the generator or inverter shall be connected to the earth system of the connectable electrical installation only when it is supplying the connectable electrical installation.

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NOTE 1 This connection converts the isolated (IT) supply characteristics to have the properties of a TN-S supply, enabling correct operation of the RCD protection.

NOTE 2 The connection is typically achieved by use of an additional pole in the changeover device. See Figures 2.8 and 2.9.

Exception: The neutral-earth connection need not be made where the isolated output source is provided with an insulating monitoring device. The device, complying with Clause 2.7.8, provides —

(i) *warning in the event of either a single fault to earth or insulation resistance between live parts and earth being below 1.0 MΩ; and*

(ii) *automatic disconnection of supply on occurrence of second fault to earth.*

(b) *RCD protected supply:* Where the electricity supply source is obtained from an RCD-protected onboard generator or inverter, the neutral connection of the generator or inverter shall be connected to the earth system of the connectable electrical installation.

The earthing conductor from an RCD protected onboard generator or inverter shall be connected to the earth system of the connectable electrical installation.

NOTE 3 This connection may result in two RCDs in series.

2.7.6 General requirements for solar photovoltaic supply

Low voltage solar photovoltaic (PV) supplies shall not be installed in or on a connectable electrical installation.

An extra-low voltage solar PV supply to a connectable electrical installation shall be connected to a battery system via a regulator in accordance with Section 5.

2.7.7 Inter-relationship of supplies

2.7.7.1 Low voltage supplies

Where it is intended that all or part of the electrical installation be supplied from more than one source, they shall be configured as alternative supplies.

A changeover switch or equivalent arrangement shall be provided such that the switch or arrangement complies with Clauses 2.7.7.2 to 2.7.7.5.

2.7.7.2 Isolation between sources

When one source is connected to part of the electrical installation, all other sources are isolated from the installation with respect to all live (active and neutral) conductors.

NOTE 1 Isolation may be achieved by —

(a) an isolating switch; or

(b) a contactor with an isolation rating; or

(c) a socket-outlet for each source and a plug for the part of the installation.

Equipment designed and tested in accordance with IEC 61810-1 to prevent back-feeding into the a.c. input connection, when the input a.c. supply is absent and the generator/inverter alternative supply is in use, may be acceptable.

NOTE 2 A source selection switch may also serve as the main switch for the various supplies.

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2.7.7.3 Sources live simultaneously

If the source of supply to the load is able to be changed while more than one supply is energized, the arrangement shall be such that the simultaneous connection of the load to both supply sources does not occur.

NOTE This may be achieved using break-before-make switching or interlocked contactors, however the simplest method for a manual switch is to have an intermediate "off" position between each pair of positions that select sources.

2.7.7.4 Voltage rating

The principles of connection to the installation including the minimum voltage rating of the switch(es) and the neutral-earth connection shall be in accordance with AS/NZS 3010.

Where a switching device is used, it shall have a minimum voltage rating not less than the maximum out-of-phase voltage between the sources.

Exception: Where a manual source selection switch has an intermediate "off" position between each pair of positions that select sources, the switch need only be rated for the nominal voltage.

2.7.7.5 Location

The source selection device(s) shall be located within or adjacent to the main switchboard that supplies the part of the installation being switched between sources of supply.

Where the main switchboard is installed externally, the changeover or source selection device may be installed at an internal switchboard.

Exception: This requirement does not apply to a changeover or source selection device that is —

(a) *incorporated into a source of supply, e.g. in an inverter/charger; or*

(b) *part of a UPS.*

Where the exception applies, a warning label shall be provided at the switchboard to warn of the possibility that some parts of the installation may remain energized and to indicate the location of the device.

This exception only applies where the internal switching arrangement of the source meets the requirements of Clauses 2.7.7.2 to 2.7.7.4. Where compliance is unproven, a separate switch shall be installed in accordance with this clause.

2.7.8 Insulation monitoring system

2.7.8.1 General

The a.c. supply into the insulation monitoring device shall be an isolated supply complying with AS/NZS 3000:2018 Section 7.

2.7.8.2 Insulation monitoring first fault

Where an insulation monitoring device is installed to provide monitoring and warnings of the supply in case of a first fault, the insulation monitoring device will allow a single fault between a live part and an exposed conductive part to occur without automatic disconnection. A single fault may occur provided that a continuously operating earth fault or insulation monitoring system is fitted and arranged to provide a warning to the operator when an earth fault occurs or insulation value falls below 1.0 MΩ.

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2.7.8.3 Insulation monitoring first and second fault

Where an insulation monitoring device is installed providing automatic disconnection of the supply in case of a first fault, the insulation monitoring device will allow a single fault between a live part and an exposed conductive part to occur without automatic disconnection. A single fault may occur provided that a continuously operating earth fault or insulation monitoring system is fitted and arranged to provide a warning to the operator when an earth fault occurs or insulation value falls below 1.0 MΩ.

A second fault shall result in automatic disconnection. A prospective touch voltage exceeding 50 V a.c. shall not persist for a time sufficient to cause a risk of harmful physiological effect in a person.

NOTE Special protective arrangements may need to be made for essential services in insulation monitoring systems.

The protective arrangements shall be —

(a) an overcurrent protective device; and

(b) an RCD with sensitivity of 30 mA maximum for final subcircuits to locations where there is an increased risk of personnel contact with live conductive parts.

Accessible conductive parts of the unit, such as the chassis and shielding of communication cabling, shall be connected to the equipotential bonding terminal within the unit.

If the insulation resistance between live parts and the unearthed equipotential bonding conductor drops below 50 V (refer to line-to-earth voltage U_0 in a fault-free system), the insulation monitoring device shall provide automatic disconnection of the supply.

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Section 3 Relocatable units

3.1 General

This section specifies the minimum requirements for the selection and installation of the following:

(a) Protection and control equipment.

(b) Switchboards.

(c) Wiring systems.

(d) Electrical equipment, including appliances and accessories.

(e) Earthing arrangements.

(f) Electrical equipment in locations subject to the effects of water or high humidity (damp situations) in a relocatable unit that includes the provision of connection to an external supply, see Figure 3.1.

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

In addition, guidance is provided so that the electrical installation functions correctly for the purpose intended.

Electrical installations in relocatable units shall be installed in accordance with —

(i) AS/NZS 3000; and

(ii) additional requirements or as varied by Section 3 of this Standard; and

(iii) any additional requirements as specified in the original equipment manufacturer's instructions.

EXAMPLE Relocatable units include homes, cabins/huts, site offices, cloakrooms, meeting offices, dormitories, canteens, first aid rooms, toilet facilities, washroom facilities, other facilities, tents for accommodation, or rigid and non-rigid annexes.

This section shall be read in conjunction with Sections 1, 2, 5 and 6 of this Standard and AS/NZS 3000 in full.

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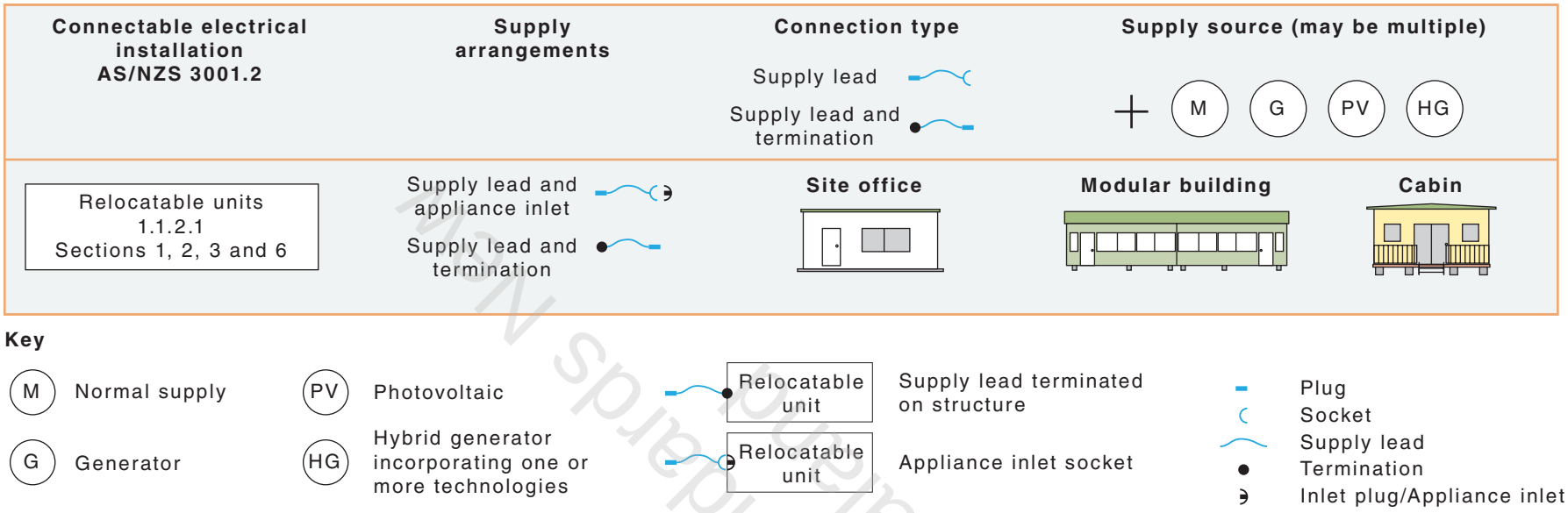


Figure 3.1 — Typical relocatable units covered by this section

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3.2 Alterations and repairs

Alterations and repairs to electrical installations in existing relocatable units shall be in accordance with Clause 1.5 of this Standard.

3.3 Supplies

All low voltage electrical supplies for a relocatable unit shall be installed to the requirements of Section 2 of this Standard.

All extra-low voltage supplies for a relocatable unit shall be installed to the requirements of Section 5 of this Standard.

3.4 Transposition sensor and phase sequence sensors

If a transposition sensor is installed in a relocatable structure, the transposition sensor shall be installed to the requirements of Clause 2.6.4.2.

If a phase sequence sensor is installed in a relocatable structure, the phase sequence sensor shall be installed to the requirements of Clause 2.6.3.

See exceptions to Clauses 3.8.2.2, 3.8.3 and 3.8.6 regarding switches operating in all live (active and neutral) conductors.

3.5 Protection

3.5.1 Maximum demand

The maximum demand of a relocatable unit shall be per the limitation method outlined in AS/NZS 3000.

3.5.2 Control of electrical installation

The supply to the electrical installation in a relocatable unit shall be controlled on the main switchboard by a main switch or switches that control the whole of the electrical installation in accordance with AS/NZS 3000.

Where there is only one final subcircuit installed, the control of the electrical installation may be provided by the current limiting protection device required by Clause 4.5.3.

A combined RCD and overcurrent circuit-breaker (RCBO) complying with the requirements of AS/NZS 61009 may be used to satisfy this requirement.

3.5.3 Protection against overcurrent

3.5.3.1 Current limitation of the incoming supply

In accordance with Clause 2.6.1, each supply to a relocatable unit shall be protected by a separate overcurrent protection device located within or on the relocatable unit.

The maximum rating of this overcurrent protection device shall not exceed the maximum current rating of the supply wiring system.

A 16 A miniature circuit breaker (MCB) may be used as overcurrent protection for a 15 A three-pin flat-pin fitting to AS/NZS 3112 in a relocatable unit.

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3.5.3.2 In Australia

In Australia, the overcurrent protection device for a relocatable unit shall operate (switch) all live (active and neutral) conductors. AS

3.5.3.3 Final subcircuit overcurrent protection

Each final subcircuit shall have an overcurrent protection device located within the switchboard. Where there is only one final subcircuit installed, overcurrent protection may be provided by the current limiting protection device required by Clause 3.5.3.1.

3.5.4 Additional protection by residual current devices

All final subcircuits shall be protected by one or more RCDs with rated residual current not exceeding 30 mA that —

(a) interrupt all live (active and neutral) conductors; and

(b) are of a type that provides protection against electric shock that complies with the requirements of a Type A RCD in accordance with AS/NZS 61008.1 or AS/NZS 61009.1.

RCDs incorporating Type A functionality along with additional functionality may be installed, including:

(i) Type F for the protection of circuits carrying high frequency leakage currents such as those associated with frequency converters and electronic ballasts; or

(ii) Type B where power inverters or frequency inverters are installed, as specified in the manufacturer's instructions for the specific current-using equipment.

3.6 Switchboards

A switchboard or switchboards shall be provided in or on the relocatable unit for the mounting or the enclosure of switchgear and protective devices in accordance with AS/NZS 3000.

Switchboards installed externally shall be a minimum of IP55.

A label shall be installed on or adjacent to the switchboard, identifying all wiring systems located within the connectable electrical installation, for example:

WARNING — THE INSTALLATION CONTAINS LOW VOLTAGE (230V), AND EXTRA LOW VOLTAGE WIRING SYSTEMS. REFER TO THE OWNER'S MANUAL.

3.7 Wiring systems for relocatable units

3.7.1 General

Wiring systems in a relocatable unit shall be selected and installed in accordance with AS/NZS 3000, and the additional requirements or as varied by Clause 3.7.

3.7.2 Selection

Low voltage a.c. wiring systems in a relocatable unit shall be selected in accordance with the requirements in AS/NZS 3000 and the AS/NZS 3008 series.

All wiring forming part of the electrical installation in a relocatable unit shall have a conductor cross-sectional area not less than 1.5 mm^2 and not less than seven strands consisting of either —

(a) multi-strand insulated and sheathed cables; or

(b) flexible cords.

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3.7.3 External influences

Wiring systems shall be installed to effectively protect against the presence and extent of relevant environmental and other influences in accordance with the requirements in AS/NZS 3000.

The design of the installation shall take into account vibration and movement during relocation.

3.7.4 Installation requirements

3.7.4.1 General

Wiring systems shall be installed to the applicable requirements of AS/NZS 3000.

3.7.4.2 Cables in contact with polystyrene or polyurethane

Cable insulation or sheathing may be compromised by a chemical reaction if it is in contact with polystyrene or polyurethane.

Cables shall be installed so there is no direct contact between the cable and polystyrene or polyurethane.

Exception: A cable that is manufactured and identified as being suitable for installation in contact with polystyrene or polyurethane is permissible.

3.7.4.3 Segregation of wiring systems

Where there are wiring systems operating at different voltages, cables of low voltage or extra-low voltage circuits shall not be enclosed in the same wiring system.

Exception: Cables of low voltage circuits and cables of extra-low voltage circuits shall only be enclosed in the same wiring system where one of the following arrangements is used:

(a) *The low voltage cables are of a type providing the equivalent of double insulation.*

(b) *All cables or each conductor of a multi-core cable are insulated for the highest voltage present.*

(c) *The low voltage cables are installed in a separate compartment of a common cable trunking system with fixed and continuous barriers between compartments.*

3.7.5 Identification

Low voltage installation wiring conductors shall be clearly identified to indicate their intended function as active, neutral, earth or equipotential bonding conductors in accordance with AS/NZS 3000.

3.8 Electrical equipment and accessories

3.8.1 General

Electrical equipment and accessories in relocatable units shall be selected and installed in accordance with the requirements of AS/NZS 3000 and as varied within this Standard.

3.8.2 Connection of electrical equipment (supply by flexible cords)

3.8.2.1 Type of socket-outlets

Socket-outlets shall be suitable for the intended application and location of installation.

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Socket-outlets shall comply with the requirements of one of the following standards or equivalent standards:

(a) AS/NZS 3112; or

(b) AS/NZS 3123; or

(c) IEC 60309-2; or

(d) AS/NZS 3131.

3.8.2.2 Switching

Switches that directly control low voltage socket-outlets shall operate in all live (active and neutral) conductors.

Exception: Where an isolating transformer or electricity converter with a polarized output, or a transposition sensor, is installed in accordance with Clause 2.6.4 for each external supply, the switches may operate in the active conductors only.

3.8.2.3 External socket-outlets

Any socket-outlet mounted on the exterior of a relocatable unit shall have a minimum degree of protection of IP34 that is compliant with AS 60529.

3.8.2.4 Termination of different wiring systems within accessories

A low voltage fixed switch or socket-outlet, or its faceplate, shall not incorporate a connecting device for telecommunications, data, television, radio or other similar wiring systems.

USB charging socket-outlets on the faceplate may be installed provided the USB socket is supplied from the low voltage source at that faceplate.

3.8.2.5 Labelling of socket-outlets

Low voltage socket-outlets shall be labelled to identify all source(s) of supply when multiple sources of supply are installed.

The labelling shall be —

(a) legible; and

(b) durable; and

(c) in the English language; and

(d) located at each socket-outlet.

See Figure 3.2 for examples of labelling that may be used.



Figure 3.2 — Typical labels for supplies

3.8.3 Light switches

All low voltage light switches that are installed in a relocatable unit shall operate in all live (active and neutral) conductors.

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Exception: Where an isolating transformer or electricity converter with a polarized output or a transposition sensor is installed in accordance with Clause 2.6.4 for each external supply, the switches may operate in the active conductors only.

3.8.4 Mounting

Flush-fitted accessories shall be installed to ensure that insulated cables do not come into contact with any conductive material.

This requirement may be satisfied by restraining the conductor by tying, lacing, clipping or containing the termination within a non-conductive shroud or enclosure.

3.8.5 Smoke alarms

Where LV smoke alarms are installed, they may be supplied from any LV circuit.

NOTE Local regulatory requirements may apply in relation to smoke alarm installation.

3.8.6 Appliances

3.8.6.1 Control

Every permanently connected low voltage appliance within a relocatable unit shall be controlled by a switch in accordance with the requirements AS/NZS 3000.

Every permanently connected low voltage appliance in a relocatable unit shall be provided with a switch that operates in all live (active and neutral) conductors.

Exception: Where an isolating transformer or electricity converter with a polarized output or a transposition sensor is installed in accordance with Clause 2.6.4 for each external supply, the switches may operate in the active conductors only.

3.8.6.2 Gas appliances and equipment

Gas appliances and equipment that also require connection to an electrical supply in a relocatable unit shall be selected and installed in accordance with the requirements of AS/NZS 3000.

3.9 Earthing

3.9.1 General

Earthing conductors in a relocatable unit shall be installed in accordance with the requirements of AS/NZS 3000.

3.9.2 Equipotential bonding

All metallic piping and metal framework in or on a relocatable unit shall be connected to the protective earthing conductor by means of —

(a) an equipotential bonding conductor in accordance with AS/NZS 3000; or

(b) clamping it to any earthed conductive parts so that reliable mechanical and electrical contact is maintained between the piping and earthed metal.

The connection of the equipotential bonding conductor to the conductive frame of the relocatable unit shall be by a permanent stud (minimum 6 mm) attached to the frame or by a nut and bolt (minimum 6 mm).

Self-drilling screws shall not be used for this connection.

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Exception: Piping systems for the supply of gas do not need to be connected to the protective earthing conductor in situations where this practice is not permitted in accordance with AS/NZS 5601.2.

3.10 Electrical installation in damp situations

3.10.1 General

Electrical installations within damp situations in relocatable units shall be in accordance with AS/NZS 3000 and this clause.

3.10.2 External fixed water containers

Two zones (Zones 0 and 2) are classified under AS/NZS 3000 for fixed water containers other than baths and showers as follows:

(a) Zone 0 shall be the area of the interior of the water container.

(b) Zone 2, for an individual water container with a capacity not exceeding 40 L and with fixed water outlets, shall be the area limited by —

(i) the vertical plane 0.15 m from the internal rim of the water container; and

(ii) the ground and the horizontal plane 0.4 m above the water container.

NOTE There is no Zone 1 or 3 for these water containers.

See Figure 3.3 and Table 3.1 for further information.

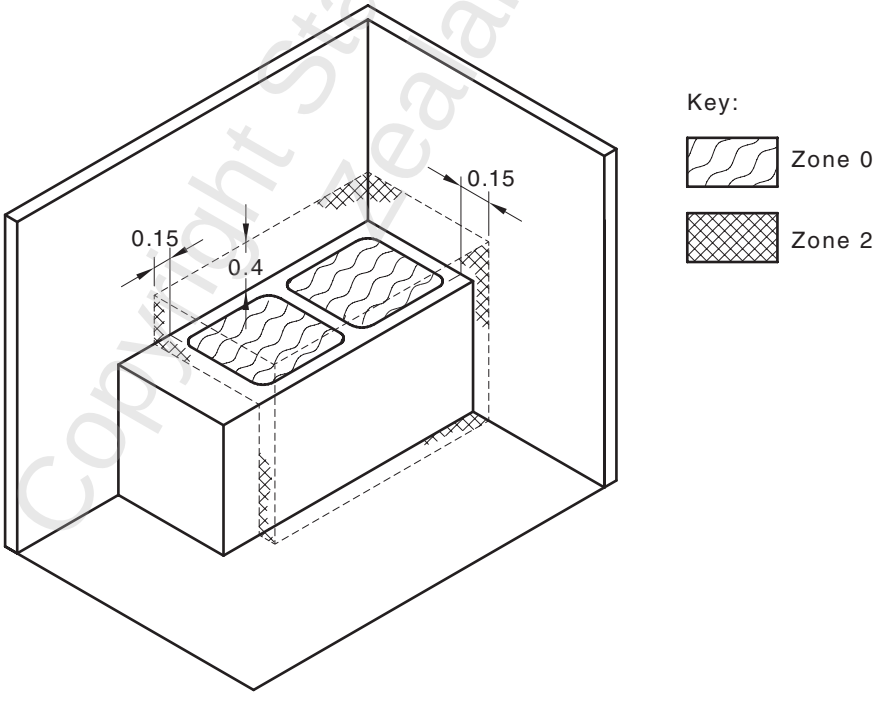


Figure 3.3 — Zone dimensions for other fixed water containers with fixed water outlets where no container has a capacity exceeding 40 L

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Table 3.1 — Selection and installation of electrical equipment for external fixed water containers

Equipment	Zone 0	Zone 2
Socket-outlets	Not permitted	RCD-protected and in a cupboard (no specific IP rating)
Switches/accessories	Not permitted	< 0.3 m not permitted from ground, floor or platform ≥ 0.3 m IPX4
Luminaires	IPX7, and specifically for use, and separated extra-low voltage (SELV) or protective extra-low voltage (PELV) supply	IPX4, or Class II construction (double or reinforced insulation), or SELV or PELV, or recessed into ceiling
Other electrical equipment	IPX7, and specifically for use, and SELV or PELV supply	IPX4, or Class II construction (double or reinforced insulation), or SELV or PELV, or recessed into ceiling
Switchboards	Not permitted	Not permitted
Electricity generation system	Not permitted	Not permitted
NOTE Table reproduced from AS/NZS 3000 with modification.		

3.10.3 Washdown facilities

For the purposes of this clause, a full chemical safety washdown facility such as a deluge shower, in which a person can stand, shall be treated as a shower under AS/NZS 3000.

In addition, a self-contained eyewash facility with a fixed or flexible hose shall be treated as a fixed water container under AS/NZS 3000.

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Section 4 Recreational vehicles and non-recreational vehicles

4.1 General

This section specifies the minimum requirements for the selection and installation of —

(a) protection and control equipment;

(b) switchboards;

(c) wiring systems;

(d) electrical equipment, including appliances and accessories;

(e) earthing arrangements; and

(f) electrical equipment in locations subject to the effects of water or high humidity (damp situations) in a recreational vehicle or non-recreational vehicle that include the provision of connection to an external supply, see Figure 4.1.

These requirements are intended to protect persons, livestock, and property from electric shock, fire and physical injury hazards that may arise from a recreational vehicle or non-recreational vehicle that is used with reasonable care and with due regard to the intended purpose of the electrical installation.

In addition, guidance is provided so that the electrical installation functions correctly for the purpose intended.

Electrical installations in recreational vehicles or non-recreational vehicle shall be installed in accordance with:

(i) the requirements provided in this section; and

(ii) any additional requirements as specified in the original equipment manufacturer's instructions.

NOTE See terms and definitions clause for examples of *recreational vehicles* (1.4.17) and *non-recreational vehicles* (1.4.14).

This section shall be read in conjunction with Sections 1, 2, 5 and 6 of this Standard.

AS/NZS 3000 may provide further guidance.

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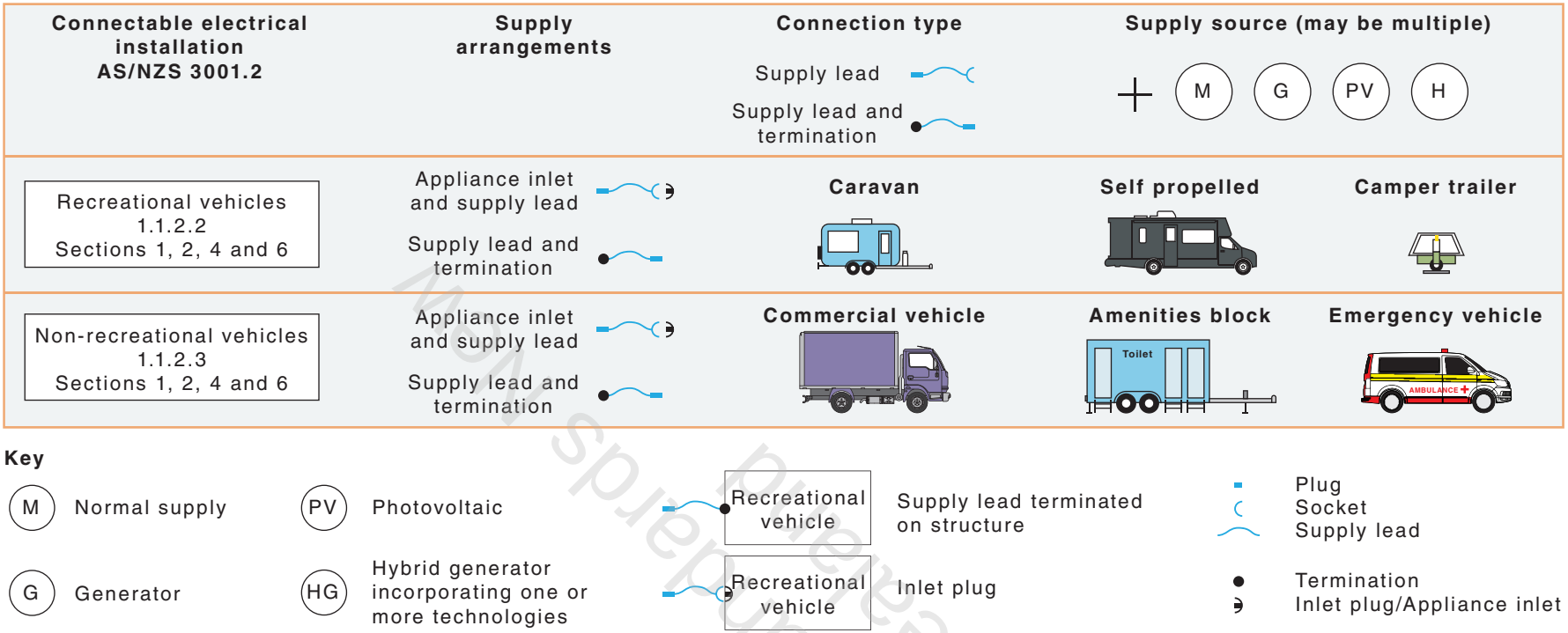


Figure 4.1 — Typical vehicles covered by this section

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4.2 Alterations and repairs

Alterations and repairs to electrical installations in existing recreational vehicles or non-recreational vehicles shall be in accordance with Clause 1.5 of this Standard.

In New Zealand, attention is drawn to the risks outlined in Clause 1.5.1 of alterations to older recreational vehicles or non-recreational vehicles, particularly the removal of neutral-earth links, which may create an unsafe outcome, as well as to the specific requirements of Clause 6.3 for inspection and testing after alterations are carried out. NZ

4.3 Supplies

All low voltage electrical supplies for a recreational vehicle or non-recreational vehicle shall be installed to the requirements of Section 2 of this Standard.

All extra-low voltage supplies for a recreational vehicle or non-recreational vehicle shall be installed to the requirements of Section 5 of this Standard.

4.4 Transposition sensor and phase sequence sensor

If a transposition sensor is installed in a recreational vehicle or non-recreational vehicle, the transposition sensor shall be installed to the requirements of Clause 2.6.4.2.

If a phase sequence sensor is installed in a recreational vehicle or non-recreational vehicle, the phase sequence sensor shall be installed to the requirements of Clause 2.6.3.

See exceptions to Clauses 4.8.1.2, 4.8.1.6 and 4.9.1 regarding switches operating in all live (active and neutral) conductors.

4.5 Protection

4.5.1 Maximum demand

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

4.5.2 Control of electrical installation

The supply to the electrical installation in a recreational vehicle or non-recreational vehicle shall be controlled on the main switchboard by a main switch or switches that control the whole of the electrical installation.

The control of the electrical installation may be provided by the current limiting protection device required by Clause 4.5.3. A combined RCD and overcurrent circuit-breaker (RCBO) complying with the requirements of AS/NZS 61009 may be used to satisfy this requirement.

4.5.3 Protection against overcurrent

4.5.3.1 Current limitation of the incoming supply

In accordance with Clause 2.6.1, each supply to a recreational vehicle or non-recreational vehicle shall be protected by a separate overcurrent protection device located within or on the recreational vehicle. The maximum rating of this overcurrent protection device shall not exceed the maximum current rating of the supply wiring system.

A 16 A miniature circuit breaker (MCB) may be used as overcurrent protection for a 15 A three-pin flat-pin fitting to AS/NZS 3112 in a recreational vehicle.

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In Australia, the overcurrent protection device for recreational vehicles or non-recreational vehicles shall operate (switch) all live (active and neutral) conductors. AS

4.5.3.2 Final subcircuit overcurrent protection

Each final subcircuit shall have an overcurrent protection device located within the switchboard. Where there is only one final subcircuit installed, overcurrent protection may be provided by the current limiting protection device required by Clause 4.5.3.1.

4.5.4 Additional protection by residual current devices

4.5.4.1 General

All final subcircuits in a recreational vehicle or non recreational vehicle shall be protected by one or more RCDs with rated residual current not exceeding 30 mA, that also —

(a) interrupts all live (active and neutral) conductors; and

(b) is of a type that provides protection against electric shock that complies with the requirements of a Type A RCD in accordance with AS/NZS 61008.1 or AS/NZS 61009.1.

RCDs incorporating Type A functionality along with additional functionality may be installed, including:

(i) Type F for the protection of circuits carrying high frequency leakage currents such as those associated with frequency converters and electronic ballasts, or

(ii) Type B where power inverters or frequency inverters are installed, as specified in the manufacturer's instructions for the specific current-using equipment.

4.5.4.2 Location of RCD protection

Where protection of final subcircuits is required, RCDs shall be installed at the switchboard from which the final subcircuit originates.

4.6 Switchboards

4.6.1 General

A switchboard or switchboards shall be provided in or on the recreational vehicle or non-recreational vehicle for the mounting or the enclosure of switchgear and protective devices in accordance with this section.

Switchboards installed externally shall be a minimum of IP55.

A label shall be installed, on or adjacent to the switchboard, identifying all wiring systems located within the connectable electrical installation. For example:

WARNING — This installation contains low voltage (230 V), extra low voltage and automotive wiring systems. Refer to the owner's manual.

4.6.2 Switchboard enclosure

Live parts shall be arranged so that basic protection is provided by the switchboard enclosure.

Basic protection shall be provided against dangers that may arise from contact with parts of the electrical installation that are live in normal service.

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Acceptable methods to achieve basic protection include:

(a) *Insulation*: Live parts shall be completely covered with insulation capable of withstanding the mechanical, chemical, electrical and thermal influences to which they may be subjected in service, and that can only be removed by destruction.

(b) *Enclosures*: Live parts shall be inside enclosures that provide a degree of protection of at least IPXXB or IP2X. Enclosures shall be firmly secured in place and have adequate stability and strength to withstand any appreciable distortion caused by the stresses likely to occur in normal operation, including external influences, so that the required degrees of protection and separation from live parts are maintained. The opening of enclosures, or withdrawal of parts of enclosures (e.g. doors, casings, lids, covers and the like) shall not be possible without the use of a key or tool.

4.6.3 Location

A switchboard installed in or on a recreational vehicle or non-recreational vehicle shall be mounted at —

(a) a minimum 100 mm from the ground, floor or platform to the bottom of the switchboard enclosure; and

(b) not more than 2 m from the ground, floor or platform to the top of the switchboard enclosure.

Switchboards shall be —

(i) accessible; and

(ii) installed in well-ventilated places; and

(iii) protected against the effects of moisture to which they may be exposed; and

(iv) arranged to provide sufficient space for the initial installation and later replacement of individual items of the control and protective devices and accessibility for operation, testing, inspection, maintenance and repair.

4.6.4 Restricted locations

4.6.4.1 Water containers and fixed or stationary cooking appliances

A switchboard shall not be installed above open water containers, or fixed or stationary cooking appliances unless installed in a cupboard in accordance with Clause 4.6.4.2.

NOTE See Clause 4.6.5.2 for baths and showers.

Exception: A switchboard may be located in an area that may be affected by splashing water or by steam, provided that the switchboard is installed within an enclosure of IP33 rating or is installed in a cupboard with close-fitting doors.

4.6.4.2 In cupboards

A switchboard installed in a cupboard or similar enclosure shall only be installed in an area set aside for the purpose. See Figure 4.2.

The provisions of this clause require that the switchboard be designed and located to be accessible for the purposes of operation and maintenance of equipment mounted on the switchboard.

The switchboard shall be —

(a) installed in a section of the cupboard separated from other sections; and

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(b) installed at the front of the switchboard section of the cupboard; and

(c) facing the cupboard access door with insufficient unused space between the switchboard and the cupboard door, when closed, to store extraneous objects in front of the switchboard; and

(d) arranged so that, below the area of the switchboard panel or enclosure, there are no projections that obstruct access for the operation and maintenance of the switchboard.

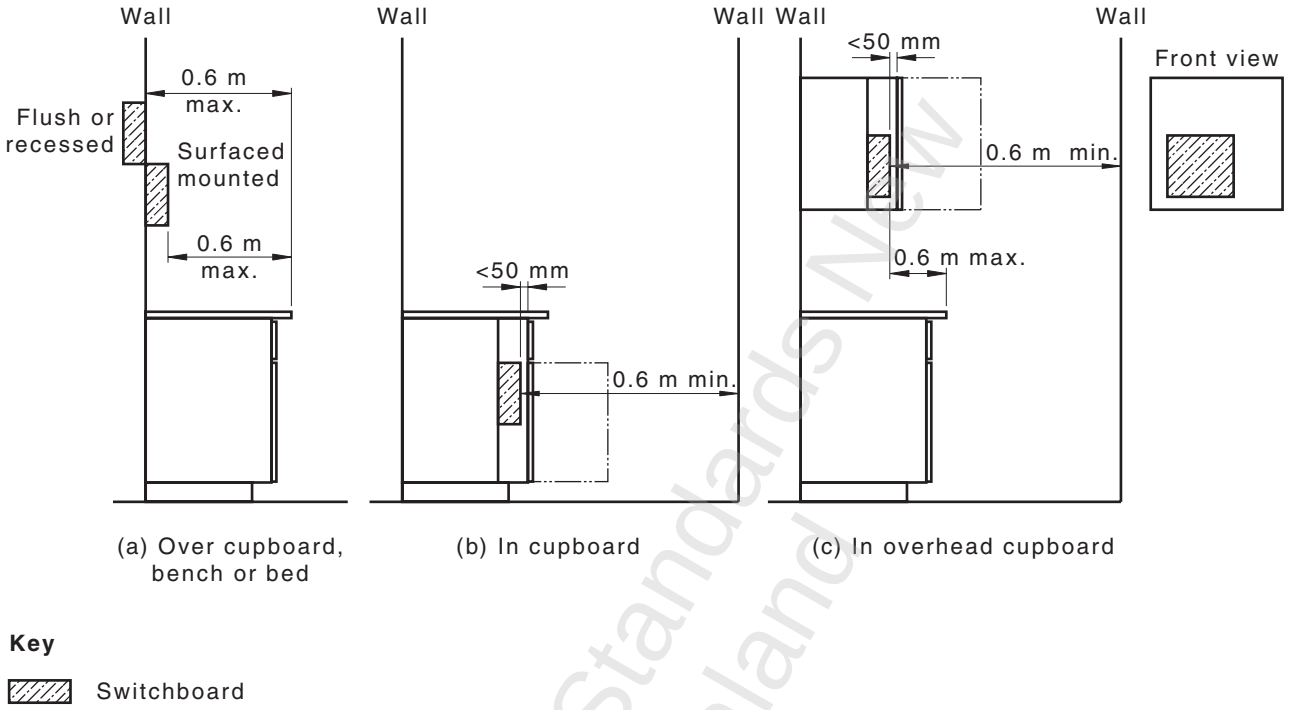


Figure 4.2 — Switchboards installed in cupboards in recreational vehicles or non-recreational vehicles

4.6.5 Equipment identification

4.6.5.1 General

All equipment installed on a switchboard shall be legibly and indelibly marked to indicate the final subcircuit or equipment each device protects.

4.6.5.2 Near baths and showers

A switchboard shall not be installed within any classified zone for a bath or shower.

4.6.6 Suitability

The switchboard shall be designed to be adequately protected against damage that may reasonably be expected from external influences and that the switchboard may be exposed to under normal operating conditions.

Damage from such influences may include mechanical damage, damage due to exposure to weather, water, excessive dampness, accumulation of dust, temperature, vibration or any other influence to which the switchboard may be exposed under the conditions of use.

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4.6.7 Orientation of protection devices

Where two or more circuit protective devices are mounted in the same row, the operating mechanism of each shall cause the circuit to open when the operating means are orientated in one direction.

Other arrangements may be used where the open circuit condition of each device is obvious or where each device is clearly marked to indicate the off position.

4.6.8 Fire-protective measures

Wiring associated with switchboards shall be installed in such a manner that, in the event of fire originating at the switchboard, the spread of fire is kept to a minimum.

Where a switchboard is enclosed in a case or surrounds, any wiring systems entering the switchboard enclosure shall pass through openings that provide a close fit.

NOTE 1 There is a very high risk that wiring enclosures, especially those that enter at the top or sides of a switchboard, may contribute to the spread of fire and for this reason wiring systems should be provided with close-fitting entries. In some cases, internal sealing should be provided.

NOTE 2 An opening with less than 5 mm diameter of free space is considered to be a close fit. Therefore, any opening of 5 mm diameter or greater should be sealed with a fire-retardant sealant.

NOTE 3 Wiring enclosures, such as conduits, with an internal free space of greater than 5 mm diameter should be sealed to stop any draft effect that may allow the spread of fire.

4.6.9 Neutral bar

Where a single protection device is installed (e.g. RCBO), the neutral terminal of the protection device is deemed to be the neutral bar.

4.7 Wiring systems for recreational vehicles or non-recreational vehicles

4.7.1 General

Wiring systems shall be selected and installed to meet the following requirements —

(a) protect against physical contact with live parts by durable insulation materials; and

(b) satisfy current-carrying capacity, voltage drop and other minimum size requirements for conductors; and

(c) provide reliability and electrical continuity of connections, joints and terminations; and

(d) provide adequate strength of supports, suspensions and fixings; and

(e) suit intended use, including applications requiring a particular type of wiring system, e.g. fire-resistance; and

(f) protect against mechanical damage, environmental and other external influences by enclosure or other means; and

(g) be installed in accordance with the requirements of this section and the additional requirements as specified in the electrical equipment manufacturer's instructions.

Criteria for the selection and installation of wiring systems are as follows —

(i) conductor materials; and

(ii) core identification; and

(iii) insulation properties; and

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(iv) temperature rise; and

(v) bending and tension limitations.

4.7.2 Selection

All low voltage wiring systems forming part of the electrical installation in a recreational vehicle or non-recreational vehicle shall have a conductor cross-sectional area not less than 2.5 mm^2 and not less than seven strands consisting of either —

(a) multi-strand insulated and sheathed cables; or

(b) flexible cords.

Exception: A 1.5 mm^2 multi-strand cable (minimum seven strands) may be used where the cable is protected by a 10 A overcurrent protection device.

See Table 4.1 for further information on selection of cables and flexible cords for recreational vehicles.

Table 4.1 — Cable current-carrying capacity for cable installation method for recreational vehicles

Conductor area mm^2		Current-carrying capacity A			
		Unenclosed	Enclosed		
Active and neutral	Earth	In air	In thermal insulation partially surrounded	In thermal insulation completely surrounded	In an enclosure in air
1.5	1.5	10	10	N/A	10
2.5	2.5	25	20	16	20
4.0	2.5	32	25	20	25
6.0	2.5	40	32	25	32

Key

"Unenclosed in air" refers to cables installed without further enclosure, that are positioned as follows —

(a) lying on a horizontal surface; or

(b) lying across ceiling joists; or

(c) supported on perforated or unperforated cable trays, ladders, hangers or racks; or

(d) clipped at intervals to a vertical or horizontal surface such as a wall or ceiling joist; or

(e) lying in the bottom of open trunking; or

(f) cables surrounded by bulk thermal insulation by a distance of less than or equal to 150 mm.

"Enclosed, in an enclosure in air" refers to cables installed in the following —

(i) metallic or non-metallic wiring enclosure; or

(ii) closed trunking or ducts; or

(iii) enclosures surrounded by bulk thermal insulation with a distance of less than or equal to 150 mm.

"Enclosed, in thermal insulation partially surrounded" refers to cables installed where the following is evident:

(A) Bulk thermal insulation is prevented from completely surrounding unenclosed or enclosed cable over a length of more than 150 mm, such as where an unenclosed or enclosed cable is clipped to a structural member or is lying on a ceiling; or

(B) Cables totally surrounded by bulk thermal insulation for a distance of more than 150 mm but not more than 400 mm are considered as a partially surrounded installation.

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Table 4.1 *(continued)*

Conductor area mm²		Current-carrying capacity A			
		Unenclosed	Enclosed		
Active and neutral	Earth	In air	In thermal insulation partially surrounded	In thermal insulation completely surrounded	In an enclosure in air
"Enclosed, in thermal insulation completely surrounded" refers to cables installed where bulk thermal insulation totally surrounds unenclosed or enclosed cables over a length of more than 400 mm.					
NOTE 1 Cable type, in this table, is insulated and sheathed cables, two-core and earth marked V-90.					
NOTE 2 This table is reproduced from AS/NZS 3000 and AS/NZS 3008.1, with modifications.					

Low voltage a.c. wiring systems shall be selected in accordance with the requirements in the AS/NZS 3008 series.

4.7.3 External influences

Wiring systems shall be able to operate safely and function in the conditions to which they are likely to be exposed at the point of installation.

To effectively protect against the presence and extent of relevant environmental and other influences, characteristics of wiring systems may include —

(a) suitable design and construction of the wiring system; or

(b) additional means, provided as part of the electrical installation, that do not adversely affect their operation.

The design of the installation shall take into account the following external influences:

(i) Ambient temperature.

(ii) External heat sources.

(iii) Water or high humidity.

(iv) Solid foreign bodies.

(v) Corrosive or polluting substances.

(vi) Mechanical damage.

(vii) Vibration.

(viii) Other mechanical stresses.

(ix) Flora.

(x) Fauna.

(xi) Solar radiation (direct sunlight).

(xii) Thermal insulation.

NOTE Further information regarding external influences requirements is provided in AS/NZS 3000.

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4.7.4 Installation requirements

4.7.4.1 Fixing of installation wiring

Unenclosed cables shall be securely fixed at intervals of not more than 300 mm by suitable clips, saddles, clamps or by means that will not adversely affect the wiring system.

Enclosed cables shall be securely fixed at intervals of not more than 500 mm in an enclosed space and supported on a horizontal surface, such as a ceiling or frame member.

4.7.4.2 Cables in contact with polystyrene or polyurethane

Cable insulation or sheathing may be compromised by a chemical reaction if it is in contact with polystyrene or polyurethane.

Cables shall be installed so there is no direct contact between the cable and polystyrene or between the cable and polyurethane.

Exception: A cable that is manufactured and identified as being suitable for installation in contact with polystyrene or polyurethane is permissible.

4.7.4.3 Connections

Connections between conductors, and between conductors and other electrical equipment, shall provide electrical continuity, an appropriate level of insulation and adequate mechanical strength.

The method of joining or connecting cables shall be suitable for the application and ensure that the conductivity of the joint or connection is not less than that of the conductor.

All cables and conductors shall be installed so that there is no undue mechanical stress on any connection.

The ends of stranded conductors shall be secured by suitable means, so as to prevent the spreading or escape of individual strands. The ends of stranded conductors shall not be soft-soldered before clamping under a screw or between metal surfaces.

Where flexible cords are used as a wiring system in a recreational vehicle, suitable ferrules shall be fitted to each conductor before termination of the conductor. Any flexible cord shall be installed so that undue stress on its connections due to a pull on the cord is alleviated by a pillar, post, grip, tortuous path, or other effective means. Flexible cords shall not be knotted.

4.7.5 Segregation of wiring systems

4.7.5.1 Automotive wiring systems

The LV installation wiring system in or on a recreational vehicle or non recreational vehicle shall be physically separated by installation location and electrically isolated from all automotive wiring systems, electrical fittings, and electrical wiring whose primary function relates to propulsion or roadworthiness of a vehicle.

4.7.5.2 Recreational vehicle or non-recreational vehicle wiring systems

Where there are wiring systems operating at different voltages, cables of low voltage or extra-low voltage circuits shall not be enclosed in the same wiring system.

Exception: Cables of low voltage circuits and cables of extra-low voltage circuits shall only be enclosed in the same wiring system where one of the following arrangements is employed:

(a) *The low voltage cables are of a type providing the equivalent of double insulation.*

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(b) *All cables or each conductor of a multi-core cable are insulated for the highest voltage present.*

(c) *The low voltage cables are installed in a separate compartment of a common cable trunking system with fixed and continuous barriers between compartments.*

4.7.6 Identification

Low voltage installation wiring conductors shall be clearly identified to indicate their intended function as active, neutral, earthing or equipotential bonding conductors.

Where identification is achieved using the colour of the conductor insulation, the colours specified in Table 4.2 shall be used.

Conductors with green, yellow or green/yellow combination coloured insulation or sheathing shall not be used as active or neutral conductors in installation wiring.

In New Zealand, use of these colours is restricted for conductors but not for sheathing. NZ

Table 4.2 — Conductor colours for low voltage installation wiring

Function	Insulation colour
Protective earth	Green/yellow
Equipotential bonding	Green/yellow
Neutral	Black or light blue
Active	Any colour other than green, yellow, green/yellow, black or light blue

NOTE The colours recommended for actives are —

(a) red or brown for single-phase; or

(b) red, white or blue for multiphase.

Where colours are used for the identification of cable cores, Australian and New Zealand cable identification colours and European cable identification colours shall not be combined within the same wiring enclosure or the same multi-core cable.

4.8 Electrical equipment and accessories

4.8.1 Socket-outlets

4.8.1.1 Type of socket-outlets

Socket-outlets shall be suitable for the intended application and location of installation. Socket-outlets shall comply with the requirements of one of the following Standards or Standards that are equivalent to —

(a) AS/NZS 3112; or

(b) AS/NZS 3123; or

(c) IEC 60309-2; or

(d) AS/NZS 3131.

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4.8.1.2 Switching

Switches that directly control low voltage socket-outlets shall operate in all live (active and neutral) conductors.

Exception: Where an isolating transformer or electricity converter with a polarized output, or a transposition sensor, is installed in accordance with Clause 2.6.4 for each external supply, the switches may operate in the active conductors only.

4.8.1.3 External socket-outlets

Any socket-outlet mounted on the exterior of a recreational vehicle shall have a minimum degree of protection of IP34 in accordance with AS 60529.

4.8.1.4 Termination of different wiring systems within accessories

A low voltage fixed switch or socket-outlet, or its faceplate, shall not incorporate a connecting device for telecommunications, data, television, radio, extra-low voltage or other similar wiring systems.

USB charging socket-outlets on the faceplate may be installed provided the USB socket is supplied from the low voltage source at that faceplate.

4.8.1.5 Labelling of socket-outlets

Low voltage socket-outlets shall be labelled to identify all source(s) of supply when multiple sources of supply are installed.

The labelling shall be —

(a) legible; and

(b) durable; and

(c) in the English language; and

(d) located at each socket-outlet.

See Figure 4.3 for examples of labelling that may be used.



Figure 4.3 — Examples of socket-outlet labels

4.8.1.6 Light switches

All low voltage light switches that are installed in recreational vehicles or non-recreational vehicles shall operate in all live (active and neutral) conductors.

Exception: Where an isolating transformer or electricity converter with a polarized output, or a transposition sensor, is installed in accordance with Clause 2.6.4 for each external supply, the switches may operate in the active conductors only.

4.8.1.7 Mounting

Flush-fitted accessories shall be installed to ensure that insulated cables do not come into contact with any conductive material.

This requirement may be satisfied by restraining the conductor by tying, lacing, clipping or containing the termination within a non-conductive shroud or enclosure.

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4.8.1.8 Smoke alarms

Where LV smoke alarms are installed, they may be supplied from any LV circuit.

NOTE Local regulatory requirements may apply in relation to smoke alarm installation.

4.9 Appliances

4.9.1 Control of directly connected appliances

Every directly connected appliance in a recreational vehicle or non-recreational vehicle shall be controlled by a switch that is placed and marked so as to be readily identifiable and convenient for its intended use. This modifies the requirement of AS/NZS 3000 in relation to isolating devices for air conditioners, hot water services and fixed or stationary cooking appliances with an open cooking surface incorporating an electric cook top.

Where a dedicated circuit is installed to supply a single appliance, the protective device at the switchboard is deemed to comply.

Every directly connected appliance in a recreational vehicle or non-recreational vehicle shall be provided with a switch that operates in all live (active and neutral) conductors.

Exception: Where an isolating transformer or electricity converter with a polarized output, or a transposition sensor, is installed in accordance with Clause 2.6.4 for each external supply, the switches may operate in the active conductors only.

4.9.2 Fixed appliances supplied by a flexible cord and plug top

A flexible cord supplying a fixed appliance in a recreational vehicle or non recreational vehicle shall be fitted with a plug top that complies with the requirements of one of the following standards:

(a) AS/NZS 3112; or

(b) AS/NZS 3123; or

(c) IEC 60309-2; or

(d) AS/NZS 3131.

Exception: This clause does not apply to flexible cords provided by the appliance manufacturer attached to the fixed appliance when installed as installation wiring.

4.9.3 Fixed appliances supplied by a flexible cord as installation wiring

A flexible cord connected to an appliance or to equipment installed as installation wiring shall be —

(a) of the heavy-duty sheathed type; and

(b) where subject to mechanical damage, installed in a suitable wiring enclosure; and

(c) limited to a total length not exceeding 4.0 m; and

(d) with a minimum cross-sectional area of any conductor being not less than 1.5 mm^2.

4.9.4 Prohibited locations

Low voltage or extra-low voltage socket-outlets and switches shall not be installed in the prohibited location shown in Figure 4.4, on any wall, cupboard or other surface within 150 mm of the edge of an open electric or gas cooking surface, in the area extending from the top of the cooking surface to a range hood, cupboard or ceiling located directly above the cooking surface.

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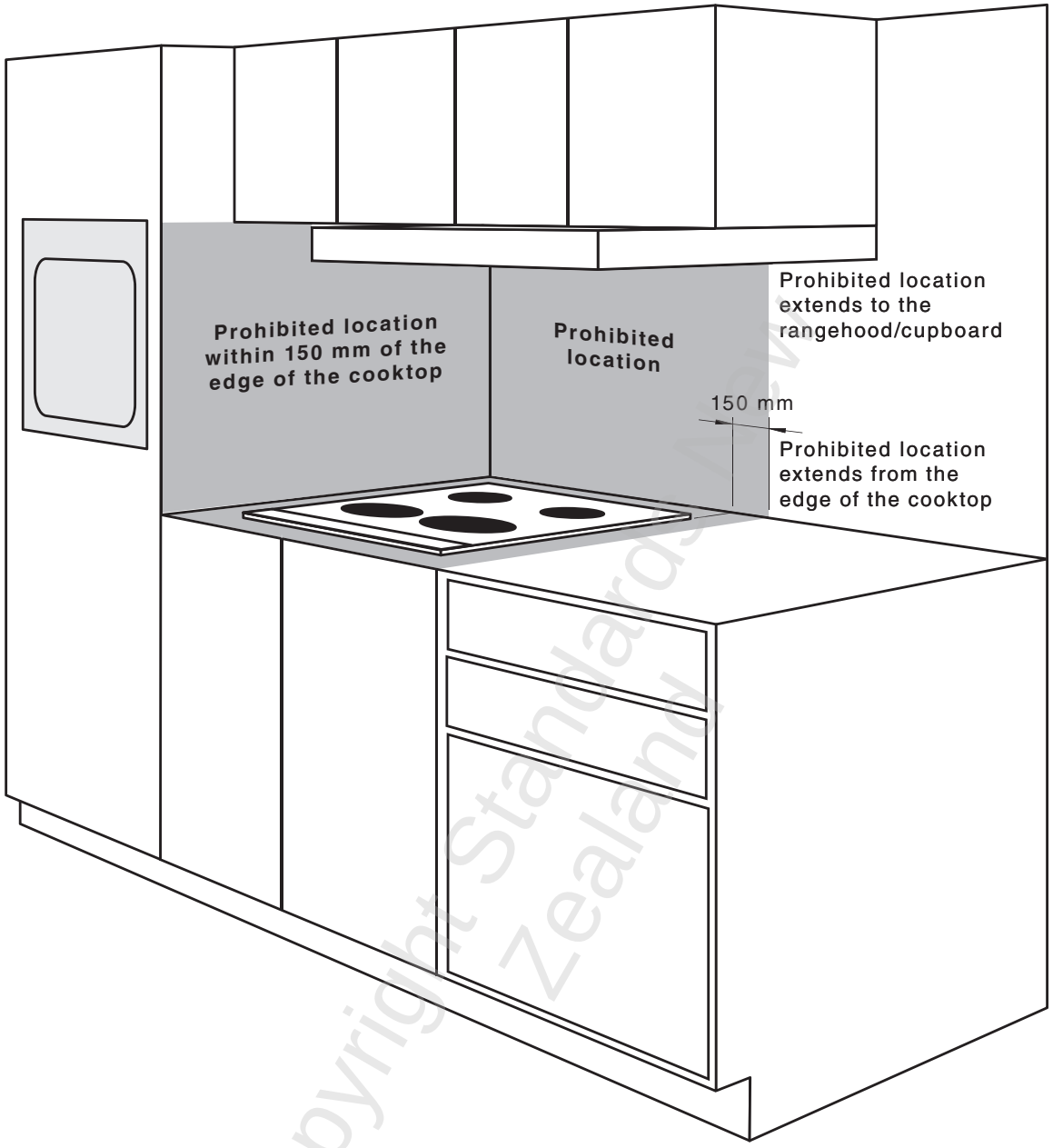


Figure 4.4 — Prohibited location for low voltage and extra-low voltage socket-outlets and switches installed near open cooking surfaces in a recreational vehicle

4.10 Gas appliances and equipment

4.10.1 General

This clause applies to the selection of electrical equipment and its installation to ensure safe use in areas where flammable or combustible materials are handled, stored or otherwise exist, and therefore may give rise to an explosive atmosphere.

4.10.2 Gas appliances

A gas cooking appliance connected to a low voltage electricity supply shall be provided with a means of electrical isolation that is adjacent to the appliance location and is accessible with the appliance in the installed position.

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For cooking appliances, the means of isolation shall not be mounted in the prohibited location specified in Figure 4.4 for clearance from open cooking surfaces.

4.10.3 Electrical requirements for hazardous areas in or on a recreational or non-recreational vehicle

4.10.3.1 General

The requirements of AS/NZS 5601.2 shall apply to the selection of electrical equipment and its installation to ensure safe use in areas where LP Gas is likely to be present.

4.10.3.2 Electrical equipment installed within gas cylinder storage enclosures (lockers)

Wiring systems, switchgear, control gear, accessories, appliances, luminaires and fittings used for such purposes as generation, conversion, storage, transmission, distribution or utilization of electrical energy in or on a recreational vehicle or non-recreational vehicle, either low voltage or extra-low voltage, shall not be installed —

(a) in an enclosure provided for the storage of, or containing, an LPG gas cylinder; or

(b) within a distance of 1.5 m horizontally from, or 0.5 m vertically above a gas drain outlet provided in the enclosure. See Figure 4.5.

Exception 1: Encapsulated devices may be installed within the hazardous area around gas cylinders. See Clause 4.10.3.4 for encapsulated device requirements.

Exception 2: This requirement does not apply to electrical fittings and electrical wiring mounted on a drawbar of an RV whose primary function relates to propulsion or road-worthiness of a vehicle.

NOTE See Section 5 for extra-low voltage installation requirements.

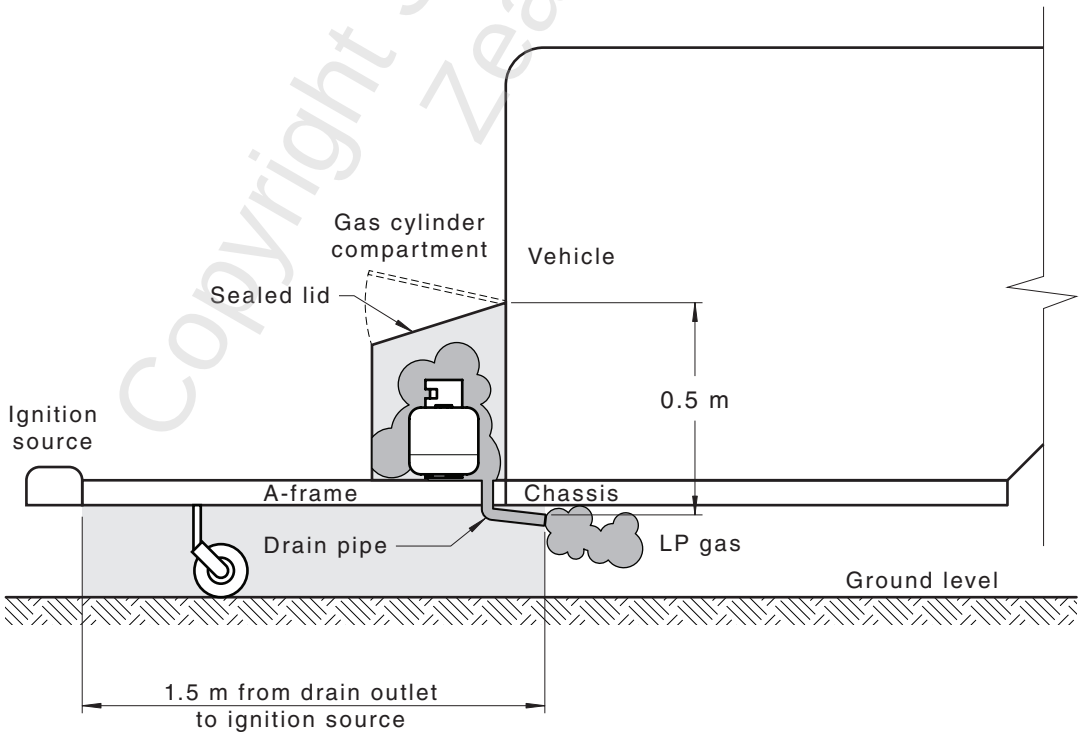


Figure 4.5 — Zone dimensions for the hazardous area around a LP Gas cylinder compartment and ventilation pipe

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4.10.3.3 Electrical equipment installed near external gas cylinders

Low voltage or extra-low voltage electrical equipment in or on a recreational vehicle or non-recreational vehicle, shall not be installed within the hazardous area shown in Figure 4.6.

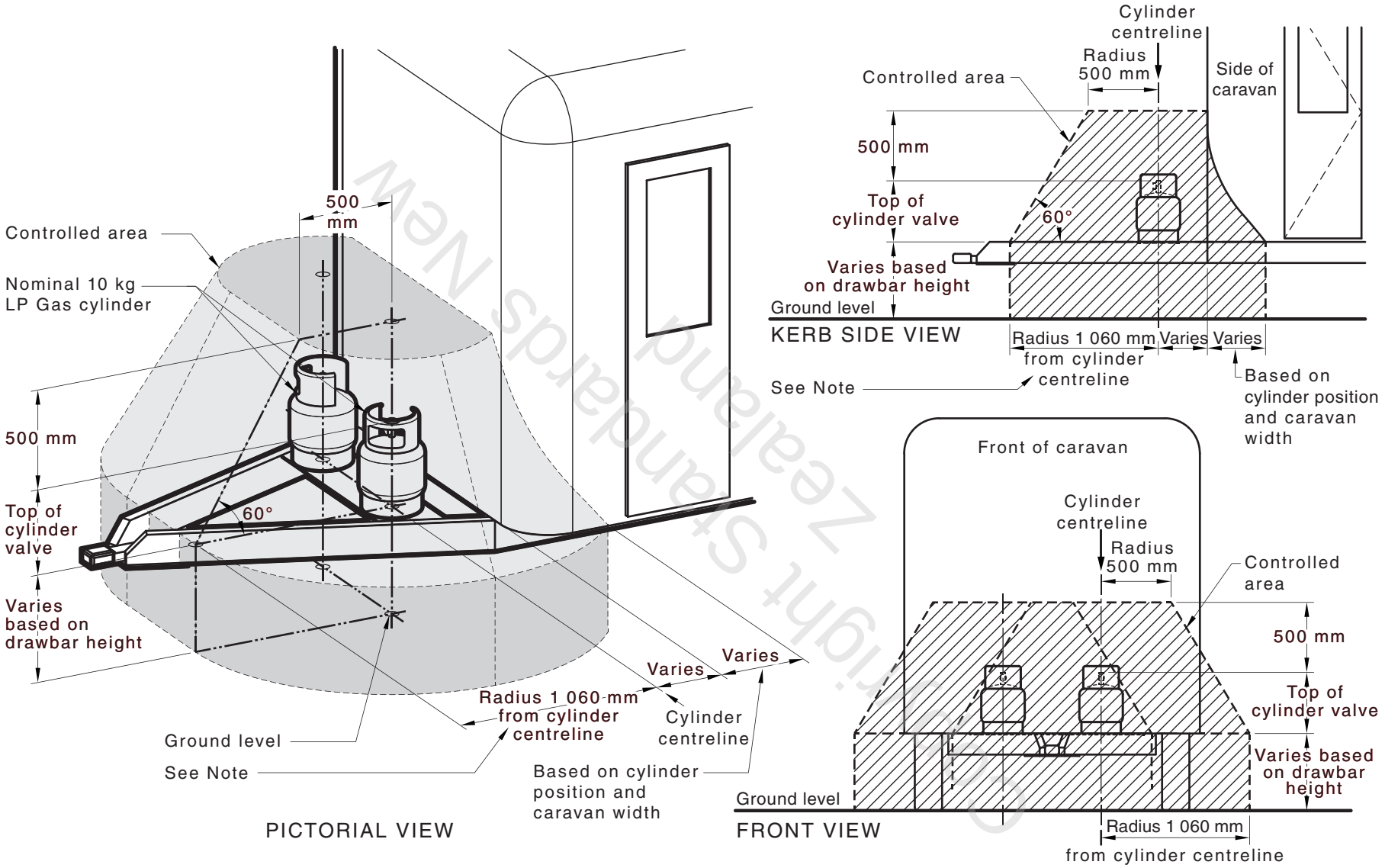
Exception 1: Encapsulated devices may be installed within the hazardous area around gas cylinders. See Clause 4.10.3.4 for encapsulated device requirements.

Exception 2: This requirement does not apply to electrical fittings and electrical wiring mounted on a drawbar of an RV whose primary function relates to propulsion or road-worthiness of a vehicle.

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NOTE: Radius of 1 060 mm (interpolated from 45 kg (0.110 kL) AS/NZS IEC 60079.10.1) is based on a 10 kg cylinder and will vary depending on the height of the cylinder.

Figure 4.6 — Hazardous areas around drawbar-mounted gas cylinders

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4.10.3.4 Encapsulated electrical devices

Encapsulated electrical items shall meet all of the following —

(a) be fully sealed in a flame-retardant polymer; and

(b) provide a minimum IP55 protection; and

(c) have no exposed terminals, i.e. be pre-fitted with flying leads or be terminated via a mating connection enclosure and cable gland; and

(d) contain no moving electrical contacts.

Electrical coils shall also include diodes as overvoltage or spike protection encapsulated with the coil.

Wiring intended to connect the device to the electrical installation shall be double insulated, or be installed in sealed conduit, be continuous and extend beyond the enclosure perimeter.

Mechanical protection shall be provided for at least the first 75 mm of the wiring leads and wiring connections to a coil.

4.10.3.5 Gas pipework

All wiring systems in or on a recreational vehicle or non-recreational vehicle, both low voltage and extra-low voltage, shall have a minimum separation distance of 25 mm from any gas pipe.

Exception: An extra-low voltage supply to a gas cut-off valve may be installed.

4.11 Earthing

4.11.1 Main protective earthing conductor (MPEC)

A protective earthing conductor, known as the main protective earthing conductor (MPEC), shall be installed between the earthing point, terminal or bar of the switchboard and —

(a) the earthing connection of the inlet plug, installed in accordance with Clause 2.4.4; and

(b) the supply lead connection, installed in accordance with Clause 2.4.3; and

(c) the conductive frame or chassis of the recreational vehicle or non-recreational vehicle.

The MPEC shall be insulated throughout its entire length.

4.11.2 Main protective earthing conductor with multiple supplies

Where there is provision for more than one external supply, the earth contact of all appliance inlets, inlet plugs and permanent connection points for such supplies shall be directly connected together, and to the earthing point, terminal or bar at the switchboard, either by an MPEC between the inlet fittings or by an MPEC between the respective switchboards.

4.11.3 Main protective earthing conductor installation requirements

The MPEC in a vehicle shall be run as directly as practicable between the input socket and the frame. The connection to the conductive frame of the recreational vehicle or non-recreational vehicle shall be a permanent stud or by a nut and bolt (minimum 6 mm diameter). Self-drilling screws shall not be used for this connection.

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4.11.4 Mechanical protection

Any protective earthing conductor shall be installed so that neither the conductor nor its connections are likely to be damaged by stones or other objects thrown up when the vehicle is moving.

Connections shall be accessible for inspection. Connections shall be provided with a locking device or some other means to prevent them from loosening under vibration.

4.11.5 Size

The MPEC shall have a current-carrying capacity not less than the rating of the highest-rated protective device for the associated external supply fittings and be not less than 4 mm^2.

4.11.6 Isolation of the protective earthing conductors

No fixed connection shall be made between any protective earthing conductor and the general mass of earth, e.g. by means of a driven electrode.

No connection shall be made between any live (active or neutral) conductor and any protective earthing conductor of the electrical installation.

Exception: A connection may be made between the MPEC and the neutral conductor of a generating set or inverter installed in accordance with Clause 2.7.

4.11.7 Structural metalwork including conductive building materials, equipment and appliances

The following structures and items of equipment shall be connected to the earthing point, terminal or bar of the switchboard:

(a) Any conductive material that forms part of the chassis or frame, regardless of the type of material used for the construction of the exterior of the recreational vehicle or non-recreational vehicle.

(b) The exterior shell (including attached rigid annexes) if constructed of conductive material. Where the exterior shell comprises a number of conductive sheets, the protective earthing conductor need only be attached directly to one sheet, provided that effective electrical continuity is maintained between all the sheets.

(c) Accessible conductive materials located within 100 mm of any live parts of the installation. For example, on a vehicle with an exterior shell consisting of non-conductive material, any conductive sheet, such as a stone guard, or other conductive components, that may be externally mounted and located within 100 mm of any part of the electrical installation.

NOTE Such materials may include door or window frames, internal linings, external cladding or items mounted on the exterior of the vehicle such as stone guards, PV arrays, or antennae.

(d) The earthing contact of all socket-outlets.

Exception: Socket-outlets supplied by a separation (isolating) transformer.

(e) The exposed conductive parts of any electrical equipment that is required to be earthed in accordance with AS/NZS 3000.

(f) The earthing contact of all permanently connected appliances.

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4.12 Electrical installation in damp situations

4.12.1 General

The requirements of this clause are based on the classification of zones surrounding the water container of a bath, shower and other fixed water containers within or on the vehicle.

Barriers, such as screens, doors, curtains and fixed partitions that provide effective protection against spraying water may be used to limit the extent of a classified zone.

Ceilings, walls with or without windows, doors and floors that limit the extent of rooms containing a bath, shower or other water container also limit the associated zones.

4.12.2 Classification of internal zones of a vehicle

4.12.2.1 Internal baths and showers

Three zones (Zones 0, 1 and 2) are classified for baths and showers as follows:

(a) Zone 0 shall be the area of the interior of a bath or a shower base.

NOTE A shower base may be defined by either a raised hob or a depression in the floor.

(b) Zone 1 shall be the area of the interior of a bath or a shower up to the height of the ceiling.

(c) Zone 2 shall be the area limited by —

(i) the vertical plane limiting Zone 1 and the parallel vertical plane 0.6 m external to Zone 1; and

(ii) the floor and the horizontal plane to the ceiling.

See Figure 4.7 (a), (b), (c) and (d).

The requirements for selection and installation of electrical equipment in these zones are provided in Table 4.3.

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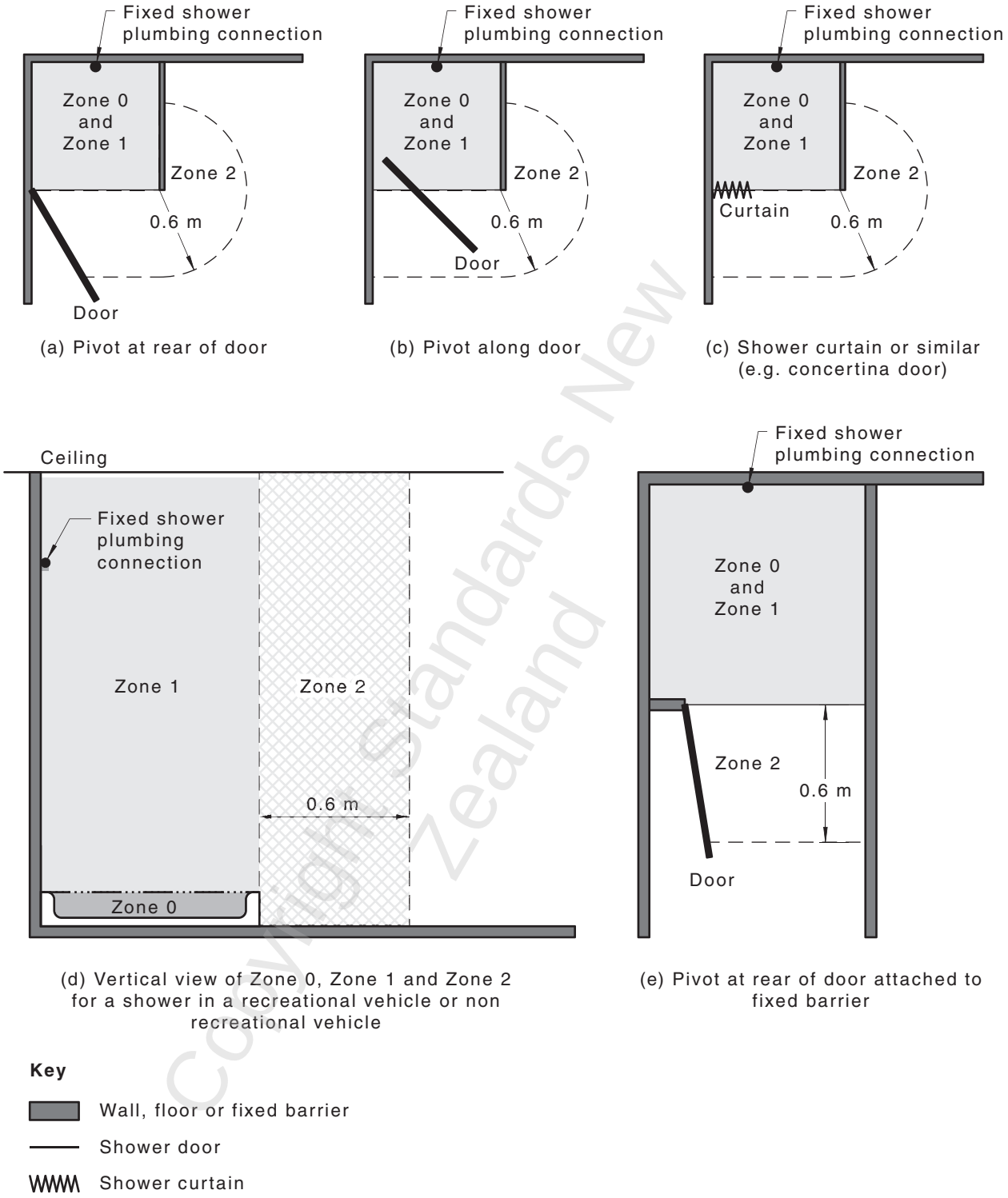


Figure 4.7 — Zone dimension (plan) — Enclosed shower

4.12.2.2 Other fixed water containers

Two zones (Zones 0 and 2) are classified for fixed water containers other than baths and showers:

(a) Zone 0 shall be the area of the interior of the water container.

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(b) Zone 2 for an individual water container with a capacity not exceeding 40 L, and with fixed water outlets, shall be the area limited by —

(i) the vertical plane 0.15 m from the internal rim of the water container; and

(ii) the floor and the horizontal plane 0.4 m above the water container.

Exception: Other fixed water containers are those designed to contain water in normal use and do not include —

(A) *fortuitous containers or areas not intended to contain water for normal operations; or*

(B) *water containers into which persons do not normally put a part or all their body.*

The requirements for selection and installation of electrical equipment in these zones are provided in Table 4.3.

Examples of these zones are shown in Figure 4.8.

NOTE There is no Zone 1 for these water containers.

Dimensions in metres

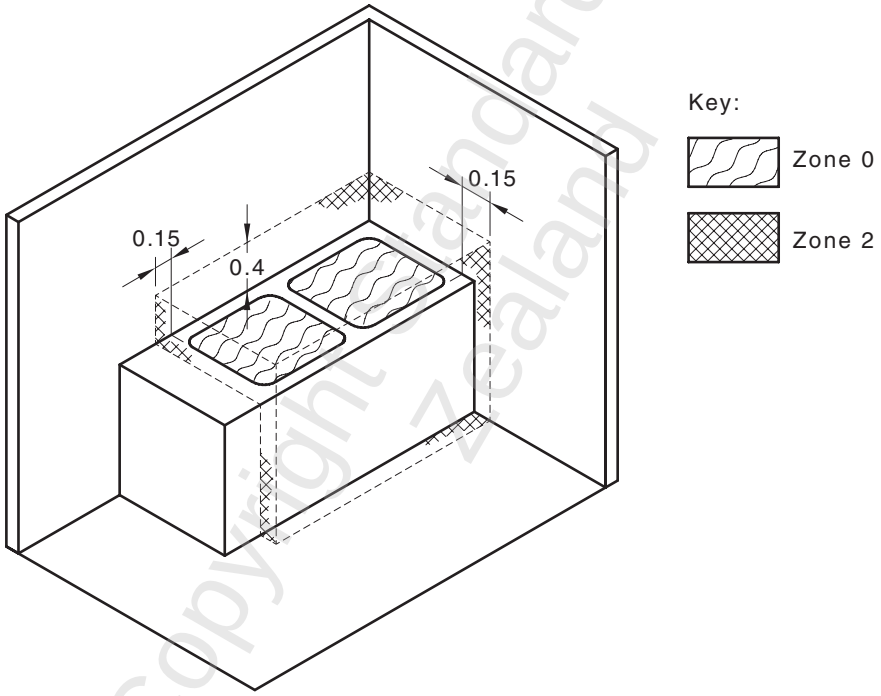


Figure 4.8 — Zone dimensions for other fixed water containers with fixed water outlets where no container has a capacity exceeding 40 L

4.12.3 Selection and installation of electrical equipment

Electrical equipment installed in a classified zone shall have at least the following degree of protection:

(a) In Zone 0: IPX7.

(b) In Zones 1 and 2: IPX4.

The requirements for selection and installation of electrical equipment are provided in Table 4.3.

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Table 4.3 — Selection and installation of electrical equipment for baths, showers and other fixed water containers

Equipment	Zone 0	Zone 1	Zone 2
Socket-outlets	Not permitted	Not permitted	RCD-protected and in a cupboard (no specific IP rating)
Switches/accessories	Not permitted	Same as Zone 2	< 0.3 m not permitted from ground, floor or platform ≥ 0.3 m IPX4
Luminaires	IPX7, and specifically for use, and SELV or PELV supply	IPX4	IPX4; or Class II construction (double or reinforced insulation); or SELV or PELV; or recessed into ceiling
Other electrical equipment	IPX7, and specifically for use, and SELV or PELV supply	IPX4	IPX4; or Class II construction (double or reinforced insulation); or SELV or PELV; or recessed into ceiling
Switchboards	Not permitted	Not permitted	Not permitted
Electricity generation systems	Not permitted	Not permitted	Not permitted
Inlet plug	Not permitted	Not permitted	Not permitted
NOTE This table is reproduced from AS/NZS 3000 with modification.			

4.12.4 Classification of external zones for a recreational vehicle — external showers

One zone (Zone 1) is classified for external showers. Zone 1 shall be the area 0.6 m each side of the fixed plumbing connection.

The requirements for selection and installation of electrical equipment in these zones are provided in Table 4.3.

The zone shall wrap around onto the adjacent surface of the recreational or non-recreational vehicle to a total linear distance of 0.6 m from the plumbing connection.

NOTE See Figures 4.9, 4.10 and 4.11 for external shower classified zones.

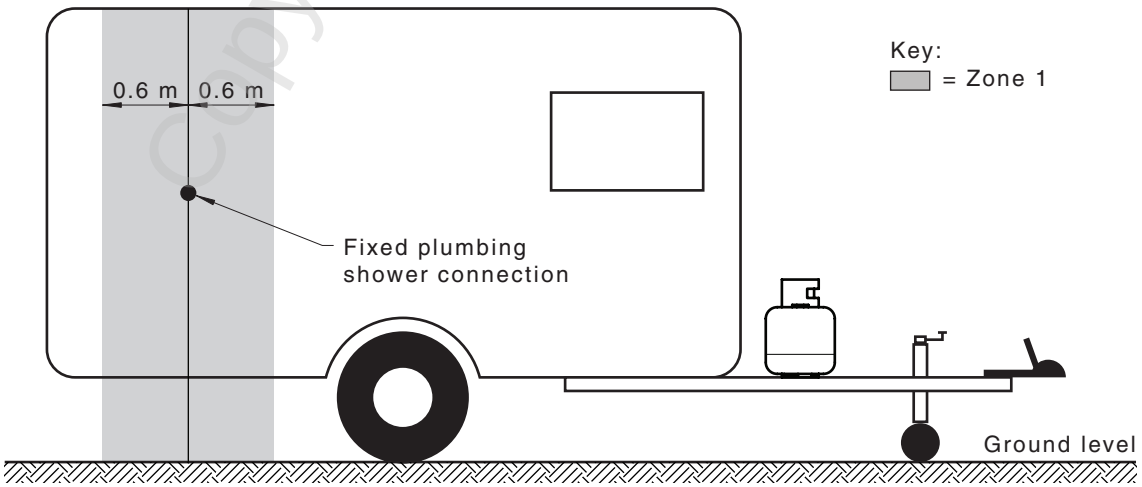


Figure 4.9 — Zone dimensions (elevation) — External shower with a fixed plumbing connection on external wall of a recreational vehicle

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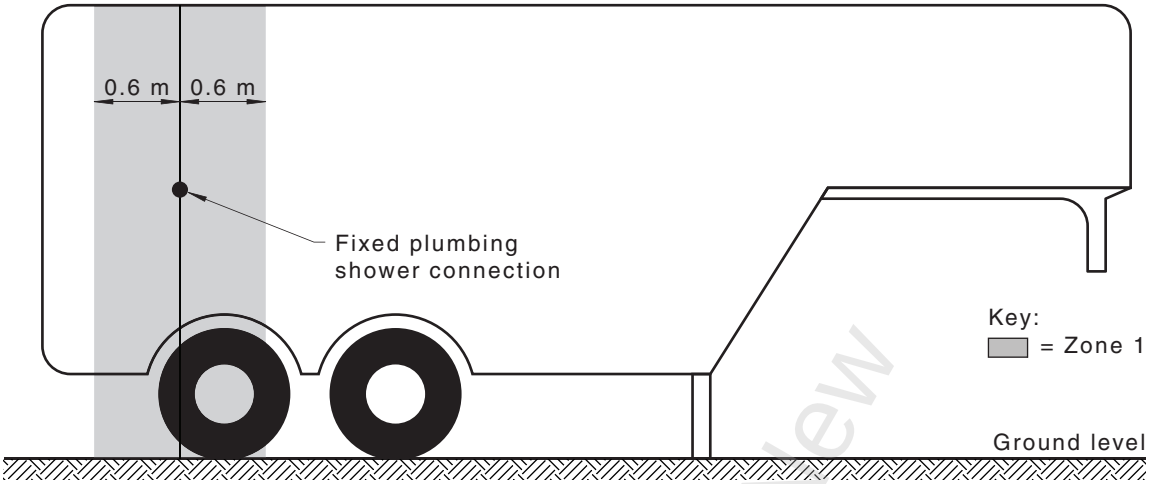


Figure 4.10 — Zone dimensions (elevation) — External shower with a fixed plumbing connection on external wall of a non-recreational vehicle

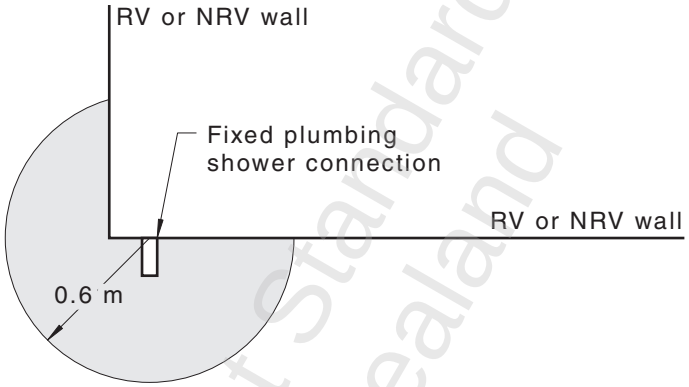


Figure 4.11 — Zone dimension overview — External shower with a fixed plumbing connection on external wall of a recreational vehicle or non-recreational vehicle

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Section 5 Extra-low voltage d.c. electrical installations

5.1 General

This section specifies the minimum requirements for the selection and installation of extra-low voltage —

(a) protection and control equipment; and

(b) switchboards; and

(c) wiring systems; and

(d) electrical equipment, including appliances and accessories; and

(e) earthing arrangements; and

(f) electrical equipment in locations subject to the effects of water or high humidity (damp situations) in a connectable electrical installation that has the facility for connection to an external low voltage supply, see Figure 5.1.

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

In addition, guidance is provided so that the electrical installation functions correctly for the purpose intended.

Extra-low voltage electrical installations in a connectable electrical installation shall be installed in accordance with —

(i) the installation requirements as specified in this section; and

(ii) any additional requirements as specified in the original equipment manufacturer's instructions.

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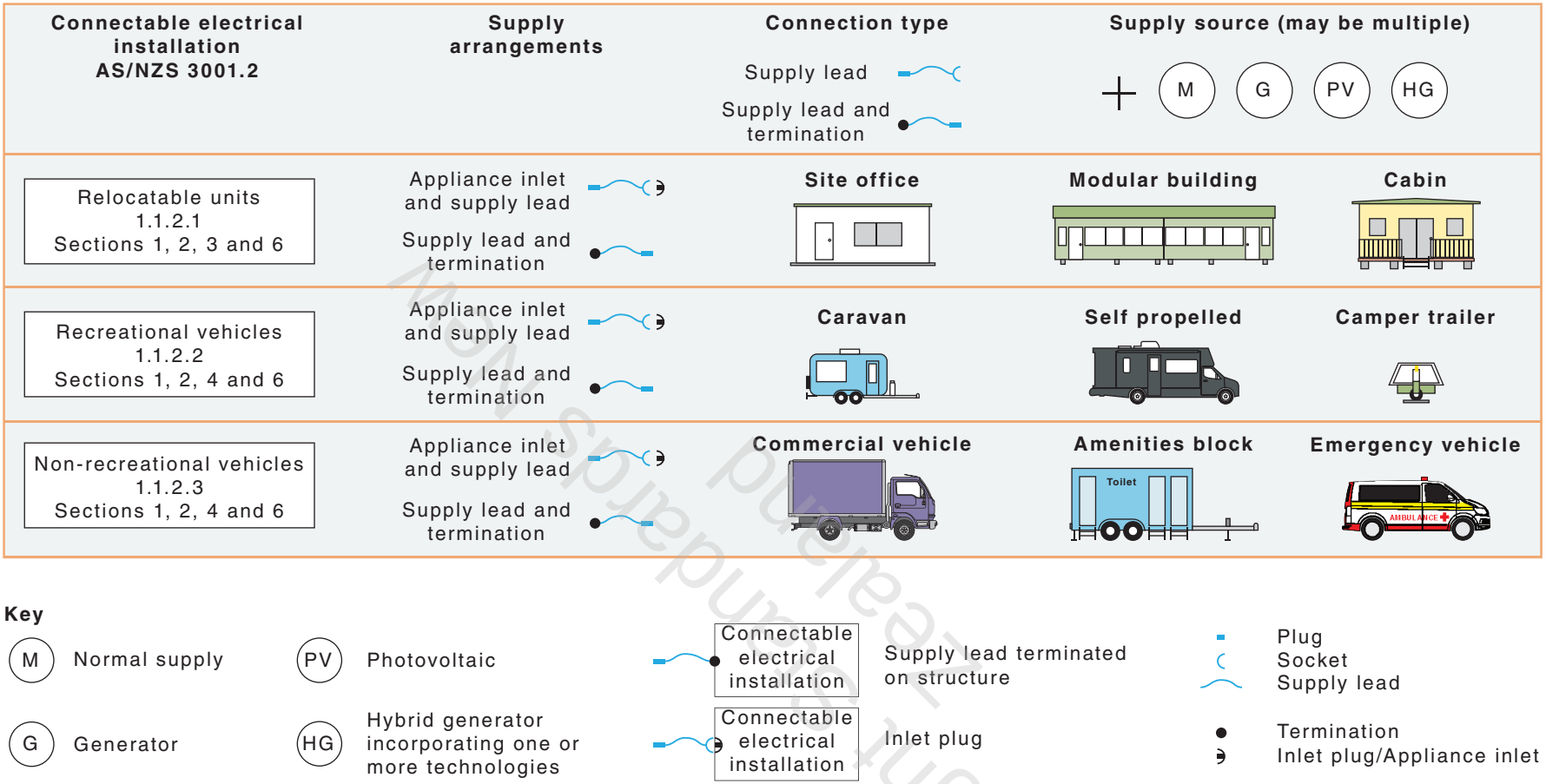


Figure 5.1 — Typical inclusions in this Standard

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5.2 Supplies

An extra-low voltage supply for a connectable electrical installation shall be obtained from one or any combination of the following sources:

(a) Connectable electrical installation battery.

(b) Extra-low voltage d.c. supply via a transformer/rectifier unit complying with AS/NZS 60335.1 and AS/NZS 61558.2.6.

(c) Extra-low voltage d.c. generator that is driven by any form of energy.

(d) Extra-low voltage solar PV power supply system or similar.

5.3 Prevention of mutual detrimental influences

The extra-low voltage installation shall be installed so that the protective measures of the low voltage installation against direct contact or indirect contact are not impaired.

Operating currents of the extra-low voltage installation shall not flow in the protective conductors of the low voltage installation.

5.4 Connectable electrical installation batteries

5.4.1 General

This Standard sets the minimum requirements for batteries installed within connectable electrical installations where the nominal voltage of the d.c. system does not exceed 48 V ripple free d.c.

For battery systems exceeding these voltages, reference the relevant standards for the installation of those battery systems.

All d.c. systems in a connectable electrical installation shall operate at extra-low voltage.

5.4.2 Type of battery

A connectable electrical installation battery should be of the rechargeable type.

NOTE 1 Non-rechargeable batteries are not vehicle batteries.

NOTE 2 Appendix C provides further information on the replacement type of batteries.

5.4.3 Capacity

A connectable electrical installation battery should have a minimum capacity of 40 Ah at a 20 h discharge rate.

NOTE Use of a cyclic battery is recommended.

5.4.4 Terminals

Connectable electrical installation battery terminals shall be clearly and durably marked with "+" and "–" or by colour on or adjacent to the terminals. Connections to connectable electrical installation battery terminals shall be securely clamped or bolted to ensure continuous contact. Connections shall be insulated unless the connectable electrical installation battery is provided with an insulating device.

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5.4.5 Installation

The battery shall be secured to prevent movement and restrained not to move more than 25 mm in any direction when a pulling force of twice the battery weight is applied through the centre of gravity of the battery vertically and horizontally.

Additional requirements have been set for lead acid batteries (Clause 5.4.11) and lithium ion batteries (Clause 5.4.12).

5.4.6 Charging

Batteries shall be charged by means that are appropriate to the type of battery being charged.

5.4.7 Isolation, switching and control

5.4.7.1 Protection device

Batteries and associated wiring shall be protected against overload and short circuit by means of fuses or circuit breakers in each unearthed pole. Each battery bank shall be protected via an independent protective device.

NOTE 1 Multiple batteries connected in series or parallel may be considered one battery bank.

NOTE 2 An unearthed pole is a conductor in a d.c circuit that is not connected to earth.

5.4.7.2 Location of protection devices

Protection devices as detailed in Clause 5.4.7.1 shall be accessible, protected against accidental damage and installed in one of the following locations —

(a) within 200 mm of the battery terminals; or

(b) directly outside the battery compartment; or

(c) 1.0 m from the battery terminals, provided each conductor is contained within a protective covering, such as a sheathing, conduit or cable trucking for its entire length from battery terminals to the circuit protective device, to reduce the risk of mechanical damage.

5.4.7.3 Conductors

Conductors connecting directly to the vehicle battery shall only be made at the terminals provided by the battery manufacturer. There shall be not more than four conductors connected to a single battery terminal.

5.4.8 Provision for connectable electrical installation battery

If a connectable electrical installation has provision for a battery, or one is provided, then the position and instructions for the installation of the battery and compartment shall be in accordance with Clause 5.4.11.3 and shall be included in the instructions for use.

A notice should be fixed in or near the proposed location stating:

"For instructions on connectable electrical installation battery installation, see the instructions for use."

The instructions for use shall contain a directive that the installation of a battery and compartment needs to be completed by a competent person.

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5.4.9 No provision for connectable electrical installation battery

Where the provision for the installation of a connectable electrical installation battery has not been provided in a recreational or non-recreational vehicle, the following statement shall be made in the instructions for use:

"This vehicle has not been designed to accommodate a vehicle battery. Do not fit one."

5.4.10 Proximity to non-electrical services

5.4.10.1 Protective devices

Overcurrent protective devices shall not be fitted in a fuel storage compartment or fuel storage housing intended for the storage of LP Gas cylinders.

5.4.10.2 Metallic services line

Metallic services lines that include: gas, diesel, water and/or other fuels that are installed within 300 mm of the horizontal or vertical plane of the battery surface containing the terminals, shall be shielded with dielectric material to protect against accidental short circuit, see Figure 5.2.

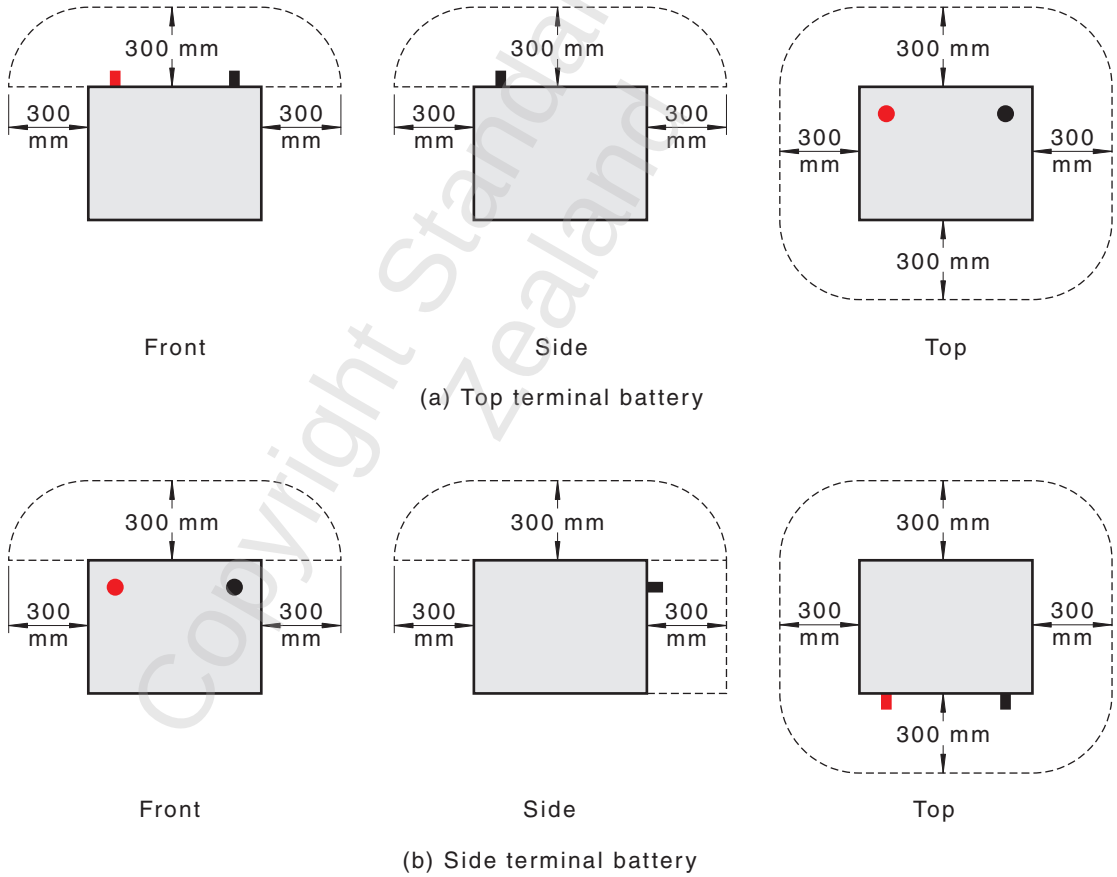


Figure 5.2 — Exclusion zones for batteries

The extent of the exclusion area may be limited by the sides of an appropriate battery box or compartment.

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5.4.11 Lead acid batteries requirements

5.4.11.1 General

Lead acid battery installations shall comply with Clauses 5.4.1 to 5.4.10 inclusive and the requirements specified in this clause.

These requirements apply to installations of all lead acid batteries whether they —

(a) employ removable vent caps or non-removable caps; or

(b) are “sealed” or “maintenance free” batteries; or

(c) have pressure-regulated valve vent systems with immobilized electrolyte (gel and AGM batteries).

5.4.11.2 Requirements for external installation

5.4.11.2.1 General

A connectable electrical installation battery installed externally to a connectable electrical installation shall be installed either in —

(a) a battery compartment inclusive of spill tray and ventilation; or

(b) open to the environment including a spill tray.

“Externally” means open to the environment or not anywhere within the enclosed structure of the connectable electrical installation. For example, a wall, compartment or barrier that prevents the egress of gases into the habitable area.

5.4.11.2.2 Location

Connectable electrical installation batteries installed externally shall comply with the following requirements:

(a) The battery shall be placed to allow for easy access for maintenance or removal.

(b) Connections shall be insulated unless the connectable electrical installation battery is provided with an insulating device.

(c) The battery shall be secured to prevent movement and restrained not to move more than 25 mm in any direction when a pulling force of twice the battery weight is applied through the centre of gravity of the battery vertically and horizontally.

(d) Be provided with sufficient mechanical protection to prevent damage from rocks and debris while the connectable electrical installation is in motion.

5.4.11.2.3 Spill tray

A tray shall be installed under a connectable electrical installation battery that can hold a minimum 20 % of the electrolyte held by the battery bank.

5.4.11.2.4 Ventilation

Ventilation shall be provided for a connectable electrical installation battery installed in a battery compartment.

The ventilation shall be such that it prevents the egress of gases into the habitable area.

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5.4.11.3 Requirements for internal installation

5.4.11.3.1 General

A connectable electrical installation battery installed within a connectable electrical installation shall be installed in a battery compartment.

5.4.11.3.2 Location of enclosure

A connectable electrical installation battery shall be located in such a way to enable easy access for maintenance or removal.

5.4.11.3.3 Spill tray

A tray shall be installed under a connectable electrical installation battery that can hold a minimum 20 % of the electrolyte held by the battery bank.

5.4.11.4 Ventilation

The interior of a connectable electrical installation battery compartment shall be ventilated and protected against the corrosive effects of acid-laden gases, by one of the following methods:

(a) Installing a connectable electrical installation battery that incorporates an external venting kit that ventilates to the exterior of the vehicle, see Figure 5.3; or

NOTE 1 The venting kit should be designed and installed to the battery manufacturer's instructions.

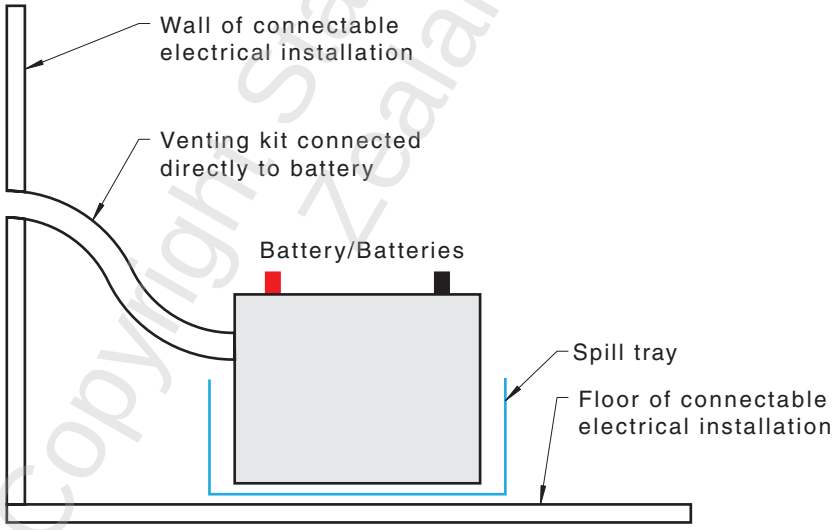


Figure 5.3 — Typical figure of a sealed battery with venting kit

(b) Installing a connectable electrical installation battery in an enclosed battery compartment that is protected internally against corrosion and is ventilated to the exterior of the vehicle by means of a suitable tube at the top of the connectable electrical installation battery compartment, see Figure 5.4. Tube ventilation shall be in accordance with Clause 5.4.11.4; or

NOTE 2 The upper vent may consist of a suitable tube at the top of the battery compartment.

NOTE 3 Ventilation through the floor of a recreational vehicle may contravene road traffic authority requirements.

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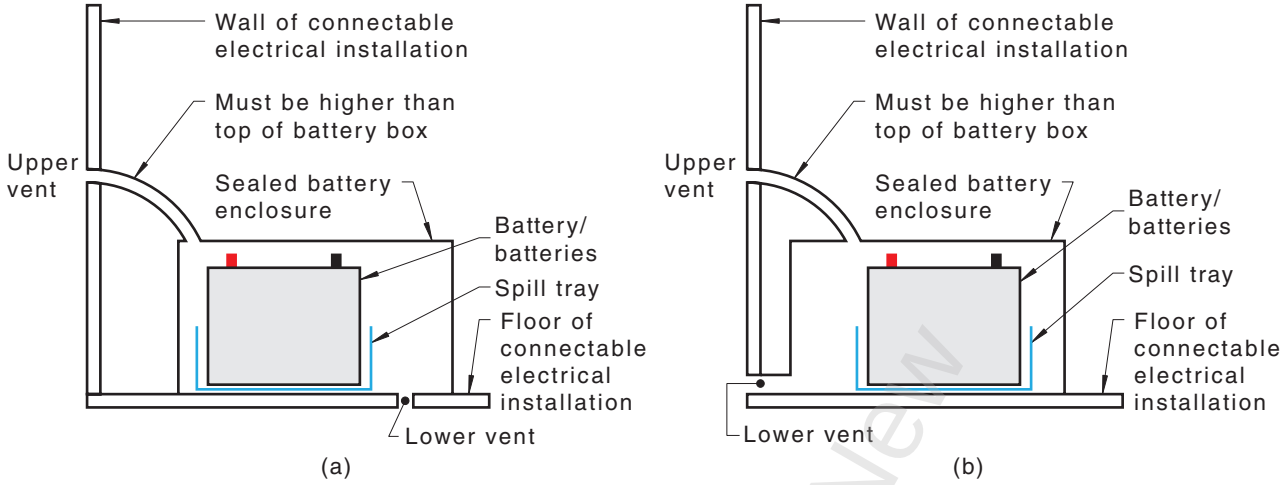


Figure 5.4 — Typical figure of battery compartment with upper and lower vents

(c) Ventilating the compartment at low-level and high-level to the exterior of the connectable electrical installation and constructing the interior of the compartment, including the sides of the ventilator openings, of acid-resistant material or providing it with an anti-corrosive finish. If the compartment opens into the interior of the connectable electrical installation, the lid shall provide an air seal, see Figure 5.5. The minimum size of ventilation to the exterior of the vehicle shall be in accordance with Clause 5.4.11.4.

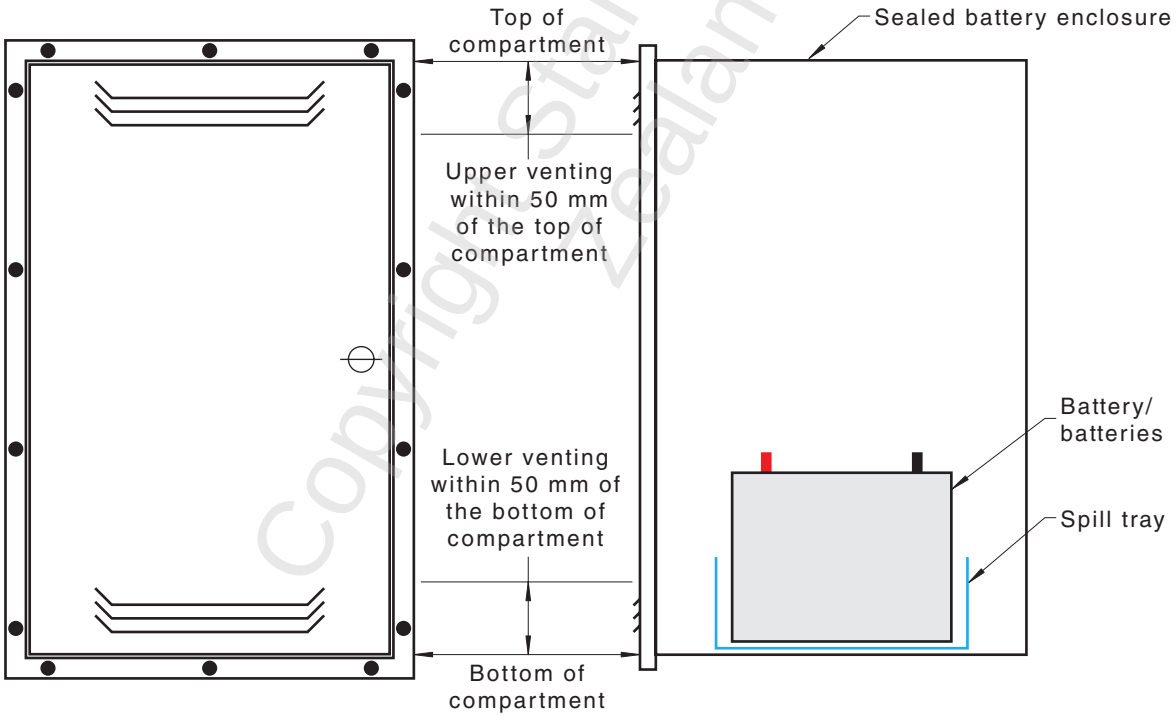


Figure 5.5 — Typical figure of battery compartment with upper and lower vents directly mounted to the external wall of connectable electrical installation battery

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5.4.11.5 Calculating ventilation requirements

The minimum ventilation size required for each of the high and low venting requirements in Clause 5.4.11.3 Items (a) and (b) is calculated by the following formula.

$$A = K \times Ah \times I \quad 5.1$$

where

A = the minimum area of vent in square millimetres

Ah = total amp/hour (Ah) of battery or battery bank

I = the maximum available charging current in amperes

K = nominal bank voltage

Values for constant (K):

12 V = 0.0534 (K)

24 V = 0.1068 (K)

48 V = 0.2136 (K)

EXAMPLE Calculate the minimum ventilation requirements for a 24 V battery system with a total *Ah* rating of 100 A that requires a current of 15 A during charging:

$A = K \times Ah \times I$

$A = 0.1068 \times 100 \times 15 = 160.2\ mm^2$

5.4.12 Lithium ion battery requirements

5.4.12.1 General

Lithium ion battery installations shall comply with Clauses 5.4.1 to 5.4.10 inclusive, and the requirements specified in this clause.

These requirements apply to installations of all lithium ion batteries.

The installer should consult with the battery manufacturer and supplier to determine a compartment design and venting mechanism that is practical for the type of battery chemistry, construction, volatility or its response to thermal runaway events.

5.4.12.2 Location

Lithium ion batteries shall —

(a) be installed externally, i.e. behind a wall, compartment or barrier that prevents the egress of gases into the habitable area; and

(b) not enter the habitable area of the structure; and

(c) be installed to operate within the manufacturer's defined operating temperatures, including IP rating; and

(d) be installed in a suitable battery container where the battery manufacturer has not provided encapsulated cells.

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5.4.12.3 Battery management safety system

5.4.12.3.1 Requirements

Each lithium ion battery shall be provided with a battery management safety system either integrated into a battery pack or as a separate component. All lithium ion batteries shall comply with AS IEC 62619.

The battery management safety system is designed to protect the lithium ion battery from potentially damaging situations.

5.4.12.3.2 Location

The battery management safety system shall be located within or adjacent to the battery and no greater than 600 mm from the battery.

5.4.12.3.3 Electrical protection

The battery management safety system shall continuously monitor the voltage, current and temperature of the battery and protect against the following by automatic disconnection —

(a) over and under voltage; and

(b) over and under temperature; and

(c) over current.

The battery management safety system should be as per the cell manufacturer's recommendation or designed and supplied by the same manufacturer.

5.4.12.3.4 Monitoring device

Each battery (or bank of batteries) shall be monitored via a battery monitor designed for managing lithium ion batteries. The monitor shall display the state of charge (SoC) and may display voltage. Communications with the monitor may be by wired or wireless connection direct to the battery management safety system.

5.4.12.3.5 Commissioning

All lithium ion battery systems should be tested and commissioned as per the battery manufacturer's requirements.

5.5 Other sources of supply

5.5.1 Extra-low voltage generators and transformer/rectifier units

Where an extra-low voltage supply is obtained from a generator or from a low voltage supply via a transformer/rectifier unit, the extra-low voltage at the output terminals of the supply unit shall be maintained between 90 % and 120 % of nominal voltage with applied loads varying from 0.5 A minimum up to the maximum rated load of the supply unit.

5.5.2 Renewable energy sources

5.5.2.1 General

Renewable energy sources, such as wind or solar energy, shall be installed only for charging batteries.

These renewable sources shall only generate extra-low voltage.

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Renewable energy sources shall only be operated with a device which prevents overcharging of the battery(ies).

5.5.2.2 Photovoltaic arrays

5.5.2.2.1 General

PV arrays installed on connectable electrical installations shall comply with Clause 5.5.2.2.

Further guidance on solar PV installations is available in AS/NZS 5033.

5.5.2.2.2 Photovoltaic wiring system

The ELV wiring system installed from the PV array to the PCE shall —

(a) be double insulated and specifically for d.c. PV array wiring; and

(b) suitably restrained and mechanically protected; and

(c) be of an appropriate size with regard to the fault currents that can be produced by the installed PV array; and

(d) have suitable IP rated connections and entries.

The temperature rise of the cable, UV rating and conductor arc effects shall be considered.

See Figure 5.6 for an example of a PV array wiring system for a connectable electrical installation.

NOTE When installing single core double insulated (SDI) conductors for d.c. PV array wiring, they should either be installed in separate enclosures or each conductor spaced a minimum of 100 mm apart.

5.5.2.2.3 Overcurrent protection

Overcurrent protection devices shall be installed at the renewable energy source in the positive conductors.

PV arrays shall be provided with overcurrent protection as follows:

(a) *Protection against circulating currents within the array* — To protect against circulating currents within the array, arrays having 3 or more strings shall be provided with overcurrent protection in each such string.

The protective devices shall be —

(i) located as close as practicable to the string junction point; and

(ii) rated at no more than 1.5 × the string short-circuit current capacity between strings.

NOTE 1 A string is 1 or more panels connected in series.

(b) *Overload and short circuit protection of array cables* — Each section of the array cables shall be protected against overload.

NOTE 2 The sections of conductors on the array side and on the battery side of the charge controller need to be considered separately, as they may be operating at different voltage and current levels.

NOTE 3 Protection of the array side section may be achieved by —

(i) the rated short circuit current of the array; or

(ii) the sum of ratings of the string protection overcurrent protection devices; or

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(iii) a separate overcurrent device located on the array side of the charge controller.

Fuses and fuse holders shall comply with Clauses 5.5.2.3.4 and 5.5.2.4.

5.5.2.3 Circuit breakers for PV arrays

5.5.2.3.1 General

Circuit breakers shall —

(a) be a non-polarized type; and

(b) be rated for d.c. use; and

(c) have a voltage rating equal to or greater than the renewable energy system maximum voltage; and

(d) be rated to interrupt overload and short circuit currents from the renewable energy system, and any other connected power sources such as batteries or generators.

NOTE Circuit breakers should not be used for string overcurrent protection.

5.5.2.3.2 PV module installation requirements on connectable electrical installations

Refer to the relevant national design rules regarding safety of vehicles for PV modules and/or arrays fitted to a connectable electrical installation.

PV modules and/or arrays fitted to a connectable electrical installation shall comply with the following requirements:

(a) *Not exceed height or width limits* — When operating on a road, PV modules and/or arrays shall meet the vehicle dimensions and mass rule.

(b) *The external projections rule* — When operating on a road, PV modules and/or arrays shall not project in such a position or be of such a protrusion as to be dangerous to other road users.

(c) *The vehicle lighting rule* — When operating on a road, PV modules and/or arrays shall not be placed in such a position to obscure lights or reflectors.

(d) PV modules and/or arrays shall comply with the strength of attachment method and have the ability to withstand forces likely to be present on a vehicle under normal operation and under emergency braking conditions or in a collision or accident.

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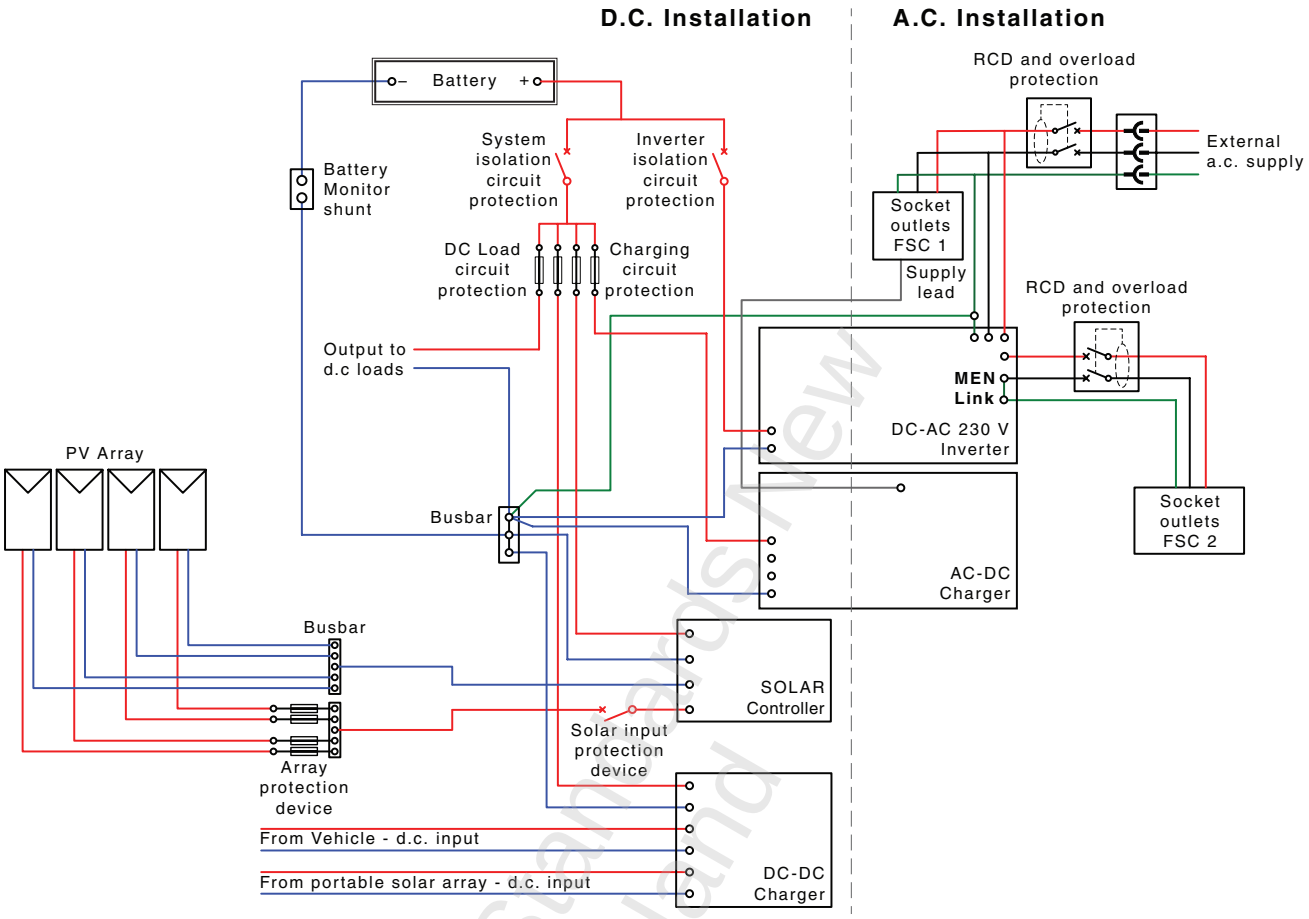


Figure 5.6 — Example of PV array wiring system for a connectable electrical installation

5.5.2.3.3 Plugs, sockets and connectors

Plugs, sockets and connectors for renewable energy systems shall —

(a) be protected from contact with live parts in connected and disconnected states (e.g. shrouded); and

(b) have a current rating equal to or greater than the current-carrying capacity for the circuit to which they are fitted; and

(c) be capable of accepting the cable used for the circuit to which they are fitted; and

(d) require a deliberate force to separate; and

(e) have a temperature rating suitable for their installation location; and

(f) if multi-polar, be polarized; and

(g) if exposed to the environment, be rated for outdoor use, be of a UV-resistant type and be of an IP rating suitable for the location; and

(h) be installed in such a way as to minimize strain on the connectors (e.g. supporting the cable on either side of the connector); and

(i) be mated only with those of the same type from the same manufacturer; and

(j) not be interchangeable with low voltage or extra-low voltage plugs, sockets or connectors.

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5.5.2.3.4 Fuses

Fuses used in renewable energy systems shall —

(a) be rated for d.c. use; and

(b) have a voltage rating equal to or greater than the renewable energy system maximum voltage; and

(c) be rated to interrupt fault currents from the renewable energy system, and any other connected power sources such as batteries or generators.

Fuses used in PV systems shall be of an overcurrent and short circuit current protective type suitable for PV systems.

5.5.2.4 Fuse holders

Fuse holders shall —

(a) have a voltage rating equal to or greater than the renewable energy system maximum voltage; and

(b) have a current rating equal to or greater than the corresponding fuse; and

(c) provide a degree of protection suitable for the location and not less than IP2X, even when the fuse link or carrier is removed.

5.6 Isolation, switching and control

5.6.1 Devices for protection against overcurrent

Batteries and associated wiring shall be protected against overload and short-circuit by means of fuses or circuit breakers at a position within, at or adjacent to, the battery compartment.

A fuse or circuit-breaker shall, as a minimum, be installed in each unearthed pole of each circuit connected directly to a battery within 200 mm of the battery terminals.

Exception: The fuse or circuit-breaker may be placed up to 1 m from the terminals, provided each conductor from the battery is contained within a protective covering, such as a sheathing, conduit or cable trunking, for its entire length from the battery terminal to the circuit protective device.

There shall be no more than four conductors connected to a single battery terminal.

5.6.2 Fuses

Fuses shall be physically protected against accidental mechanical damage.

5.6.3 Proximity to non-electrical services

Overcurrent protective devices shall not be fitted in a fuel storage compartment or fuel storage housing intended for the storage of LP Gas cylinders.

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5.6.4 Wiring systems

5.6.4.1 General

Extra-low voltage wiring systems shall be selected and installed in a connectable electrical installation to meet the following criteria:

(a) Protect against physical contact with live parts by durable insulation materials or by placing live parts out of reach; and

(b) satisfy current-carrying capacity, voltage drop and other minimum size requirements for conductors; and

(c) provide reliability and electrical continuity of connections, joints and terminations; and

(d) provide adequate strength of supports, suspensions and fixings; and

(e) suit intended use, including applications requiring a particular type of wiring system; and

(f) protect against mechanical damage, environmental and other external influences by enclosure or other means; and

(g) be installed in accordance with the requirements of this section and the additional requirements as specified in the manufacturer's installation instructions.

Where there are wiring systems operating at different voltages, cables of low voltage or extra low voltage circuits shall not be enclosed in the same wiring system.

Exception: Cables of low voltage circuits and cables of extra-low voltage circuits shall only be enclosed in the same wiring system where one of the following arrangements is employed:

(i) *The low voltage cables are of a type providing the equivalent of double insulation.*

(ii) *All cables or each conductor of a multi-core cable are insulated for the highest voltage present.*

(iii) *The low voltage cables are installed in a separate compartment of a common cable trunking system with fixed and continuous barriers between compartments.*

5.6.4.2 Types of wiring systems

Cables shall be of stranded construction and shall be suitably insulated and/or sheathed for the applicable installation.

Cable insulation and or sheathing may be compromised by a chemical reaction if it is in contact with polystyrene and polyurethane.

Cables shall be installed so there is no direct contact between the cable and polystyrene and/or polyurethane.

Exception: A cable that is manufactured and identified as being suitable for installation in contact with polystyrene and polyurethane is permissible.

5.6.4.3 Current-carrying capacities

Every conductor shall have a current-carrying capacity in accordance with the manufacturer's installation instructions and not less than the current to be carried by the conductor.

5.6.4.4 Voltage drop in extra-low voltage installations

Where the d.c. supply is from batteries, the voltage drop to any point in the installation shall not exceed 10 % of the nominal voltage.

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A d.c. conductor of adequate cross-sectional area between the charging source(s) and the batteries is vital for satisfactory charging of the batteries. A voltage drop for this conductor should not exceed 1 % of the rated voltage during charging, unless the charging source has battery voltage sensing and automatic output voltage compensation, in which case voltage drop at full charge should not exceed the range of compensation.

5.6.4.5 Proximity of wiring systems to other services

Cables including those used for automotive purposes shall not be installed through a compartment or housing intended for liquefied petroleum gas storage cylinders.

Exception: A gas safety shut-off valve, and its associated cabling, that is encapsulated may be installed within the LP Gas cylinder compartment.

5.6.4.6 Identification

Extra low voltage installation wiring conductors shall be clearly identified to indicate their intended function. Refer to the owner's manual to determine the intended function.

Conductors with green or green-yellow combination coloured insulation or sheathing shall only be used as protective earthing or equipotential bonding conductors in installation wiring.

NOTE 1 Conductors with green insulation or sheathing may be used for ADR purposes (vehicle roadworthy wiring systems).

NOTE 2 The use of alternative colours to LV wiring systems for identification of ELV wiring systems is recommended.

5.7 Extra-low voltage accessories

5.7.1 General

Information on the prohibited locations for extra-low voltage accessories is provided in Clauses 4.9.4.

5.7.2 Socket-outlets

Extra-low voltage socket-outlets shall be two pole non-reversible and different from those provided for any low voltage installation. The voltage and maximum power rating of the circuit should be stated on or adjacent to the socket-outlets.

Socket-outlets on the exterior of a vehicle should be constructed or enclosed to provide protection against the ingress of water with a degree of protection of not less than IP34.

5.7.3 Battery chargers

For battery chargers connected to a low voltage a.c. supply, refer to the relevant clauses of AS/NZS 60335.2.29. The d.c. output should be electronically regulated so the maximum d.c. output voltage or amps of the battery manufacturer's specifications are not exceeded.

The battery charger output should be rated to a minimum of 10 % of the capacity of the connectable electrical installation battery in Ah at 20 h discharge rate (C20 rating) and not exceeding the maximum charge rate of the battery manufacturer's specifications.

5.7.4 External lights

Lights, such as door lamps, fixed outside on a caravan should be constructed or enclosed to provide protection against the ingress of water with a degree of protection of not less than IP34.

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5.7.5 Inlets

The inlet, when the plug is disconnected, should be protected against the ingress of water, foreign bodies and accidental damage.

5.8 Extra-low voltage appliances

All appliances should be fitted and connected in a connectable electrical installation as set out in the appliance manufacturer's installation instructions.

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Section 6 Verification

6.1 Application

This section specifies the minimum requirements for inspection and testing to satisfy the fundamental safety principles in relation to verification of an installation in a connectable electrical installation.

When carrying out verification, precautions shall be taken to ensure the safety of persons, and to avoid damage to property and the electrical installation equipment during inspection and testing.

Connectable electrical installation verification shall be completed by a competent person.

NOTE Local regulatory requirements may apply in relation to licensing and qualifications.

6.2 General requirements

6.2.1 Initial verification

Before placing an electrical installation, or any part thereof, in service following construction or alteration, it shall be verified, as far as practicable, that the installation is safe to energize and will operate in accordance with the requirements of this Standard and of AS/NZS 3000, except as varied herein.

To confirm that the requirements of this Standard have been met, after completion and before being placed in service, the installation shall be —

(a) inspected in accordance with AS/NZS 3000 and this Standard as far as is practicable; and

(b) tested in accordance with AS/NZS 3000 and this Standard as appropriate.

Where the electrical installation work performed is an alteration to an existing electrical installation, it shall be verified that the alteration complies with this Standard and has not impaired the safety of the existing electrical installation. See Clause 6.3 for initial verification inspection and tests.

NOTE This verification assessment should be recorded. A sample verification record is in Appendix F.

6.2.2 Initial verification following repairs

Where the electrical installation work performed is a repair to an existing electrical installation, it shall be verified that the repair complies with either this Standard or the requirements that applied when it was first installed; and that the work has not impaired the safety of any other part of the electrical installation.

6.2.3 Testing of earth connections in New Zealand

In New Zealand, testing following alterations or repairs, including removal of a neutral-earth link, shall include testing to ensure the integrity of all earth connections in accordance with Clause D.5.5. NZ

6.3 Initial verification inspection and tests

6.3.1 General

Before placing an electrical installation, or any part thereof, in service following construction, alteration or repair, it shall be verified, as far as practicable, that the installation is safe to energize and will operate in accordance with the requirements of this Standard.

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To confirm that the requirements of this Standard have been met, after completion and before being placed in service, the installation shall be —

(a) inspected in accordance with Clause 6.3.2 as far as is practicable; and

(b) tested in accordance with Clause 6.3.3.

Precautions shall be taken to ensure the safety of persons and to avoid damage to property and the electrical installation equipment during inspection and testing.

Where the electrical installation is an alteration or repair to an existing electrical installation, it shall be verified that the alteration or repair complies with this Standard and does not impair the safety of the existing electrical installation.

6.3.2 Inspection

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

The visual inspection shall be carried out before, or in association with, testing. The visual inspection should, where practicable, be made before the relevant part of the electrical installation is placed in service.

Exception: Where the visual inspection of a part of the electrical installation is not practicable at the completion of the work, e.g. not accessible because of enclosure in the building structure, consideration should be given to inspecting that part during the course of the installation.

The following items shall be checked, where applicable during the visual inspection, in order to assess that the relevant requirements of this Standard are satisfied.

General items include:

(a) Basic protection (protection against direct contact with live parts), e.g. insulation and enclosure.

(b) Fault protection (protection against indirect contact with exposed conductive parts), e.g. by the use of automatic disconnection of supply, double insulation or isolating transformers.

(c) Protection against hazardous parts, e.g. enclosure, guarding or screening of flammable materials, hot surfaces and parts that may cause physical injury.

(d) Protection against spread of fire, e.g. penetration of fire barriers.

(e) General condition of the electrical equipment, e.g. signs of damage that could impair safe operation, disconnection of unused electrical equipment.

Specific items for visual inspection may be located in AS/NZS 3000.

6.3.3 Testing

After completion of, or in association with, the visual inspection, tests shall be carried out on the electrical installation to determine that it complies with the requirements of this Standard and that it is suitable for the use intended.

If necessary, additional tests may be carried out.

AS/NZS 3017 sets out common test methods that may be used to determine that a low voltage electrical installation complies with this Standard, and also includes minimum safety standards for test instruments.

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Testing shall be carried out in such a manner that the safety of the operator and other people in the vicinity, and test equipment is not placed at risk.

NOTE The test methods set out in this clause are given as reference methods. Other methods are not precluded, provided that they give equally valid results.

Low voltage installations testing shall include the following tests —

(a) Continuity of the earthing system (earth resistance of the main earthing conductor, protective earthing conductors, PEN conductors and bonding conductors).

(b) Insulation resistance.

(c) Polarity and correct circuit connections.

(d) Assessment of impedance required for automatic disconnection of supply (earth fault-loop impedance.

(e) Operation of RCDs.

See Figure 6.1 for the recommended sequence of the above tests.

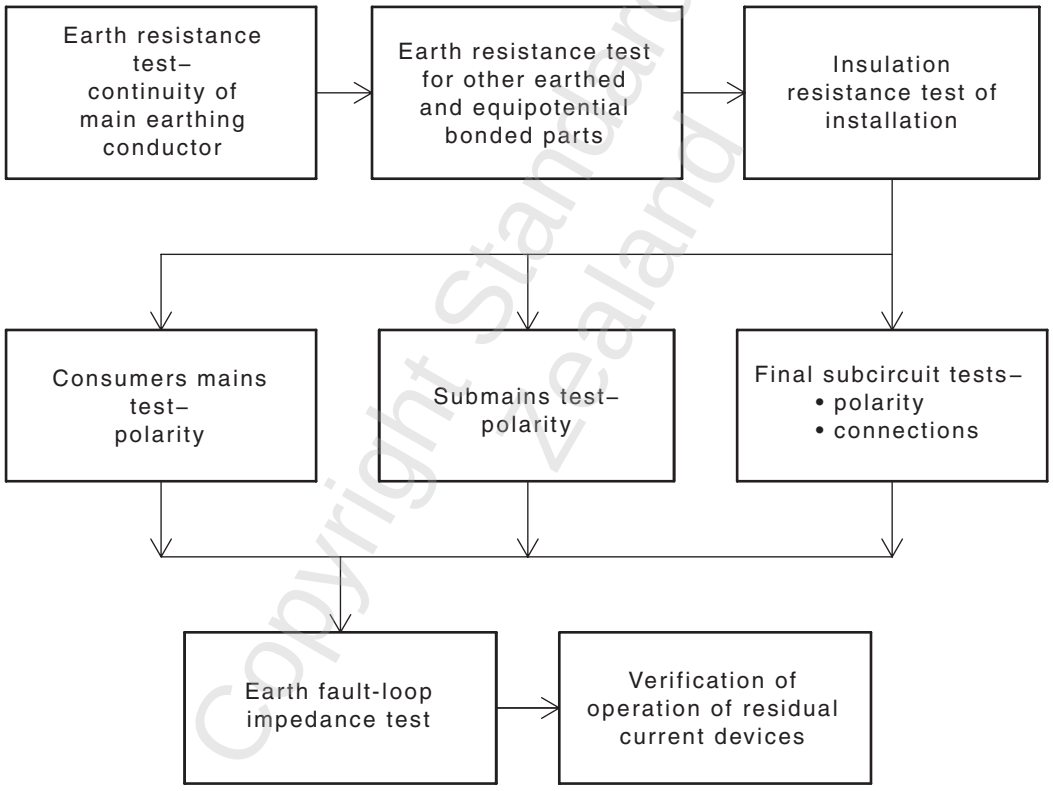


Figure 6.1 — Testing sequence for low voltage connectable electrical installations

In New Zealand, testing following prescribed electrical work, including removal of the neutral-earth link, shall include testing to ensure the integrity of the earth connections in accordance with Clause D.5.5. NZ

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6.4 Periodic verification

6.4.1 In Australia

AS

Periodic inspection and testing of electrical installations should be performed to confirm the safety of the installation.

NOTE 1 Local regulatory requirements may apply in relation to inspection and testing.

NOTE 2 The owner or occupier of the connectable electrical installation may set out additional requirements in relation to inspection and testing.

NOTE 3 Recommended periodic testing arrangements are set out in AS/NZS 3019.

6.4.2 In New Zealand

NZ

The verification requirements for the issue of a New Zealand warrant of electrical fitness (WoEF) are specified in Appendix D.

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Appendix A
(informative)

Electrical supply to tents and non-rigid annexes

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A.1 General

This appendix provides general information about connecting different types of tents and non-rigid annexes on the one site by supply lead(s) and detachable supply leads from service pillars and outlet boxes.

Electrical equipment in tents and non-rigid annexes should be connected to the site supply only if the tent or non-rigid annex is securely erected and the electrical equipment is located so as to be protected from external influences e.g. UV, rain or other environmental influences under normal conditions of occupancy.

A.2 Connections to site supply

A.2.1 General

A supply lead or detachable supply lead used for the following purposes should be in one unbroken length —

(a) connection to site supply, as covered in Clause 2.2; or

(b) connection to the electrical equipment in tents or non-rigid annexes as covered in this Appendix.

Refer to Clause 2.5 for mandatory requirements.

A.2.2 Site installation of supply lead — safety considerations

A.2.2.1 General

Any supply lead should be arranged so that it will not obstruct persons walking in the vicinity of the connectable electrical installation, tent or non-rigid annex.

A.2.2.2 Location and protection

The supply lead should be located or provided with suitable protection where it will not be subject to the following —

(a) mechanical damage; or

(b) damage by high temperatures; or

(c) ultraviolet radiation.

NOTE Caravan park operators should supply connection instructions, see Appendix B.

A.2.2.3 Underground cabling

Supply leads should not be buried.

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A.2.2.4 Number of supply lead connections

There should only be one supply lead providing electrical power to a site.

This should be connected between any socket-outlet in the caravan park or camping ground to the connectable electrical installation or outlet box within a tent or non-rigid annex.

A.2.2.5 Undesirable supply lead connections

The supply of electricity for use in any connectable electrical installation, tents or non-rigid annexes should not be obtained —

(a) from a socket-outlet installed in another connectable electrical installation, tent or non-rigid annex on another site; or

(b) by the use of EPODs, socket-outlet adaptors, piggy back plugs (tap on) or double adaptors.

A.3 Supply to electrical equipment

A.3.1 One item to be supplied

Where only one item of electrical equipment such as a handlamp or appliance is to be supplied, it should be connected to the site supply via —

(a) an external socket-outlet; or

(b) a cord extension socket; or

(c) an outlet box.

A.3.2 Multiple items to be supplied

Where more than one item of electrical equipment is to be supplied, these items should be connected to the site supply only by means of an outlet box.

A.4 Connection of supply

A.4.1 General

Multiple tents or non-rigid annexes may be supplied on the one site.

Where multiple tents or non-rigid annexes are to be supplied, the following principles should apply —

(a) Any supply from a connectable electrical installation described in Sections 3 and 4 to tents or non-rigid annexes should originate at an external socket-outlet on the connectable electrical installation on the same site.

(b) The distribution point in a tent or non-rigid annex to other tents or non-rigid annexes should be an outlet box.

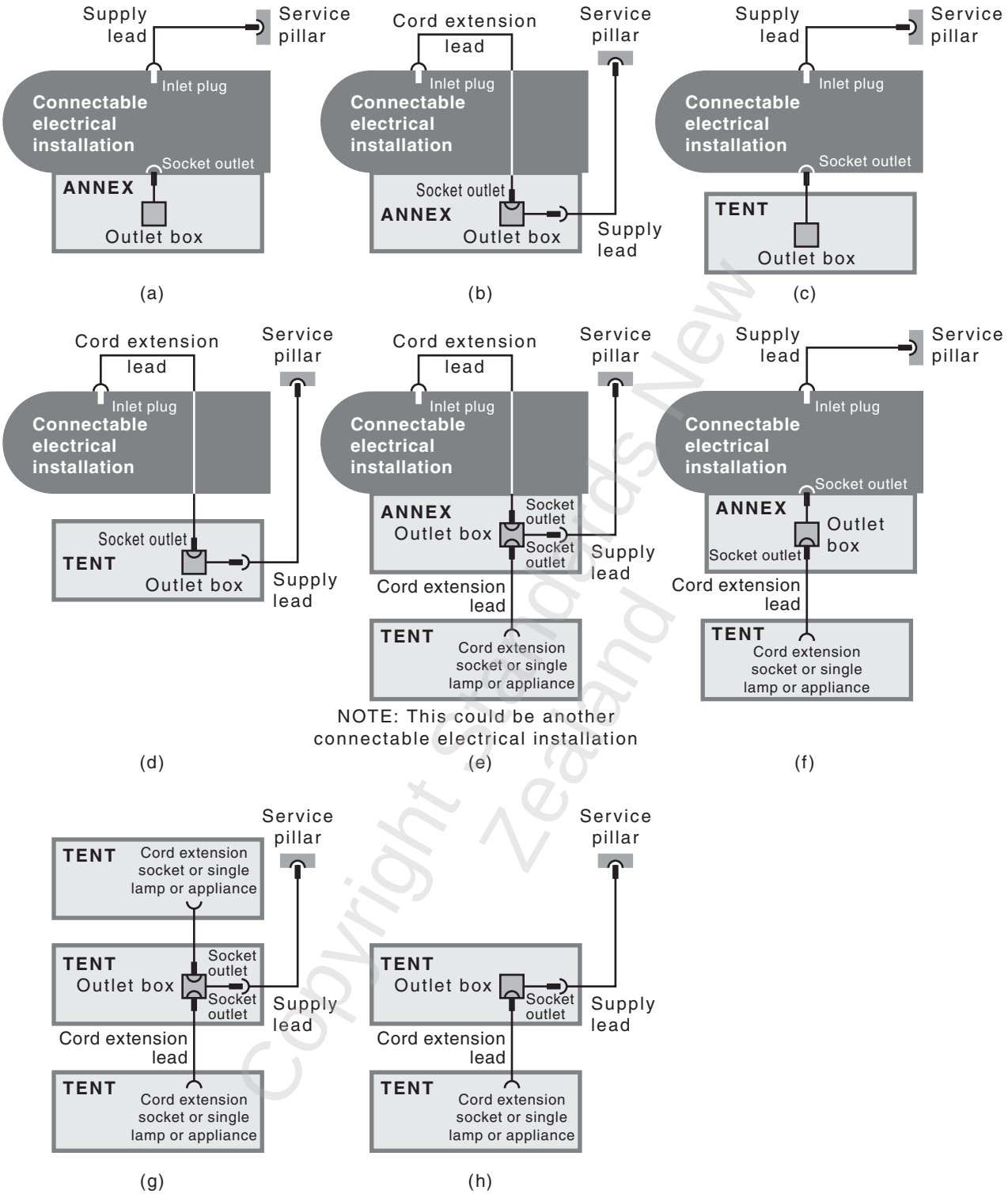
(c) Only one outlet box should be used in any connection of multiple tents or non-rigid annexes.

Examples of typical arrangements for the supply of multiple tents or non-rigid annexes on the one site are shown in Figure A.1.

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NOTE 1 Outlet box may be connected to site supply through an inlet socket and cord extension lead.

NOTE 2 Supply lead may be a cord extension lead or a permanent connected lead into the outlet box.

Figure A.1 — Typical arrangements for supplying connectable electrical installations, tents and non-rigid annexes on one site

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A.4.2 Multiple loads

Supply to multiple loads should be arranged in one of the following ways —

(a) by means of a separate supply lead to each load; or

(b) via an outlet box.

A.4.3 Outlet boxes

A.4.3.1 General

The outlet box should comply with AS/NZS 3100 where applicable and, where lighting equipment is included, AS/NZS 3128. In addition, electrical portable outlet devices (EPODs) aligning with AS/NZS 3105 should not be used as outlet boxes.

A.4.3.2 Construction

An outlet box should be as per the relevant recommendations of a portable socket-outlet assembly (PSOA) within AS/NZS 3190. The outlet box should be marked to indicate compliance to AS/NZS 3190 and this Standard.

NOTE In Australia and New Zealand, a PSOA is required to have regulatory approval and to be marked with a Regulatory Compliance Mark (RCM) or approval number.

Outlet boxes should —

(a) be of Class II (double insulated) construction; and

(b) be supplied by a flexible cord of the heavy-duty sheath type in line with AS/NZS 3191 of a maximum length 2 m and fitted with a plug in line with AS/NZS 3112; and

(c) incorporate overload protection by means of a MCB not exceeding the rating of the supply lead and the supply lead plug; and

(d) be protected by an RCD with maximum residual current of 30 mA that operates in all live (active and neutral) conductors; and

(e) be selected according to operating and geographical location to prevent the ingress of dust or moisture.

A.4.3.3 Termination of supply lead

The outlet box should be provided with terminals and cord anchorage facilities suitable for permanent connection of the supply lead.

A.4.3.4 Overcurrent protection

A.4.3.4.1 General

The total output from the outlet box should be limited by the use of one or more MCBs, rated appropriately for the current-carrying capacity of the permanently connected supply lead or appliance inlet, as applicable, so that the total output cannot exceed the rating of the outlet box.

NOTE This may be achieved by the use of a single MCB at the inlet or by the sum of the ratings of all the MCBs installed to protect the outgoing circuits.

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A.4.3.4.2 Rating

The incorporated overload protection MCB or circuit breakers should not exceed the rating of the socket-outlets, supply lead or supply lead plug, whichever is the smaller.

A.4.3.4.3 Operation

In Australia, these circuit-breakers operate in all live (active and neutral) conductors. AS

A.4.4 Protection against earth leakage current

For information on protection against earth leakage current of the circuits and socket-outlets or electrical equipment on an outlet box, refer to AS/NZS 3100.

A.4.5 Control switches

In Australia, any switch controlling electrical equipment mounted on the outlet box should operate in all live (active and neutral) conductors. AS

A.4.6 Marking

The maximum loading of the outlet box should be clearly and indelibly marked on the outlet box in a prominent position by the manufacturer, specifying either the maximum wattage or maximum amperage. For example:

Maximum XX watts loading

or

Maximum XX amps loading

where "XX" is the maximum loading value which should be inserted by the manufacturer of the outlet box.

A.4.7 Socket-outlets

Socket-outlets incorporated into an outlet box should be of a type designed to accommodate a plug that complies with AS/NZS 3112, AS/NZS 3123 or IEC 60309-2.

The minimum current rating of socket-outlets in an outlet box is —

(a) 10A for socket-outlets compliant with AS/NZS 3112;

(b) 20A for socket-outlets compliant with AS/NZS 3123; and

(c) 16A for socket-outlets compliant with IEC 60309-2.

A.4.8 Earthing

The earthing terminal of each socket-outlet should be connected to the earthing terminal of the appliance inlet or the earthing terminal provided for the permanent connection of the supply lead, as applicable.

A.5 Lighting

A.5.1 Handlamps

Handlamps used in tents or non-rigid annexes should be of the electric inspection type complying with AS/NZS 60598.2.8.

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A.5.2 Other lighting equipment

Lighting equipment should —

(a) be of Class II (double-insulated) construction; and

(b) incorporate protection against lamp breakage; and

(c) comply with AS/NZS 60598.1.

NOTE Alternatively, separated extra-low voltage lighting equipment may be used.

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Appendix B
(informative)

Provision of connection instructions for caravan parks or camping ground patrons

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All site occupiers intending to connect their connectable electrical installations to the site supply by means of a detachable connection should be provided with an instruction notice that conveys the following information:

(a) Only connect one supply lead to each socket-outlet of the site supply.

(b) Use only one unbroken length of supply lead to connect a connectable electrical installation to a site supply socket-outlet.

(c) Do not obtain the supply of electricity for use in individual connectable electrical installations from a socket-outlet inside another connectable electrical installation or by the use of socket-outlet adaptors (double adaptors).

(d) Where a supply lead is coiled on or in a reel, drum, storage box or similar, do not connect the lead to the site supply while coiled.

(e) To reduce mechanical damage to supply leads when in service, locate the supply lead away from walkways and areas used for the moving of vehicles.

(f) Ensure electrical installations in connectable electrical installations are inspected regularly, e.g. annually, by a competent person to ensure their safe and effective operation.

(g) Test RCDs used for the protection of connectable electrical installations by operating the push button on the RCD to check that the device trips. After tripping, reset the RCD. If the RCD fails to trip, report this failure to the caravan park manager.

(h) The location of the device (within the premises or at the service pillar) should be noted for resetting in the event of a loss of supply.

(i) In New Zealand only, present a valid WoEF to the operator before connecting to the electrical supply. NZ

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Appendix C
(normative)

Owner user instructions

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The following information shall be provided in the instructions for use, in the English language:

(a) A warning worded as follows:

WARNING — A CONNECTABLE ELECTRICAL INSTALLATION BATTERY SHALL ONLY BE REPLACED BY ONE OF THE SAME TYPE AND SPECIFICATION AS THAT ORIGINALLY FITTED. UPGRADES TO THE BATTERY OR SYSTEM SHALL ONLY BE PERFORMED BY A COMPETENT PERSON.

(b) In order to ensure safe operation of the electrical installation, a simplified diagram of the wiring of the extra-low voltage and low voltage installation, with details of the cable colours, shall be provided.

(c) Type of appliances that can be used and from what source of supply.

(d) Instructions for the correct operation and maintenance of fitted appliances, as supplied with the appliance by the manufacturer.

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Appendix D
(normative)

Verification of connectable electrical installations (New Zealand only)

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D.1 Introduction

New Zealand legislation uses the term “connectable installation” rather than “connectable electrical installation”. For consistency with New Zealand legislative requirements the term “connectable installation” is used in this appendix. NZ

This appendix specifies the initial and periodic verification requirements for connectable installations.

NOTE 1 Attention is drawn to the fact that in New Zealand, directly-connected appliances are considered to be part of the connectable installation.

NOTE 2 Additional requirements for verification of mobile medical facilities are set by NZS 6115.

D.2 Initial verification

A warrant of electrical fitness (WoEF) shall only be issued for the initial verification of a connectable installation that has been inspected and tested in accordance with AS/NZS 3000:2018 Section 8 and the additional requirements of this Standard, and where the connectable installation complies in all respects.

D.3 Periodic verification

For periodic verification of a connectable installation originating in either Australia or New Zealand, a WoEF shall only be issued if it has been inspected and tested in accordance with the requirements of Clauses D.4 and D.5 and it complies in all respects.

For periodic verification of a connectable installation not originating in either Australia or New Zealand, a WoEF shall only be issued if it has been inspected and tested in accordance with the requirements of Clauses D.4 and D.5, and the additional requirements of Appendix E, and where the connectable installation complies in all respects.

NOTE A WoEF certifies the safety of not only the installation within the connectable installation, but also any appliances that are connected to the installation by other than a detachable connection.

D.4 Inspection of connectable installations

D.4.1 Exposed live parts

The connectable installation, including the supply lead, shall not have any exposed live part, including damaged electrical equipment or appliances.

D.4.2 Unearthed metallic parts

The connectable installation shall not contain any unearthed metallic electrical equipment where such equipment is required to be earthed in accordance with Clauses 2.6.2, 2.7.4, 3.9, and/or 4.11.

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D.4.3 Exposed basic insulation

The connectable installation shall not contain any exposed basic insulation protecting live parts.

D.4.4 Damage

All fittings shall be free of mechanical damage or damage due to water ingress.

D.4.5 Overcurrent protection

Each external supply shall have overcurrent protection fitted to ensure that the maximum demand does not exceed the rating of the lowest-rated component of the supply lead and supply lead fittings.

NOTE This may be achieved by use of a single device that limits the current, or by the sum of the ratings of all final subcircuit overcurrent protective devices not exceeding the figure, or, for connectable installations with no socket-outlets, by the total connected load not exceeding the figure.

All installation wiring shall have overcurrent protection suitable for the conductors in accordance with AS/NZS 3000.

D.4.6 Protection against the ingress of moisture

External electrical equipment shall have a minimum degree of protection of IP24.

D.4.7 Inlet plugs (appliance inlets)

Inlet plugs (appliance inlets) if provided, shall comply with IEC 60309-2, AS/NZS 3123 or AS/NZS 3120.

Exception: This requirement does not apply to a connectable installation that is not in a recreational vehicle, where a specific configuration of connection to the electricity supply has been chosen for special purposes.

Each inlet plug shall have provision for strain relief for the supply lead connection.

D.4.8 Supply lead plug

The supply lead plug shall comply with Clause 2.5.

Exception: This requirement does not apply to a connectable installation that is not in a recreational vehicle, where a specific configuration of connection to the electricity supply has been chosen for special purposes.

If the plug complies with AS/NZS 3112, the connectable installation shall be protected by an RCD against earth leakage current by one or more RCDs in accordance with Clause D.4.11.

D.4.9 Supply lead

Each supply lead shall comply with all the following requirements —

(a) the length and cross-sectional requirements of Table 2.1; and

NOTE For recreational vehicles, the supply lead should be a minimum of 10 m.

(b) if permanently connected, be provided with an external storage compartment; and

(c) if detachable, have a connector complying with Clause 2.5; and

(d) have provision for strain relief for the supply lead connection; and

(e) heavy duty flex; and

(f) all parts of the supply lead shall have a minimum ingress protection rating of IP34, in accordance with AS 60529.

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D.4.10 Electricity supply arrangements

Electricity supply arrangements shall comply with the following requirements:

(a) The connectable installation shall not include any neutral-earth link or connection, other than as required under Clause D.5.8.2.

(b) For RVs with an in-line RCD in the supply lead, the supply lead shall not be detachable.

Exception: These requirements do not apply to any connectable installation, other than a recreational vehicle, where alternative arrangements for ensuring that touch voltages do not exceed the values specified in the IEC shock currents Standard (IEC/TS 60479-1) and the values have been chosen for special purposes.

D.4.11 RCD requirements

RCDs shall comply with the following requirements:

(a) Any RCD provided shall switch all live (active and neutral) conductors, be of a type providing protection against electric shock that complies with the relevant requirements of AS/NZS 61008.1 or AS/NZS 61009.1 for a Type A RCD, and have a residual current rating not exceeding 30 mA.

(b) All wiring to the input of any RCD from the appliance inlet or permanently attached supply lead junction box shall be double-insulated, with strain relief at cable terminations to prevent contact with earthed metal in the event of dislodgement of cable terminations.

(c) Where an in-line RCD is fitted in the supply lead, the RCD shall be located within 0.6 m of the supply lead plug or be combined in the supply lead plug.

D.4.12 External socket-outlets

External socket-outlets shall be verified as being provided protection against earth leakage current by an RCD with maximum rated residual current 30 mA.

Exception 1: Caravans manufactured before 1 April 1993 need not comply.

Exception 2: Caravans manufactured between 1 April 1993 and 31 December 2002 may instead have exterior sockets supplied via an isolating transformer.

D.4.13 Socket-outlets

D.4.13.1 Low voltage

Single-phase socket-outlets shall provide a nominal 230 V/50 Hz supply.

Three phase socket-outlets shall provide a nominal 400 V/50 Hz three phase supply.

D.4.13.2 Extra-low voltage

Extra-low voltage socket outlets shall comply with Clause 5.7.2.

D.4.14 Electrical equipment near gas installations

The connectable installation shall contain no electrical equipment in either of the following locations (see Figure 4.5):

(a) In any gas bottle storage compartment; or

(b) Within 1.5 m horizontally from, or 0.5 m vertically above, a gas drain outlet from a gas bottle storage compartment.

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The connectable installation shall not contain any fittings within the hazardous area around a gas bottle shown in Figure 4.6.

Exception: These requirements do not apply to:

(i) *Encapsulated devices (e.g.extra-low voltage gas shut-off valve) complying with Clause 4.10.3.4).*

(ii) *Electrical fittings and electrical wiring, mounted on the drawbar of a towed vehicle, whose primary function relates to the propulsion or road-worthiness of a vehicle.*

D.4.15 Batteries and battery compartments

Connectable electrical installation batteries and their compartments shall comply with all of the following:

(a) All batteries shall be adequately secured in position against —

(i) forward, backward or sideways movement; and

(ii) tipping; and

(iii) lifting.

(b) *Lead acid batteries:*

To avoid the build-up of hydrogen gas, lead-acid batteries shall be —

(i) sealed from all accommodation spaces; and

(ii) vented to the exterior of the vehicle in accordance with Clause 5.4.11.3.

Exception: Absorbed glass matt (AGM) batteries need not comply.

(c) *Lithium ion batteries:*

To avoid excessive heating, lithium ion batteries shall be provided with a battery management safety system (BMSS) in accordance with Clause 5.4.12.3, either integrated into a battery pack or as a separate component.

(d) *Battery terminals:*

Battery terminals and terminal blocks shall have a protective cover to prevent loose items from short circuiting the battery.

(e) *Overcurrent protection:*

Batteries with capacity 1 Ah or greater shall have overcurrent protection in accordance with Clause 5.4.7 for their connecting cables. For vented lead acid batteries, the overcurrent device shall not be within the same compartment as the battery.

(f) *Battery charging devices:*

Battery chargers shall not be connected by connectors relying on spring tension (e.g. alligator clips).

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D.4.16 Photovoltaic arrays

To reduce the risk of fire from overcurrents, PV arrays and associated wiring systems shall have overcurrent protection in each non-earthed conductor as follows:

(a) Where there are three or more strings in the array, there shall be an overcurrent device in each string that is both —

  (i) located as close as practicable to where the string is connected to other strings; and

  (ii) rated no higher than 1.5 × the strong short-circuit current.

(b) Overload protection for the array output by —

  (i) the rated short circuit of the array; or

  (ii) the sum of ratings of the string protection overcurrent protection devices; or

  (iii) a separate overcurrent device located on the array side of any charge controller.

(c) Overload and short circuit protection, suitable for the prospective short circuit current of the battery, located as close as practicable to the battery end of the array cables.

D.4.17 Appliances

Directly-connected appliances shall be inspected as far as practicable in accordance with AS/NZS 5761 to ensure they are safe for use.

D.4.18 Damp situations

Equipment in damp situations shall comply with Clauses 3.10 or 4.12, as applicable.

D.5 Testing of connectable installations

D.5.1 Polarity and phase rotation of socket-outlets

Socket-outlets shall be verified as having the correct polarity.

All multi-phase socket-outlets of the same type shall be verified as having the same phase rotation.

D.5.2 Operation of RCDs

Where RCDs are provided, they shall be tested in accordance with Section 8 of AS/NZS 3000. RCDs shall operate to disconnect all live (active and neutral) conductors.

RCD(s) in supply lead(s) shall disconnect all live conductors on loss of supply voltage.

D.5.3 Polarity of the supply lead(s) and inlet plug(s)

Supply lead conductors shall have the correct polarity.

Appliance couplers shall have the correct polarity.

D.5.4 Polarity and phase rotation sensors

Polarity reversal sensing devices, where fitted, shall provide clear indication of transposition of active and neutral.

Phase rotation sensing devices, where fitted, shall prevent operation of 3-phase equipment on incorrect phase rotation.

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D.5.5 Continuity of earthing conductors

Connectable installations shall have effective continuity of all earthing conductors from the earth pin of the supply lead plug to —

(a) the chassis/conductive framework;

(b) the earth pin of every other external supply;

(c) exposed conductive parts of internal supply source equipment;

(d) the earth pin of each low voltage socket-outlet (unless supplied by isolating transformer);

(e) each directly-connected item of Class I equipment;

(f) each sheet of conductive exterior cladding;

(g) accessible conductive materials within 100 mm of live parts;

(h) all other items required to be earthed by AS/NZS 3000 (see Clauses 2.6.2, 2.7.4, 3.9 and 4.11).

The resistance shall not exceed the relevant R_e values in AS/NZS 3000:2018 Table 8.2 for the current limiting device required by Clause D.4.5.

D.5.6 Segregation of extra-low voltage and low voltage

Connectable installations shall pass a 500 V d.c. insulation resistance test between the active and each unearthed extra-low voltage circuit. The resistance shall be not less than 1 MΩ.

D.5.7 Insulation resistance

With all directly-connected appliances switched on, connectable installations shall pass a 500 V d.c. insulation resistance test between the live conductors (active and neutral combined) and earth.

Exception 1: For equipment containing electronics/MOVs/EMI filtering, the test may be made at 250 V d.c. or the equipment may be disconnected before testing.

Exception 2: Where the connectable installation has permanently connected appliances or equipment containing electronics/MOVs/EMI filtering, the insulation resistance test may be carried out at 250 V d.c. or the earth leakage current may be determined in accordance with AS/NZS 3760.

Exception 3: Where the connectable installation includes a supply polarity sensing device, the test may be conducted between active and earth.

If an in-line RCD is fitted in the supply lead, the insulation resistance test shall be conducted from the connectable installation switchboard.

The resistance shall be not less than 1 MΩ.

D.5.8 Multiple electricity supply systems

D.5.8.1 Changeover switch testing

The changeover switch (or similar arrangement) shall be tested to verify that —

(a) when any supply source is connected to the connectable installation, all other supply sources are disconnected from all live (active and neutral) conductors in the installation; and

NOTE 1 Source selection arrangements that are deemed acceptable include those using either an isolating changeover swirth or a detachable connection.

(b) the changeover switch (or other arrangement) provides a “break before make” action.

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NOTE 2 For a switch, relay or contactor, this requires use of either two moving contacts per pole, an intermediate “OFF” position between each pair or sources, or interlocking.

D.5.8.2 Electricity supply source connections

D.5.8.2.1 Isolated or equipotentially bonded supplies

When an electricity supply source is obtained from an isolated onboard generator or inverter, or an equipotentially bonded converter, the neutral connection of the generator or inverter shall be connected to the earth system of the connectable installation only when it is supplying the connectable installation. See Figure 2.9.

D.5.8.2.2 RCD protected supplies

When an electricity supply source is obtained from an RCD protected onboard generator or inverter, the neutral connection of the generator or inverter shall be connected at all times to the earth system of the connectable installation upstream of the RCD. See Figure 2.8.

D.6 Warrant of Electrical Fitness checklist, form and sticker

D.6.1 Checklist

A checklist should be used to record all checks and the results of all tests.

An example of such a checklist is in Figure D.1.

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Warrant of Electrical Fitness Checklist

Client (person requesting the WoEF): _____

Date of Assessment: _____ Name of assessor: _____

Details of connectable installation:

Unique ID _____
Registration plate number, VIN, plant number, or similar

Description _____
Make, model, function, etc

Type of connectable installation:
- ☐ a relocatable unit
- ☐ a recreational vehicle
- ☐ a non-recreational vehicle
- ☐ a mobile medical facility

☐ First Issue (new connectable installation)

Certificate of Compliance (CoC): _____
Issued by: _____
Date: / /

☐ Re-issue

☑ = *Pass* ☒ = *Fail* ⊟ = *Not applicable*

☐ **D.4.1** The connectable installation, including the supply lead, has no exposed live parts.

☐ **D.4.2** The connectable installation contains no unearthed metallic electrical equipment that is required to be earthed.

☐ **D.4.3** The connectable installation contains no exposed basic insulation protecting live parts.

☐ **D.4.4** All fittings are free of mechanical damage.

☐ **D.4.4** All fittings are free of damage due to water ingress.

☐ **D.4.5** Over-current protection is installed for each external supply to ensure that the maximum demand does not exceed the rating of the lowest-rated component of the supply lead and supply lead fittings.

Rating of protection: _____ A Located at: _____

Achieved by
- ☐ MCB
- ☐ RCBO
- ☐ Sum of ratings: _____

☐ **D.4.5** All installation wiring has overcurrent protection suitable for the conductors in accordance with AS/NZS 3000.

☐ **D.4.6** External electrical equipment (low voltage and extra-low voltage) has a minimum degree of protection of IP24.

D.4.7 Inlet plug(s) (Appliance inlets) comply with	(number)	(rating)
☐ IEC 60309-2	_____	_____ A
☐ AS/NZS 3123	_____	_____ A
☐ AS/NZS 3120	_____	_____ A

☐ Each inlet plug has provision for strain relief for the supply lead connection, *e.g. hook adjacent to inlet.*

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D.4.8 The supply lead plug(s) comply with (number) (rating)

- ☐ IEC 60309-2 _____ _____ A (min 16 A)
- ☐ AS/NZS 3123 _____ _____ A (min 20 A)
- ☐ AS/NZS 3112* > / =15 A _____ _____ A (min 15 A)
- ☐ AS/NZS 3112* 10 A ** _____ _____ A

* ☐ If AS/NZS 3112 plug; all low voltage final subcircuits have RCD protection

** ☐ (Detachable) lead includes 10 A current limitation

or ☐ The lead is permanently attached; and the connectable installation has maximum demand limitation rated no higher than 10 A

☐ Other, non-recreational vehicle; with specific configuration for special purposes

D.4.9 Supply lead(s)

☐ Lead(s) permanently connected: external storage compartment provided for each

☐ Lead(s) detachable: connector(s) comply with

- ☐ IEC 60309-2 _____ _____ A (min 16 A)
- ☐ AS/NZS 3123 _____ _____ A (min 20 A)
- ☐ AS/NZS 3120 _____ _____ A (min 15 A)

☐ Other; non-recreational vehicle with specific configuration for special purposes

☐ All leads heavy duty flex _____ number of leads _____

☐ All leads comply with the length and cross-sectional requirements of Table 6.1

NOTE: For RVs the supply lead should be a minimum of 10 m.

☐ All leads have provision for strain relief for the supply lead connection, e.g. fixed loop in flex (detachable lead) or clamp on flex (fixed lead).

☐ All fittings of leads minimum IP 34; including plugs, connectors and enclosures for overcurrent protection.

D.4.10 Electricity supply arrangements

Electricity supply arrangements shall comply with the following requirements:

☐ **No** neutral-earth link or connection in the connectable installation (other than for on-board supply sources as per D.5.8.2)

☐ For recreational vehicles with an in-line RCD in the supply lead; supply lead not detachable

☐ Alternative arrangements for ensuring that touch voltages do not exceed the values specified in the IEC shock currents Standard (IEC/TS 60479.1) and the values have been chosen for special purposes.

Details: _____

_____

D.4.11 RCD requirements

All RCDs

- ☐ Switch all live conductors
- ☐ Are of a type providing protection against electric shock that complies with the requirements of a type A RCD in accordance with AS/NZS 61008.1 or AS/NZS 61009.1
- ☐ Have a residual current rating not exceeding 30 mA

All wiring to the input of all RCDs from the inlet plug/supply lead connection:

- ☐ is double-insulated
- ☐ has strain relief at cable terminations

RCD in the supply lead:

- ☐ The RCD is combined with, or located within 0.6 m of, the supply lead plug

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Socket-outlets

D.4.13.1 Low voltage socket outlets number: _____

☐ Single-phase: provide a nominal 230 V/50 Hz supply.

☐ Three phase: provide a nominal 400 V/50 Hz three phase supply.

D.4.13.2 Extra-low voltage socket outlets number: _____

☐ 2-pole non-reversible.

☐ Not compatible with low voltage sockets/plugs.

D.4.12 External socket-outlets provided with personal protection: number: _____

☐ By an RCD with maximum rated residual current 30 mA.

☐ Supplied via an isolating transformer
(only for caravans manufactured between 1 April 1993 and 31 December 2002)

☐ Caravans manufactured before 1 April 1993 need not comply.

D.4.14 Electrical equipment near gas installations

(a) Gas bottle lockers:

Other than an extra-low voltage gas shut-off valve and associated extra-low voltage wiring; the connectable installation contains no electrical equipment:

☐ In any gas bottle storage compartment;

☐ Within 1.5 m horizontally from, or 0.5 m vertically above a gas drain outlet from a gas bottle storage compartment

(b) Unenclosed gas bottles:

Other than an extra-low voltage gas shut-off valve and associated extra-low voltage wiring; the connectable installation contains no electrical equipment:

☐ Within the hazardous area around a gas bottle shown in Figures 4.6.

D.4.15 Connectable installation batteries and their compartments

All batteries:

☐ Are secured in position against movement in all directions, including tipping and lifting.

☐ Have overcurrent protection suitable for their connecting cables.

☐ Have overcurrent protection in all non-earthed conductors.

Lead Acid batteries:

☐ Are absorbed glass matt (AGM) batteries

OR

☐ Separated from all accommodation spaces; and

☐ Vented to the exterior of the vehicle in accordance with Clause 5.4.11.3;

☐ The overcurrent device(s) are not within the same compartment as the battery.

Lithium ion batteries:

☐ Are provided with a battery management system in accordance with Clause 5.4.12.

Connections to battery terminals

☐ Battery terminals and terminal blocks have a protective cover.

☐ Battery chargers are not connected by connectors relying on spring tension (e.g. alligator clips).

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D.4.16 Photovoltaic arrays

Overcurrent protection is provided in non-earthed conductors of the array as follows:

☐ (If 3 or more strings) overcurrent device in each string that is both
- ☐ Located as close as practicable to where the string is connected to other strings; and
- ☐ Rated no higher than 1.5 × the string short-circuit current

☐ Overload and short circuit protection, suitable for the prospective short circuit current of the battery, located as close as practicable to the battery end of the array cables

☐ Overload protection between array and charge controller
- ☐ By max output of array; or
- ☐ By sum of ratings of the string overcurrent protection devices; or
- ☐ By separate overcurrent device located on array side of charge controller

D.4.17 Appliances

☐ Directly-connected appliances passed inspection in accordance with AS/NZS 5761.

List appliances found: _____

_____

D.4.18 Damp situations

Electrical equipment in damp situation zones comply with the following clauses:

- ☐ Clause 3.10 (relocatable units).
- ☐ Clause 4.12 (recreational and non-recreational vehicles).

D.5 Testing of connectable installations

D.5.5 Earth continuity

Effective continuity of earthing conductors from the earth pin of the supply lead plug to:

- ☐ The chassis or conductive framework;
- ☐ The earth pin of every other external supply;
- ☐ Exposed conductive parts of internal supply source equipment;
- ☐ The earth pin of each low voltage socket-outlet (unless supplied by isolating transformer);
- ☐ Each directly-connected item of Class I equipment;
- ☐ Conductive exterior cladding (each sheet);
- ☐ Accessible conductive materials with 100 mm of live parts (e.g. door or window frames, internal linings, stoneguards, photovoltaic modules, antennae); and
- ☐ All other items required to be earthed by AS/NZS 3000.

Polarity and phase rotation

☐ **D.5.3** All supply leads have the correct polarity.

☐ **D.5.4** All inlet plugs have correct polarity.

☐ **D.5.1** All socket-outlets verified as having the correct polarity.

☐ **D.5.1** All multiphase sockets of same type have same phase rotation

☐ **D.5.4** Polarity sensing device (where fitted) provides clear indication of active / neutral reversal

☐ **D.5.4** Phase rotation sensing device (where fitted) prevents operation of 3-phase equipment if rotation incorrect

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D.5.7 Insulation resistance

☐ With all directly-connected appliances switched on; minimum 1 MΩ @ 500 V d.c. resistance test

☐ Between live conductors (active and neutral combined) and earth; OR

☐ Between active conductor and earth (if polarity sensing device requires)

☐ Tested from supply lead plug OR

☐ Tested from switchboard (in-line RCD only)

Electronics/MOVs/EMI filtering ☐ Disconnected during test OR

☐ Tested at 250 V d.c. OR

☐ Leakage current test carried out

D.5.6 Segregation of extra-low voltage and low voltage

☐ Not less than 1 MΩ between active conductors and each non-earthed extra-low voltage circuit.

Multiple electricity supply systems

D.5.8.1 Change over switch testing

☐ When any supply source is connected to the connectable installation, all other supply sources are disconnected from all live (active and neutral) conductors in the installation.

☐ The changeover switch (or similar arrangement) provides a 'break before make' action.

Electricity supply source connections

☐ **D.5.8.2.1 Isolated supplies**

The neutral of each electricity supply source obtained from an on board isolated generator or inverter, or equipotentially bonded inverter, is connected to the earth system of the connectable installation only when it is supplying the connectable installation.
Number of such sources: _____

D.5.8.2.2 RCD protected supplies

The neutral of each electricity supply source obtained from an RCD protected onboard generator or inverter is connected to the earth system of the connectable installation at all times.
Number of such sources: _____

D.5.2 Operation of RCDs

Each RCD tested, to confirm disconnection of all live conductors, by

☐ Integral test button; or

☐ External test equipment

Number of RCDs tested: _____

☐ PRCD(s) in supply leads(s) disconnect on loss of supply

☐ Connectable installation requires remedial work and rechecking

Signed: _____ Date: / /

☐ Connectable installation meets all requirements for issue of a WoEF

Signed: _____ Date: / / WoEF serial number: _____

Figure D.1 — Example of a Warrant of Electrical Fitness checklist

D.6.2 Warrant of Electrical Fitness (WoEF) form and sticker

D.6.2.1 WoEF form

A warrant of electrical fitness (WoEF) form shall include all the following data:

(a) The regulatory compliance mark specified in AS/NZS 4417.

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(b) A unique identifier for the connectable installation (e.g. a plant number, registration plate number, VIN).

(c) A description of the connectable installation (e.g. make, model and function).

(d) The name of the person requesting the WoEF.

(e) A statement that the WoEF is issued in accordance with the requirements of this Standard.

(f) The date of issue.

(g) The expiry date.

(h) The name and electrical licence number of the issuer.

(i) The issuer's signature.

NOTE 1 Supply leads that are detachable should be tagged to indicate the date they were tested, the date the next WoEF is due, and the unique identifier (ID) of the connectable installation for which they are to be used. A test tag as used for in-service testing in accordance with AS/NZS 3760, is deemed to be suitable for this purpose.

An example of a WoEF form is shown in Figure D.2.

NOTE 2 The Electricity (Safety) Regulations set requirements for issuing WoEF forms.

NOTE 3 WoEF forms (in duplicate) and stickers are available from the Electrical Workers Registration Board.

Warrant of Electrical Fitness (WoEF)

Client (person requesting the WoEF): _____

Details of connectable installation:

Unique ID _____

Registration plate number, VIN, plant number, or similar

Description _____

Make, model, function, etc

This WoEF is for:

☐ A transportable structure

☐ A recreational vehicle (RV)

☐ A non-recreational vehicle (non-RV)

☐ A mobile medical facility

The connectable installation identified above has been checked and tested in accordance with the requirements for issue of a Warrant of Electrical Fitness specified in AS/NZS 3001. If a mobile medical facility, it has also been checked and tested in accordance with the requirements of NZS 6115 for periodic verification of such facilities.

Date of issue: ____ / ____ / _____

This Warrant of Electrical Fitness will expire on: ____ / ____ / _____

Issuer's name: _____

Practising licence: _____

Signature: _____

WoEF sticker number: _____

Figure D.2 — Example of a warrant of electrical fitness form

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D.6.2.2 WoEF sticker

The WoEF sticker shall —

(a) be a minimum of 65 mm × 45 mm; and

(b) be sticky on the front, for attaching to the inside of windows; and

(c) use lettering and symbols that —

  (i) contrast with the background colour;

  (ii) are clearly legible; and

  (ii) are resistant to fading; and

(d) include all of the following data:

  (i) The regulatory compliance mark specified in AS/NZS 4417.

  (ii) A statement that the WoEF is issued in accordance with the requirements of the Electricity (Safety) Regulations 2010.

  (iii) The year of expiry in **bold numerals** that are a minimum of 10 mm high.

  (iv) A unique identifier for the connectable installation (e.g. a plant number, registration plate number, VIN).

  (v) The date of issue.

  (vi) The expiry date.

  (vii) The electrical licence number of the issuer.

The sticker may include other information, such as a serial number, and may have provision for punching out or otherwise clearly denoting the month of expiry.

NOTE To minimize fading, provision for recording items under Clause D.6.2.2 (iv), (v), (vi), and (vii) should be on the reverse (non-sticky) side.

An example of a WoEF sticker is shown in Figure D.3.

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Jan Feb Mar Apr May Jun

WARRANT OF ELECTRICAL FITNESS

Jul

WoEF issued in accordance with the Electricity (Safety) Regulations 2010.

Aug

WoEF is valid to the date marked below

Sep

2029

Serial number: 208736

Oct

Date of issue: / /

Nov

WoEF expiry date: / /

Dec

Issuer's Licence number:_____

ID of connectable installation:_____

Figure D.3 — Example of a warrant of electrical fitness sticker

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Appendix E
(normative)

Additional verification of connectable electrical installations manufactured outside Australia and New Zealand (New Zealand only)

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E.1 Introduction

E.1.1 General

New Zealand legislation uses the term "connectable installation" rather than "connectable electrical installations". For consistency with New Zealand legislative requirements, the term "connectable installation" is used in this appendix. NZ

E.1.2 Application

This appendix specifies the additional initial and periodic verification requirements before the issue of a WoEF, for connectable installations manufactured overseas (excluding Australia).

E.2 Initial verification for WoEF issue

E.2.1 General

Initial verification for issue of a WoEF shall be carried out as follows

(a) *Category 1* — For connectable installations claimed to comply with AS/NZS 3000 and this standard (AS/NZS 3001.2), see Clause E.3.

(b) *Category 2* — For connectable installations claimed to comply with the IEC 60364 series, in particular —

(i) IEC 60364-7-721 (caravans); or

(ii) IEC 60364-7-717 (non-caravan mobile units),

see Clause E.4.

(c) *Category 3* — For connectable installations claimed to comply with other standards, see Clause E.5.

NOTE 1 Attention is drawn to the statement in the introduction of IEC 60364-7-717 and IEC 60364-7-721 that these Standards supplement, modify or replace certain requirements of the general parts of IEC 60364 Parts 1 to 6.

NOTE 2 For recreational vehicles originating in the United Kingdom, BS 7671–721 is deemed to be equivalent to IEC 60364-7-721.

NOTE 3 See Figure E.1 for a sample checklist for verifying imported connectable installations.

E.2.2 Periodic verification

Periodic verification for issue of a WoEF shall be carried out in accordance with Appendix D in addition to sighting a certificate of initial verification.

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E.2.3 WoEF required before sale in New Zealand

An initial verification inspection should be carried out before the sale of a connectable installation that has not been previously issued with a WoEF. At the time of sale, the WoEF should be issued no longer than one month earlier.

E.3 Connectable installations claiming to be compliant with AS/NZS 3000 and this Standard

E.3.1 Initial verification in New Zealand

The connectable installation shall be inspected and tested in accordance with Clause 6.2.1 to verify compliance with those Standards.

If the connectable electrical installation is assessed to be fully compliant, a certificate shall be issued attesting compliance of the connectable installation. Such a certificate is deemed to be evidence of compliance with Part 1 of AS/NZS 3000 for purposes of periodic verification and issue of a WoEF.

An example of a certificate of initial verification is shown in Figure E.1.

NOTE 1 This certificate is a substitute for the Certificate of Compliance that would be required for a NZ-built connectable installation.

NOTE 2 A copy of this certificate should remain with the connectable installation for future reference.

E.3.2 Periodic verification

Provided a copy of the certificate referred to in Clause E.2.1 has been sighted, the connectable electrical installation may be inspected and tested in accordance with Appendix D only. No additional inspection and testing is required by this appendix.

E.4 Connectable installations claiming to be compliant with IEC or BS Standards

E.4.1 Evidence

E.4.1.1 Recreational vehicles

Recreational vehicles (RVs) shall have documented evidence of compliance with either of the following:

(a) IEC 60364-7-721:2007; or

(b) IEC 60364-7-721:2017; or

(c) a later edition of IEC 60364-7-721.

NOTE For recreational vehicles originating in the United Kingdom, BS 7671–721 is deemed to be equivalent to IEC 60364-7-721.

E.4.1.2 Other connectable installations

Other connectable installations shall have documented evidence of compliance with IEC 60364-7-717.

E.4.1.3 Evidence insufficient

Where evidence of compliance in accordance with Clause E.3 is absent or inadequate; the connectable installation shall be inspected and tested in accordance with Clause E.4.

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E.4.2 Initial verification

E.4.2.1 Recreational vehicles complying with IEC 60364-7-721

Recreational vehicles (RVs) complying with IEC 60364-7-721:2017 shall also comply with Clause E.3.

If the connectable installation is assessed as being fully compliant, a certificate of initial verification shall be issued attesting compliance of the connectable installation. An example of a certificate of initial verification is shown in Figure E.1.

NOTE A certificate of initial verification is deemed to be evidence of compliance with Part 1 of AS/NZS 3000 for the purposes of issuing a WoEF.

E.4.2.2 Mobile units complying with IEC 60364-7-717

Mobile units complying with IEC 60364-7-717 shall also comply with Clause E.3.

If the connectable installation is assessed as being fully compliant, a certificate of initial verification shall be issued attesting compliance of the connectable installation. An example of a certificate of initial verification is shown in Figure E.1.

NOTE A certificate of initial verification is deemed to be evidence of compliance with Part 1 of AS/NZS 3000 for purposes of issuing a WoEF.

E.4.3 Additional checks and tests

E.4.3.1 General

Live parts and basic insulation shall not be accessible without use of a tool.

NOTE 1 Attention is drawn to the common overseas practice of accessories and appliances being connected to wiring looms by detachable connections that permit access to live parts and/or basic insulation without need for use of a tool.

NOTE 2 Attention is drawn to the common overseas practice of installing flexible cables in accessible and/or exposed locations (e.g. within storage compartments and/or under floors) without providing additional protection against mechanical damage.

E.4.3.2 Mechanical damage

Wiring systems shall be suitably protected against mechanical damage.

NOTE Attention is drawn to the common overseas practice of installing flexible cables in accessible and/or exposed locations (e.g. within storage compartments and/or under floors) without providing additional protection against mechanical damage.

E.4.3.3 Protection against earth leakage current

All final subcircuits shall be protected against leakage current by one or more RCDs.

E.4.3.4 Socket-outlets

E.4.3.4.1 Low voltage

Low voltage socket-outlets shall comply with AS/NZS 3112, AS/NZS 3123 or IEC 60309-2.

Exception: Socket-outlets of the country of origin may remain for the connection of built-in appliances such as microwave ovens, electric hobs, refrigerators and the like.

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E.4.3.4.2 Extra-low voltage

Extra-low voltage socket-outlets shall be of a form not compatible with low voltage sockets.

E.4.3.5 Testing

E.4.3.5.1 General

Some connectable installations complying with IEC Standards include an indicator light for polarity of the incoming supply. Where such an indicator is connected between a live conductor (active or neutral) and earth, it may adversely affect the results of insulation testing. Such equipment may be disconnected while carrying out the test.

E.4.3.5.2 Appliances

The connectable installation shall not contain any appliances other than Class I or Class II.

NOTE Attention is drawn to the requirements for importers of appliances, including appliances installed in connectable installations, to provide evidence of the safety and compliance of those appliances.

E.5 Other connectable installations

E.5.1 General

This clause applies to connectable installations described in Clause E.1.2(d).

Such connectable installations shall comply with Part 1 of AS/NZS 3000. Matters requiring particular attention include, but are not limited to, those listed in Clause E.4.2.

NOTE Attention is drawn to the fact that this appendix is to be applied in conjunction with Appendix D. In some cases, in particular for connectable installations originally intended for use on 110 V 60 Hz supplies, achieving compliance will require substantial modification.

Such connectable installations, including directly-connected appliances, shall be checked in accordance with Clause E.4.2 and E.4.3, and tested in accordance with Clause E.4.3.5.

If the connectable installation is assessed as being fully compliant, a certificate of initial verification shall be issued attesting compliance of the connectable installation. An example of a certificate of initial verification is shown in Figure E.1.

E.5.2 Inspection

E.5.2.1 Voltage

E.5.2.1.1 Rating

All fittings of circuits intended to operate at standard low voltage (230 V) shall have a minimum voltage rating of 450 V.

NOTE 1 Wiring originally intended for use at 110 V is unlikely to be suitably rated for use at 230 V.

NOTE 2 Equipment rated for 220 V is not deemed suitable unless the voltage rating includes 230 V.

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E.5.2.1.2 Non-standard voltage

Circuits supplied at other voltages above extra-low voltage (e.g. 110 V) shall be supplied via a safety isolating transformer complying with AS/NZS 61558.2.6.

NOTE A safety isolating transformer provides fault protection by electrical separation. Attention is drawn to the need to maintain electrical separation between equipment supplied by the transformer and any earthed conductive parts of the connectable installation. Configurations including earthing of the secondary winding cannot provide fault protection by automatic disconnection of supply due to the inability of the transformer to provide sufficient fault current for correct operation of overcurrent protective devices.

E.5.2.1.3 Segregation of different voltages

Equipment operating at low voltage shall be separated from equipment operating at extra-low voltage by enclosure or barriers.

E.5.2.2 Frequency

Electrical equipment that is frequency-dependent shall be suitable for operation on 50 Hz.

NOTE Appliances incorporating motors designed to operate at other frequencies are unlikely to be suitable for operation at 50 Hz.

E.5.2.3 Protection against shock

Live parts and basic insulation shall not be accessible without use of a tool.

NOTE Attention is drawn to the common overseas practice of accessories and appliances being connected to wiring looms by detachable connections.

E.5.2.4 Control and protection

E.5.2.4.1 Switchboard

All low voltage circuit protective devices shall be located together in a readily accessible position.

E.5.2.4.2 Separated circuits

All control or protective devices for low voltage circuits supplied from an isolating transformer shall operate in all live conductors.

E.5.2.4.3 Semi-enclosed rewireable fuses

Semi-enclosed rewireable fuses shall not be installed.

E.5.2.4.4 Protection against earth leakage current

All low voltage final subcircuits, other than those supplied via a safety isolating transformer, shall be protected against leakage current by one or more RCDs.

E.5.2.5 Wiring systems

E.5.2.5.1 Identification of conductors

Conductors are identified as follows:

(a) Conductors with green or green/yellow insulation shall be used only as earthing conductors.

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(b) Active and neutral conductors shall be identified by colour at terminations in accordance with AS/NZS 3000.

E.5.2.5.2 Mechanical damage

Wiring systems shall be suitably protected against mechanical damage.

NOTE Attention is drawn to the common overseas practice of installing flexible cables in accessible and/or exposed locations (e.g. within storage compartments and/or under floors) without providing additional protection against mechanical damage.

E.5.2.5.3 Stranding

Conductors not adequately secured against vibration and other movement shall have a minimum of seven strands.

E.5.2.6 Socket-outlets

E.5.2.6.1 Low voltage

Low voltage socket-outlets shall comply with AS/NZS 3112, AS/NZS 3123, or IEC 60309-2.

E.5.2.6.2 Extra-low voltage

Extra-low voltage socket-outlets shall be of a form not compatible with low voltage sockets.

E.5.2.7 Appliances

The connectable installation shall not contain any appliances other than Class I or Class II.

NOTE Attention is drawn to the requirements for importers of appliances, including appliances installed in connectable installations, to provide evidence of the safety and compliance of those appliances.

E.5.3 Certification of conversion work

Where a connectable installation has been modified for operation at standard low voltage, a Certificate of Compliance (CoC) for the modification work shall be sighted before issuing a WoEF.

E.5.4 Testing

E.5.4.1 Isolating transformers

Isolating transformers shall be tested in accordance with AS/NZS 3760.

Appliances shall be tested in accordance with AS/NZS 5761.

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EXAMPLE CHECKLIST AND CERTIFICATE OF INTITIAL VERIFICATION OF IMPORTED CONNECTABLE INSTALLATION

Certificate of Initial Verification of Connectable Installation
This certificate should remain with the connectable installation

Client (person requesting the WoEF): _____

Date of Assessment: _____ / _____ / _____

Name of assessor: _____

Details of connectable installation:

Unique ID _____
Registration plate number, VIN, plant number, or similar

Description _____
Make, model, function, etc

Country of origin: _____

Type of connectable installation:

- ☐ A relocatable unit
- ☐ A recreational vehicle
- ☐ A non-recreational vehicle
- ☐ A mobile medical facility

Category of imported connectable installation (complying with Standards):

- ☐ AS/NZS 3000 and AS/NZS 3001.2
- ☐ IEC 60364 series, in particular IEC 60364-7-721 (caravans)
- ☐ IEC 60364-7-708 (non-caravan mobile units)
- ☐ Other standards: _____

Category 1 (AS/NZS) checks Clause E.2

I have inspected and tested the connectable installation and declare that it complies both with the relevant requirements of Part 2 of AS/NZS 3000 and with AS/NZS 3001.2

Signature _____ Practising Licence _____ Date ___ / ___ / _____

Proceed to inspection and testing (Appendix D) for issue of WoEF

Category 2 (IEC & BS) checks Clause E.3

☑ = *Pass* ☒ = *Fail* ⊟ = *Not applicable*

☐ **E.3.1** Evidence of compliance: Document sighted: _____

Complying with Standard: _____
(include edition number and date)

- ☐ **E.3.3.1** Live parts and basic insulation are not accessible without use of a tool.
- ☐ **E.3.3.2** Wiring systems are suitably protected against mechanical damage.
- ☐ **E.3.3.3** All final subcircuits are protected against leakage current by one or more RCDs.
- ☐ **E.3.3.4** Readily accessible low voltage socket-outlets comply with AS/NZS 3112, AS/NZS 3123, IEC 60309-2 or IEC 60884.1.

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☐ **E.3.3.5** Extra-low voltage socket-outlets are of a form not compatible with low voltage sockets.

☐ **E.3.3.5.1** **Appliances**

☐ The connectable installation does not contain any appliances other than Class I or Class II

☐ Directly-connected appliances pass AS/NZS 5761 inspection.

I have inspected and tested the connectable installation and declare that it complies with the requirements of AS/NZS 3001.2 for this category of connectable installation

Signature _____ Practising Licence _____ Date _____ / _____ / _____

Proceed to inspection and testing (Appendix D) for issue of WoEF

Category 3 checks (not IEC or AS/NZS) Clause E.4

☑ = *Pass* ☒ = *Fail* ⊟ = *Not applicable*

☐ **E.4.2.1.1** Voltage

☐ Low voltage wiring of SLV circuits has a minimum voltage rating of 450 V.

☐ All fittings of circuits intended to operate at SLV (230 V) rated for 230 V.

☐ Appliances directly-connected to SLV circuits are rated for 230 V.

☐ **E.4.2.1.2** Circuits supplied at other voltages above extra-low voltage (e.g. 110 V) are supplied via a safety isolating transformer. Utilisation voltage: _____ V.

AS/NZS 3000 Equipment operating at low voltage is:

☐ Separated from equipment operating at extra-low voltage by enclosure or barriers

☐ Insulated for the highest voltage present

☐ **E.4.2.2** Electrical equipment that is frequency-dependent is suitable for operation on 50 Hz

☐ **E.4.2.3** Live parts and basic insulation shall not be accessible without use of a tool.

☐ **E.4.2.4.1** All low voltage circuit protective devices are located together in a readily accessible position

☐ **E.4.2.4.2** All control or protective devices for low voltage circuits supplied from an isolating transformer operate in all live conductors.

☐ **E.4.2.4.3** No semi-enclosed rewireable fuses are installed.

☐ **E.4.2.4.4** All low voltage final subcircuits, other than those supplied via a safety isolating transformer, are protected against leakage current by one or more RCDs.

☐ **E.4.2.5.1** Identification of conductors

☐ Conductors with green or green/yellow insulation are used only as earthing conductors.

☐ Active and neutral conductors are identified by colour at terminations; in accordance with AS/NZS 3000.

☐ **E.4.2.5.2** Wiring systems are suitably protected against mechanical damage.

☐ **E.4.2.5.3** Conductors not adequately secured against vibration and other movement have a minimum of seven (7) strands.

☐ **E.4.2.6.1** Low voltage socket-outlets comply with AS/NZS 3112, AS/NZS 3123, IEC 60309-2 or IEC 60884.1.

☐ **E.4.2.6.2** Extra-low voltage socket-outlets are of a form not compatible with low voltage sockets.

☐ **E.4.2.7** The connectable installation does not contain any appliances other than Class I or Class II.

☐ **E.4.3** CoC for conversion work sighted _____

Issued by _____

Date _____ / _____ / _____

☐ **E.4.4.1** Isolating transformers tested in accordance with AS/NZS 3000.

I have inspected and tested the connectable installation and declare that it complies with the requirements of AS/NZS 3001.2 for this category of connectable installation

Signature _____ Practising Licence _____ Date _____ / _____ / _____

Proceed to inspection and testing (Appendix D) for issue of WoEF

Figure E.1 — Example checklist and certificate of imminent verification for verifying imported connectable installations (New Zealand only)

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Appendix F
(informative)

Example record of verification of recreational vehicle low voltage installation

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Where the verification assessment is to be recorded, a form such as the following shown in Figure F.1 may be used.

Record of verification of low voltage installation in recreational vehicle

(refer to AS/NZS 3000 and AS/NZS 3001.1)

Details of recreational vehicle:

Unique ID _____
Registration plate number, VIN, plant number, chassis number, or similar

Description _____
Make, model, function, etc

☑ = *Pass* ☒ = *Fail* ⊟ = *Not applicable*

Inspection

Connection to site supply (Clause 2.4) Number of connections _____ (see below)

Inlet

- ☐ 15 A AS/NZS 3120
- ☐ 20 A AS/NZS 3123
- ☐ 16 A IEC 60309-2

Inlet/connection point

- ☐ IP24 (both plugged in and detached; if applicable)
- ☐ Not in wet area zone (Clause 4.12)

If lead supplied:

Lead

- ☐ Non-detachable (Clause 2.4.3)
- ☐ Detachable (Clause 2.4.4)
- ☐ Securely anchored
- ☐ Strain relief of lead
- ☐ Provision for strain relief at inlet/locker
- ☐ Adequate lead storage
- ☐ Warning sign for coiled lead (Clause 2.5.4)

Length: _____ Cable Size _____ mm^2

- ☐ Complies with Table 2.1 (length vs size)
- ☐ Minimum *10 m*
  maximum lengths for 16 A: *1.5 mm^2, 25 m;* *2.5 mm^2, 40 m*

Plug (Clause 2.5)

- ☐ 16 A AS/NZS 3123
- ☐ 15 A AS/NZS 3112
- ☐ 16 A IEC 60309

Connector (Clause 2.5)

- ☐ 15 A AS/NZS 3120
- ☐ 20 A AS/NZS 3123
- ☐ 16 A IEC 60309
- ☐ matches inlet

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Wiring between inlet/lead connection and switchboard (Clause 4.7)

☐ All double insulated
☐ Strain relief for terminations

Control and Protection (Clause 4.5)

Main switches: ☐ For each source of supply

Overcurrent protection for supply fittings and lead

☐ Current limitation provided rating _____ A
☐ All live conductors [A]
☐ All active conductors [NZ]

Overcurrent protection for final subcircuits Number installed _____

☐ All protected against overcurrent

Switchboards (Clause 4.6)

Location

☐ All devices together OR ☐ Labelled to indicate other location(s)
☐ Accessible;
☐ Handy to entrance
☐ Suitably protected against moisture
  ☐ If external; IP55
☐ Not in bath/shower zone
☐ Not below 1.2 m, unless all live parts fully enclosed
☐ Not above cooker/water container, unless in cupboard or IP33
☐ 0.6 m space in front (if in cupboard, with cupboard door open)
  If in cupboard:
  ☐ In separate section;
  ☐ At front;
  ☐ Facing cupboard door;
  ☐ No space for storage of extraneous material;
  ☐ No obstructions to access.
☐ Cable entries sealed against fire
☐ Devices oriented in same manner (unless obvious)
☐ All equipment labelled as to function
☐ No rewirable fuses (for low voltage a.c. circuits)
☐ No unenclosed neutral connection/bar

Protection against earth leakage (Clause 4.5.4)

☐ All final subcircuits protected by RCD Number of RCDs _____
☐ RCDs operate in all live conductors
☐ Rating not greater than 30 mA
☐ Labelled as for Type A

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Alternative supplies installed (Clause 2.7) ☐ Yes ☐ N/A

☐ Generator Type (make/model) _____
Capacity _____ kVA
☐ Isolated output
☐ RCD-protected output

☐ Inverter Type (make/model) _____
Capacity _____ kVA
☐ Isolated output
☐ RCD-protected output

☐ UPS Type (make/model) _____
Capacity _____ kVA
☐ Isolated output
☐ RCD-protected output

Reverse polarity (transposition) sensor (Clause 2.6.4)

☐ **Not** required for onboard transformer or converter (including inverter) with polarised output
☐ **Not** required where isolation and control switches operate in all live conductors
☐ Interlocking type
☐ Auto-correction type

Phase sequence sensor (Clause 2.6.3)

☐ **Not** required if all multiphase equipment is safe regardless of phase rotation
☐ Device corrects phase rotation
☐ Device prevents operation on incorrect phase rotation

Wiring (Clause 4.7)

☐ Minimum 2.5 mm^2
☐ Minimum seven (7) strands
☐ Protected from damage
☐ Double insulation maintained
☐ Bushed where passing through metal framework
☐ Fixed in place (maximum 300 mm; 500 mm in enclosed space)
☐ Suitable for/segregated from polystyrene/polyurethane
☐ Low voltage and extra-low voltage not in common wiring enclosure; unless
☐ All low voltage conductors double insulated
☐ All conductors insulated for highest voltage present
☐ Low voltage cabling in separate compartment of wiring enclosure

Main protective earthing conductor(s) (Clause 4.11)

☐ Run directly from each inlet to switchboard
☐ Complies for current-carrying capacity (CCC) and minimum size

If multiple supplies either: ☐ Run directly between fittings
or ☐ Run directly between switchboards

If chassis or frame conductive:
☐ Run directly from switchboard to chassis/frame
☐ Connection to chassis/frame by 6 mm bolt/stud

☐ All MPECs and chassis connections protected from damage

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General

☐ No exposed live parts (refer to AS/NZS 3000)
☐ No exposed basic insulation protecting live parts (refer to AS/NZS 3000)

Equipment and accessories (Clause 4.8)

☐ Extra-low voltage and low voltage not on common plate
☐ If flush-fitted; no contact between single-insulated conductors and conductive parts of structure
☐ Switches all-active [A]
☐ Three-pin flat pin sockets used ONLY for 230 V 50 Hz.
Number installed: _____
☐ External: IP34 Number: _____
☐ Other external fittings: IP X4
(list) _____
☐ Not in cooker zone (Figure 4.4)

Appliances (Clause 4.9) (list) _____

☐ Controlled by switch; adjacent to or on appliance (unless dedicated circuit)
  ☐ Switches operate in all live conductors
  ☐ Switches operate in all live conductors (transposition sensor fitted)
  ☐ Switches not in cooker zone (Figure 4.4)
☐ Water heater cut-out operates on all live conductors [A]
through-roof air conditioner
  ☐ Connected by plug and socket

Gas equipment (Clause 4.10)

☐ **No** low voltage wiring/equipment within locker/zone
☐ **No** extra-low voltage wiring/equipment within locker/zone (except cut-off valve)
☐ Combined gas and electrical appliances have means of electrical isolation by:
  ☐ Plug and socket
  ☐ Isolating switch ☐ operating in all live conductors [A]
☐ 25 mm separation between wiring systems (low voltage and extra-low voltage) and gas pipes

Fittings in wet area zones (Clause 4.12)

Sockets: ☐ Not in Z0 or Z1
☐ in Z2: ☐ in cupboard or ☐ shaver

Switches and accessories: ☐ Not in Z0
☐ in Z1 or Z2: IPX4 and ☐ not below 0.3 m

Luminaires: ☐ Z0: specifically designed, IPX7 and extra-low voltage
☐ Z1: IPX4
☐ Z2: either ☐ IPX4 or ☐ Class II or extra-low voltage

Other: ☐ Z0: specifically designed, IPX7 and extra-low voltage
☐ Z1: IPX4
☐ Z2: IPX4

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Testing (Clause 7.2)

Earthing *max. value:* *As per AS/NZS 3000, Table 8.2 (R_e values)*

For 16 A C-curve protection: 0.6 ohms

Tested from: ☐ Supply lead plug pin
☐ Inlet plug pin

MPEC(s) ☐ for each supply, to every switchboard
☐ for each supply to chassis/frame

Items required to be earthed

☐ Exposed conductive parts of permanently connected Class I equipment
☐ Water heater ☐ Califont
☐ Room heater ☐ Cooker
☐ Fridge ☐ Microwave
☐ Other directly-connected Class I equipment _____
☐ Each low voltage socket-outlet
☐ Low voltage lighting points number: _____
☐ Body shell (if conductive)

Conductive parts within 100 mm of low voltage wiring including:

☐ Door and window frames
☐ Stoneguards
☐ Other: _____

Equipotential bonding *maximum value 0.5 ohms*

☐ Metallic piping (except gas)

Insulation resistance *minimum 1 MΩ*

Test at supply lead plug/inlet plugpins *Switch on all appliances before testing.*

☐ Tested at 500 V
☐ Tested at 250 V *
☐ Leakage test carried out *

(permitted if MOVs etc fitted in permanently connected equipment)*

Low voltage circuits

☐ Active and neutral to earth

If any 2-way switching, operate one switch and test again

Different voltage levels

☐ Active and neutral to each unearthed extra-low voltage circuit [isolated supplies]

Segregation from vehicle (road travel) wiring

☐ Active and neutral to each road travel circuit

Isolating transformer(s)

☐ Primary/secondary;
☐ Secondary/input earth;
☐ Secondary/output equipotential bond
☐ Secondary/each unearthed extra-low voltage circuit.

Multiple external supplies *minimum 1 MΩ*

☐ No interconnections: active(s) and neutral

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Polarity

Supply lead(s) ☐ Active(s), neutral and earth correct
Appliance coupler(s) ☐ Active(s), neutral and earth correct
Socket-outlets ☐ Active(s), neutral and earth
☐ (Multiphase) same rotation
Switches (including sockets) ☐ operate in all actives
☐ also operate in neutral
☐ unless transposition sensor fitted
Operation of transposition sensor(s)
Interlocking type: ☐ no supply unless polarity correct
☐ visual indication of incorrect polarity
Auto-correction type ☐ incorrect polarity corrected
Operation of phase rotation sensor(s)
☐ no supply unless phase rotation correct
☐ visual indication of incorrect polarity
Auto-correction type ☐ incorrect phase rotation corrected

Correct circuit connections

☐ Earthing conductors cannot carry normal load current
☐ No short circuit between different circuits

Alternative supply systems:

☐ Cannot back-feed to any external supply

Changeover switch(es):
☐ When any supply connected, all others are isolated (active and neutral)
☐ Break-before-make operation

Onboard genset/inverter (including inverter-charger):
☐ Isolated output: neutral connected to earth only when that source supplying
☐ RCD-protected output: neutral connected to earth of installation at all times

UPS:
☐ Complies with AS (IEC) 62040.1
Transformerless type: ☐ does not supply fixed wiring
Other type: ☐ supplies only circuits that have no other source
☐ circuits supplied have RCD protection
☐ operation of RCD on UPS source confirmed

Personal Protection

Operation of RCD(s) tested using either: ☐ Integral test device; or
☐ RCD tester
☐ RCDs operate on current imbalance
☐ When operated, all outgoing circuits isolated (active and neutral)

Date of Inspection ____ / ____ / _____ **Signed** _____

Figure F.1 — Example record of verification of recreational vehicle (RV) low voltage installation

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AS/NZS 60598.2.8, *Luminaires, Part 2.8: Particular requirements—Handlamps (IEC 60598-2-8, Ed. 3.0 (2013) MOD)*

ISO 13297, *Small craft — Electrical systems — Alternating and direct current installations*

IEC 60364-7-708, *Low-voltage electrical installations – Part 7-708: Requirements for special installations or locations – Caravan parks, camping parks and similar locations*

IEC 60479-1, *Effects of current on human beings and livestock, Part 1: General aspects*

IEC 61810-1, *Electromechanical elementary relays – Part 1: General and safety requirements*

Further reading

AS/NZS 3003, *Electrical installations—Patient areas*

AS/NZS 3004.2, *Electrical installations—Marinas and boats, Part 2: Boat installations*

AS/NZS 3199, *Approval and test specification — Cord extension sets*

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