

Australian/New Zealand Standard™

Electrical installations—Generating sets

AS/NZS 3010:2005

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 11 May 2005 and on behalf of the Council of Standards New Zealand on 20 May 2005. This Standard was published on 27 June 2005.

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Canterbury Manufacturers Association New Zealand
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Consumers' Federation of Australia
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Australian/New Zealand Standard™

Electrical installations—Generating sets

Originated as AS 3010.1—1987.
Revised and redesignated AS/NZS 3010:2005.

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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 3010.1—1987.

The objective of the Standard is to establish safety requirements for the use of generating sets for the supply of electricity at voltages normally exceeding 50 V a.c. or 120 V d.c.

Major changes to AS 3010.1—1987 are as follows:

- (a) The Standard has become a single Standard (i.e. without parts) as some types of generators listed in the previous preface such as—
 - (i) rotary converters;
 - (ii) static invertors;
 - (iii) hydro and wind driven generators; and
 - (iv) photovoltaic arraysmay be covered by other publications.
- (b) Switching of the normal supply neutral is not allowed for MEN earthing systems.
- (c) The inclusion of guidance connection drawings.
- (d) Changes of terminology to align with AS/NZS 3000.
- (e) It is published as a joint Australian/New Zealand Standard.

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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard**Electrical installations—Generating sets**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out the minimum safety requirements related to the use of generating sets for the supply of electricity at voltages normally exceeding 50 V a.c. or 120 V d.c.

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

This Standard does not—

- (a) set out performance and constructional requirements for generating sets; or
- (b) specifically apply to specialized automatic sources of supply, e.g. no-break systems or generating sets operated by Electricity Generating entities or Electricity Distributors; or
- (c) apply to uninterruptible power supplies; or
- (d) apply to other generation systems; such as:
 - (i) Inverters.
 - (ii) Photovoltaic arrays.
 - (iii) Water or wind driven.

NOTES:

- 1 While not intended to be applied to other than generating sets driven by internal combustion engines, the electrical principles could be applied to generating sets with other types of energy sources.
- 2 Requirements for the performance and construction of transportable generating sets up to 25 kW are given in AS 2790.
- 3 Requirements for the design, installation and operation of emergency power supplies in hospitals are given in AS/NZS 3009.
- 4 Requirements for the design, installation and operation of uninterruptible power supplies are given in the AS 62040 series of Standards.
- 5 Attention is drawn to the fact that some Regulatory Authorities have requirements for limitation of noise levels and pollution emissions.

1.2 APPLICATION

In addition to complying with this Standard, the generating set installation may be required to comply with requirements of Electricity Distributors and other relevant Regulatory Authorities. It is, therefore, recommended that these Authorities be consulted prior to the installation of equipment.

Section 2 outlines general requirements for the installation of generating sets. Sections 3 and 4 introduce additional requirements for permanently connected and plug and socket-outlet connected generating sets respectively.

1.3 REFERENCED DOCUMENTS

The following Standards are referred to in this Standard:

AS

- 1319 Safety signs for the occupational environment
- 1668 The use of ventilation and air-conditioning in buildings
- 1668.2 Part 2: Ventilation design for indoor air contaminant control
- 1940 The storage and handling of flammable and combustible liquids
- 2067 Switchgear assemblies and ancillary equipment for alternating voltages above 1 kV
- 2676 Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings (all parts)
- 2790 Electricity generating sets—Transportable (up to 25 kW)
- 4024 Safeguarding of machinery
- 4024.1 Part 1: General principles
- 62040 Uninterruptible power systems (UPS) (all parts)

AS/NZS

- 1768 Lightning protection
- 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)
- 3009 Electrical installations—Emergency power supplies in hospitals
- 3011 Electrical installations—Secondary batteries installed in buildings (all parts)
- 3947 Low-voltage switchgear and controlgear
- 3947.6.1 Part 6.1: Multiple function equipment—Automatic transfer switching equipment

1.4 DEFINITIONS

For the purposes of this Standard, the definitions given in AS/NZS 3000 and those below shall apply.

1.4.1 Generating set

An alternator, d.c. generator, or combination thereof, including any internal combustion engine and associated switchgear and controlgear.

1.4.2 Emergency supply system

A supply system used in case of failure of the normal supply, in order to maintain operation of the installation, or part thereof, for safety reasons.

1.4.3 Independent supply system

A supply system that forms the only source of supply to an electrical installation or load.

1.4.4 Standby supply system

A supply system used in case of failure of the normal supply in order to maintain normal operation of the electrical installation, or part thereof.

SECTION 2 GENERAL REQUIREMENTS FOR THE INSTALLATION OF GENERATING SETS

2.1 GENERAL

This Section gives general requirements for the location, protection, control and connection of generating sets. Additional requirements, relevant to permanently connected generating sets and plug and socket-outlet connected generating sets, are given in Sections 3 and 4 respectively.

2.2 LOCATION

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

In addition, generating sets shall not be installed—

- (a) in damp situations or exposed to the weather unless suitably protected; or
- (b) in hazardous areas, unless the equipment and method of installation complies with AS/NZS 3000 and the additional requirements of any relevant Regulatory Authority.

2.3 MECHANICAL AND THERMAL PROTECTION

2.3.1 Protection from mechanical damage

All components of a generating set including mechanical parts, fuel systems, wiring, switches, instruments and controls shall be adequately protected against mechanical damage.

2.3.2 Protection from moving parts

All moving parts that may cause injury to persons shall be protected by barriers to prevent unintentional personal contact with such parts. The protection shall be provided by guards, enclosures, railings or fences.

NOTES:

- 1 Regulatory Authorities may have additional requirements for the guarding of machinery.
- 2 Guidance on the protection from moving parts is provided in AS 4024.1.

2.3.3 Protection against thermal effects

All parts of a generating set which operate at temperatures in excess of 120°C shall be protected or positioned to prevent accidental personal contact.

NOTE: Guidance on temperature limits for electrical equipment is given in AS/NZS 3000.

2.3.4 Protection against fuel leakage

Any tanks or filling facilities associated with flammable fuels shall not be—

- (a) installed in the vicinity of high temperature surfaces or equipment that may emit arcs, sparks or hot particles; or
- (b) located in such a position that spilled or leaking fuel could fall on such high temperature surfaces or equipment.

NOTE: Attention is drawn to additional requirements that may be specified by relevant Regulatory Authorities. See AS 1940 for requirements affecting the storage and handling of flammable fuels.

2.4 CONTROL OF GENERATING SET

2.4.1 General

Adequate means shall be provided to control—

- (a) the sequence of operations necessary for the safe starting, running and shutting down of the generating set; and
- (b) the voltage and frequency of the generating set output supply; and
- (c) the speed of the prime mover.

2.4.2 Isolating devices

2.4.2.1 General

Every prime mover shall be provided with an isolating device, which may be a shutdown device, to prevent the starting of the generating set when inspection, repair or maintenance is being carried out.

NOTE: An emergency shutdown device may also be necessary under certain conditions.

2.4.2.2 Operation

The isolating device shall prevent the generating set being started by any automatic device or remote control switch.

Where a switch located in a control or starting circuit is used for this purpose, it shall disconnect all live conductors of the circuit.

2.4.2.3 Location

The isolating device shall be readily accessible to maintenance or other authorized personnel and be—

- (a) installed adjacent to or on the generating set so that a person operating the device has a clear view of any person working on the machine; or
- (b) provided with a means of securing the device in the isolated position that requires a deliberate action to engage or disengage it.

2.4.3 Synchronization

Where generating sets are to be synchronized with an Electricity Distributor's system, particular requirements should be obtained from the Electricity Distributor.

Where generating sets are to be synchronized with one another, consideration should be given to any particular requirements for control, protection and synchronization of such generating sets.

2.5 ELECTRICAL INSTALLATION

2.5.1 General

The electrical installation shall be in accordance with the appropriate requirements of AS/NZS 3000. Safety clearances for parts at high voltage are provided in AS 2067.

2.5.2 Overcurrent protection

All outgoing circuits from a generating set shall be provided with overcurrent protection at the generating set, except where an alternative position, or the omission of overcurrent protective devices, is permitted by AS/NZS 3000.

2.5.3 Isolation from the normal supply system

In general, all generating sets shall be connected to the electrical installation in such a manner that they remain isolated from the normal supply system.

Where it is intended that a generating set will operate in parallel with the normal supply, approval from the relevant authorities should be obtained.

NOTE: Requirements for operating a generating set in parallel with the normal supply are not provided in this Standard.

2.5.4 Principles of connection to an installation

Where a changeover device is installed, the following principles of connection shall apply:

- (a) The neutral-earth connection shall be made in the installation.
NOTE: This may require disconnection of any winding to frame links within the generator.
- (b) The neutral-earth connection shall be made at the switchboard to which the generator is connected.
- (c) The incoming neutral to main/MEN switchboard shall not be switched.
- (d) Neutral and earth conductors shall not operate in parallel, except as specified in Item (e).
- (e) When operating under generator supply, in accordance with Figures 2.4 or 2.8, neutral and earth conductors may be operated in parallel provided that:
 - (i) Earth conductors are not overloaded by current sharing.
 - (ii) Neutral and earth conductors are individually suitable for the maximum calculated fault current.
 - (iii) The nominal size of copper earthing conductors complies with the requirements of AS/NZS 3000.
 - (iv) The current-carrying capacity of neutral conductors shall be not less than that of their associated active conductor.
- (f) Unless otherwise specified, the changeover device shall be designed to prevent backfeed.
- (g) The changeover device shall be selected to maintain the function of and prevent damage to the electrical installation being supplied.

NOTE: Examples of functions to be maintained include the overlapping of neutrals, the operation of residual current devices or the continued operation of uninterruptible power supplies.

2.5.5 Changeover facilities

2.5.5.1 General

Where a generating set is to be run as an emergency or standby supply system in the case of failure of the normal supply system, one or more changeover devices shall be provided complying with the requirements of Clauses 2.5.5.2 to 2.5.5.8.

NOTE: Automatic transfer switches complying with the relevant requirements of AS/NZS 3947.6.1 may comply with these requirements.

2.5.5.2 Operation

- (a) *General* Changeover devices shall interrupt one source of supply before connecting the other source of supply.
- (b) *Active switching* Changeover devices shall operate in all active conductors.
- (c) *Neutral switching* Where the MEN system of earthing is used, changeover devices shall not operate in the neutral conductor of the normal supply at the switchboard where the MEN link is provided.

Changeover devices may, however, operate in the neutral conductor of normal supply of a switchboard where there is no MEN link, and a connection exists between the neutral and earth on the generator supply, as shown in Figures 2.8 and 2.9.

A switched neutral pole of a changeover device shall break not before, and shall make not after, the other poles. If a pole having an appropriate short-circuit breaking and making capacity is used as a neutral pole, then all poles, including the neutral pole, may operate substantially together.

- (d) *Earthing conductor switching* Changeover devices shall not operate in any earthing conductor.

NOTE: Examples of changeover arrangements are shown in Figures 2.1 to 2.9.

2.5.5.3 Interlocking

Changeover devices shall incorporate a mechanical interlock to prevent the simultaneous connection of the generating set system and the normal supply system.

2.5.5.4 Changeover device with intermediate 'off' position

A permanently connected changeover device having an intermediate 'off' position may be used in place of a main switch or a switch controlling submains or final subcircuits or an individual final subcircuit, such that supply may be obtained from either of two sources and isolated from both. Such a device may also be connected as in Clause 2.5.5.5.

NOTE: Changeover devices having an intermediate 'off' position would normally be used for manual operation only.

2.5.5.5 Changeover device without an intermediate 'off' position

A permanently connected changeover device or contactor having no intermediate 'off' position shall be connected in one of the following ways, such that supply may be obtained from either of two sources:

- (a) Ahead of a main switch, (see Figure 2.1(a)).
- (b) Ahead of switch(es) controlling a submain(s) or final subcircuit(s), (see Figure 2.1(b)).
- (c) Ahead of a switch controlling an individual final subcircuit (see Figure 2.1(c)).

NOTE: Figure 2.1 is only intended to show the location of changeover devices relevant to other switches for the purpose of this clause.

2.5.5.6 Rating

Changeover devices shall have a voltage rating appropriate to the maximum out-of-phase voltage between contacts connected to the different sources of supply.

2.5.5.7 Access

Changeover devices should be accessible only to authorized persons.

2.5.5.8 Identification

Changeover devices shall be marked to indicate the purpose and switching positions of the device. Terminals of changeover devices shall also be provided with a notice to indicate the sources of supply.

Where the operation of a changeover device automatically brings into service an alternative supply, the purpose of the device shall be marked accordingly.

2.5.5.9 Automatic changeover to normal supply

Where an automatic changeover device is provided, it shall operate to transfer loads back to normal supply after the voltage and frequency of the normal supply have been maintained at normal levels on all phases for a specified period, except that in the case of failure of the

generating set supply, the transfer shall occur without delay, provided normal supply is available.

NOTES:

- 1 The specified period is usually controlled by an adjustable delay of between 1 min and 30 min. Typically, the delay selected is 15 min.
- 2 A further delay period prior to shutting down the generating set may be necessary to allow adequate cooling of particular engines.

2.5.5.10 *Three pole/three pole changeover devices*

A three pole/three pole changeover device may be used to connect a generating set at a switchboard.

Where a three pole/three pole changeover device is used, the generating set neutral and earth conductors shall be connected as shown in Figures 2.2 or 2.4.

A three pole/three pole changeover device shall be used where an Earth Sheath Return (ESR) system is used as shown in Figure 2.4.

NOTES:

- 1 A one pole/one pole changeover device may be used for the connection of a single-phase (other than centre-tapped type) generating set as shown in Figure 2.5.
- 2 A two pole/two pole changeover device may be used for the connection of a two-phase 120° generating set as shown in Figure 2.6.
- 3 A two pole/two pole changeover device may be used for the connection of a single-phase center-tapped generating set as shown in Figure 2.7.

2.5.5.11 *Three pole/four pole changeover devices*

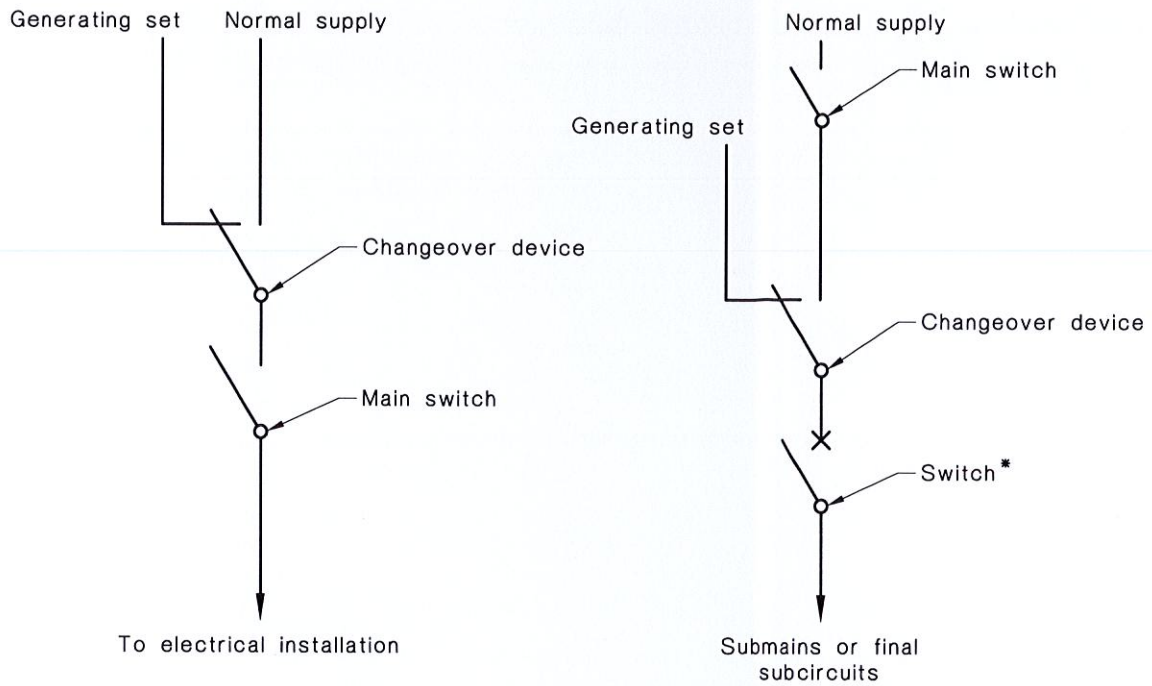
A three pole/four pole changeover device may be used to connect a generating set at a switchboard.

Where a three pole/four pole changeover device is used, the generating set neutral and earth conductors shall be connected as shown in Figures 2.3 or 2.8.

2.5.5.12 *Four pole/four pole changeover device*

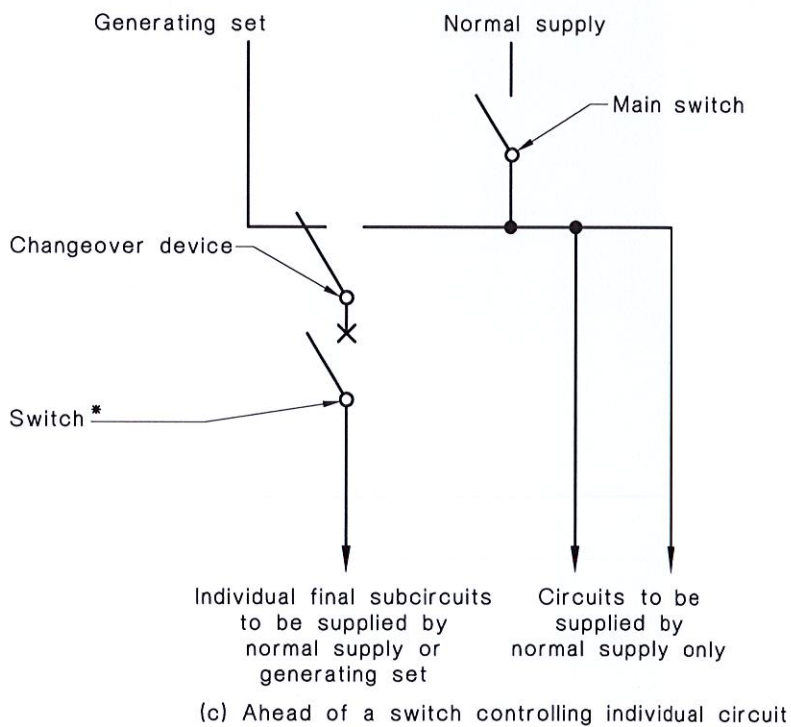
A four pole/four pole changeover device may be used to connect a generating set at a switchboard.

Where a four pole/four pole changeover device is used, the generating set neutral and earth conductors shall be connected as shown in Figure 2.9.



(a) Ahead of main switch

(b) Ahead of switch(es) controlling submain(s) or final subcircuit(s)








(c) Ahead of a switch controlling individual circuit

* May also be a circuit-breaker or switch fuse

FIGURE 2.1 LOCATION OF CHANGEOVER DEVICE WITHOUT AN INTERMEDIATE 'OFF' POSITION

TABLE 2.1
KEY TO SYMBOLS IN FIGURES 2.2 TO 2.9 AND 4.1 TO 4.3

| SYMBOL | DESCRIPTION |
|---|---|
| E | Earth conductor |
| E-BAR | Earth bar or connection point |
| EE | Earth electrode |
| L or L1, L2, L3 | Supply Active Phases |
| MEN | MEN link |
| N | Neutral conductor |
| N-BAR | Neutral bar or connection point |
|  | Neutral conductor |
|  | Protective earth conductor |
|  | Combined protective earth and neutral conductor |
|  | Frame or chassis |
|  | Interlock |

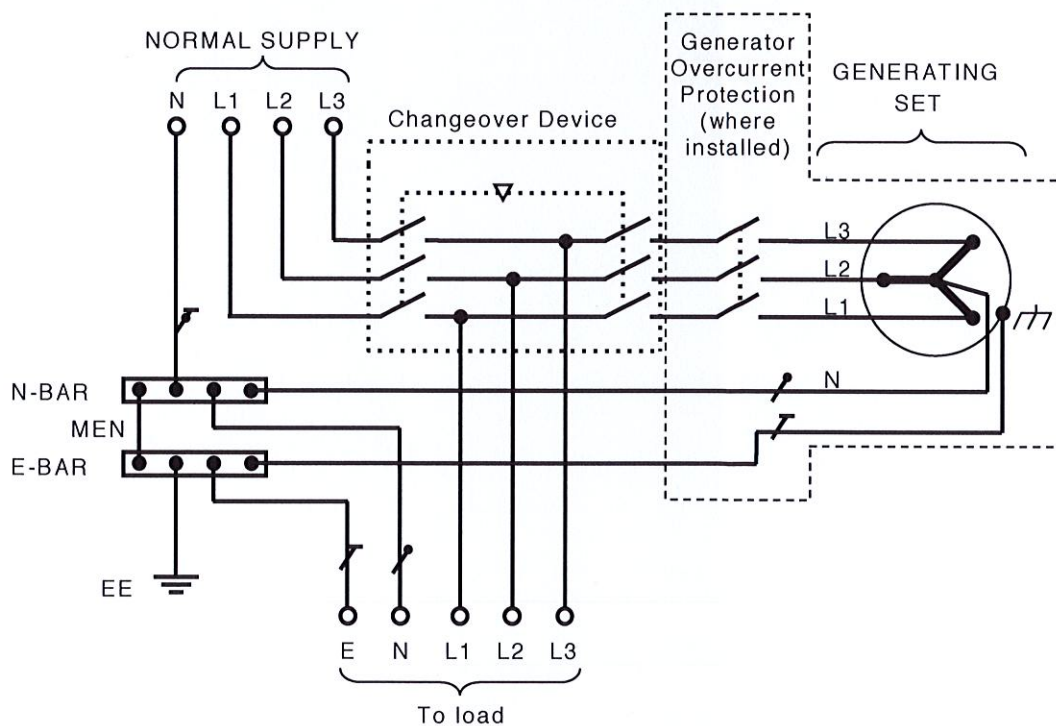


FIGURE 2.2 THREE POLE/THREE POLE CHANGEOVER ARRANGEMENT FOR A THREE-PHASE GENERATING SET INSTALLED ON A SWITCHBOARD WITH AN MEN LINK

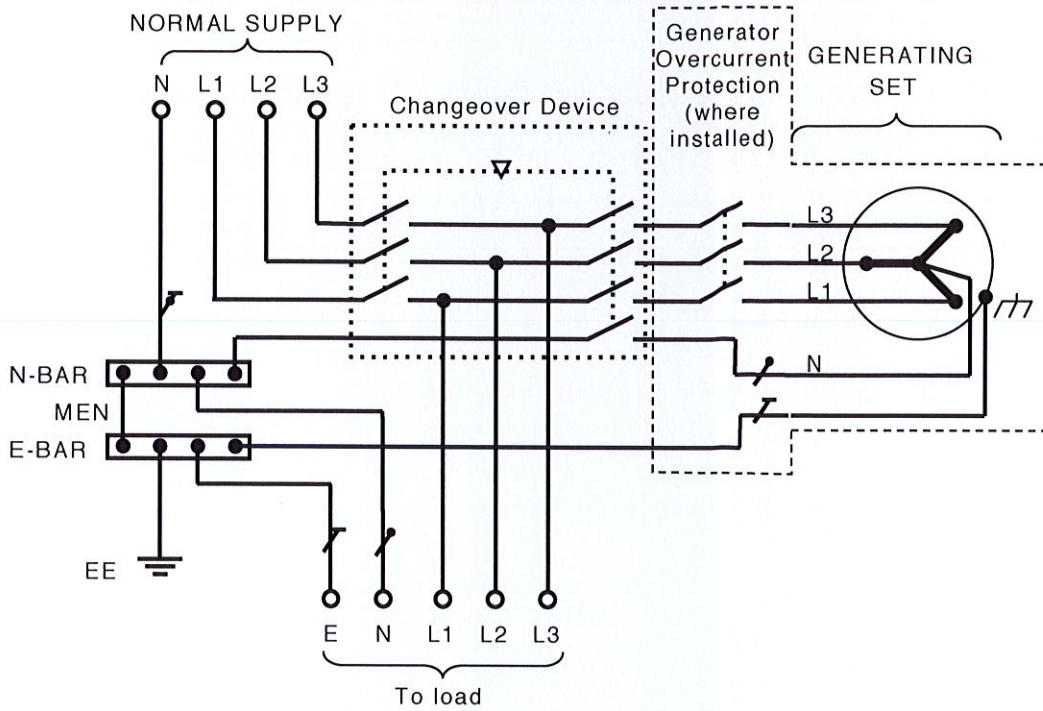


FIGURE 2.3 THREE POLE/FOUR POLE CHANGEOVER ARRANGEMENT FOR A THREE-PHASE GENERATING SET INSTALLED ON A SWITCHBOARD WITH AN MEN LINK

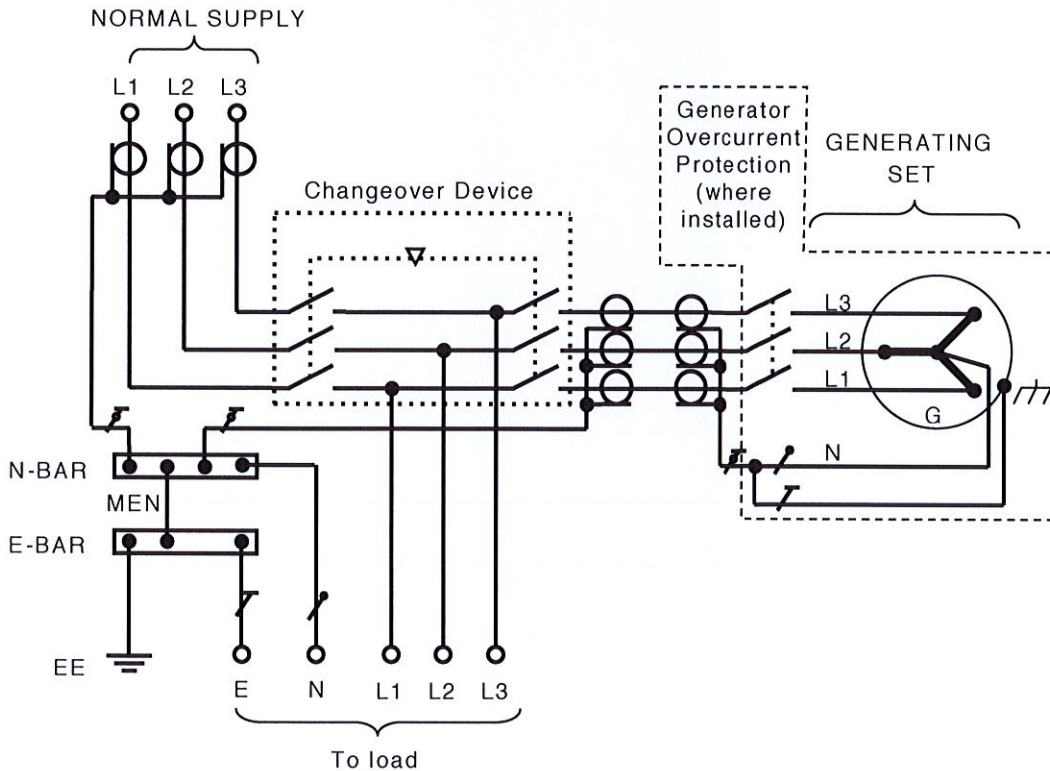


FIGURE 2.4 THREE POLE/THREE POLE CHANGEOVER ARRANGEMENT FOR A THREE-PHASE GENERATING SET INSTALLED WITH AN EARTH SHEATH RETURN SYSTEM

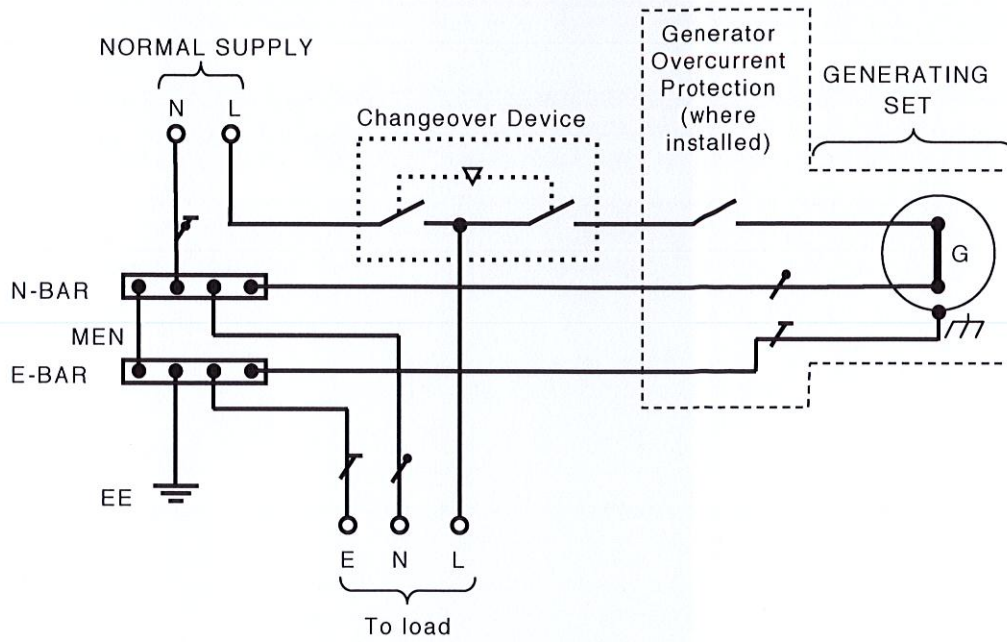


FIGURE 2.5 ONE POLE/ONE POLE CHANGEOVER ARRANGEMENT FOR A SINGLE-PHASE GENERATING SET INSTALLED ON A SWITCHBOARD WITH AN MEN LINK

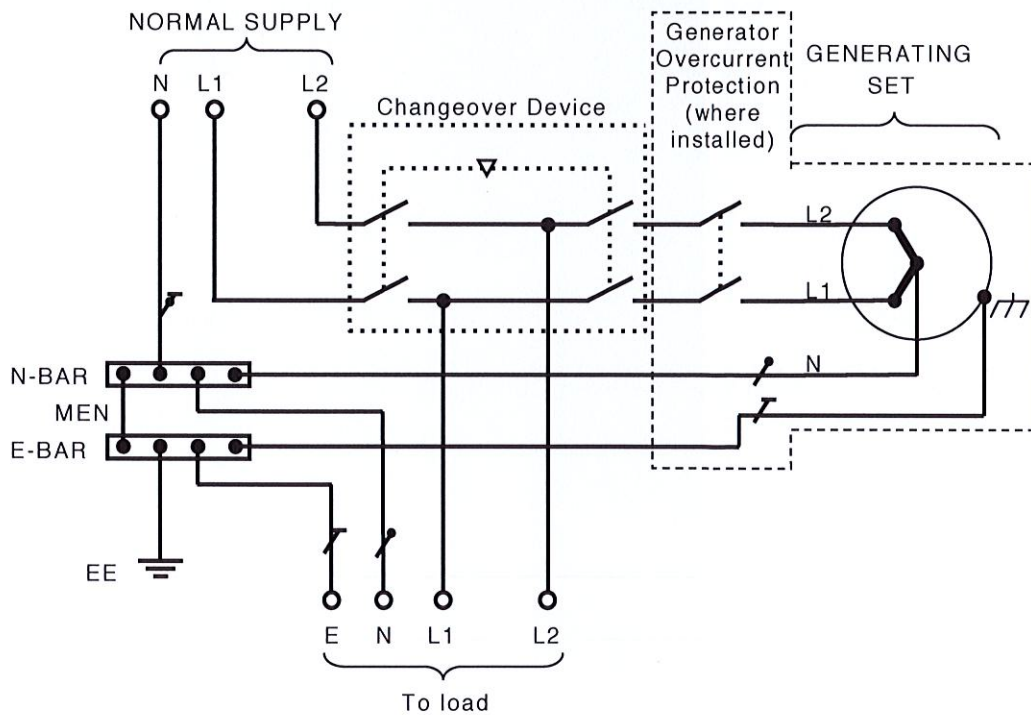


FIGURE 2.6 TWO POLE/TWO POLE CHANGEOVER ARRANGEMENT FOR A TWO-PHASE 120° GENERATING SET INSTALLED ON A SWITCHBOARD WITH AN MEN LINK

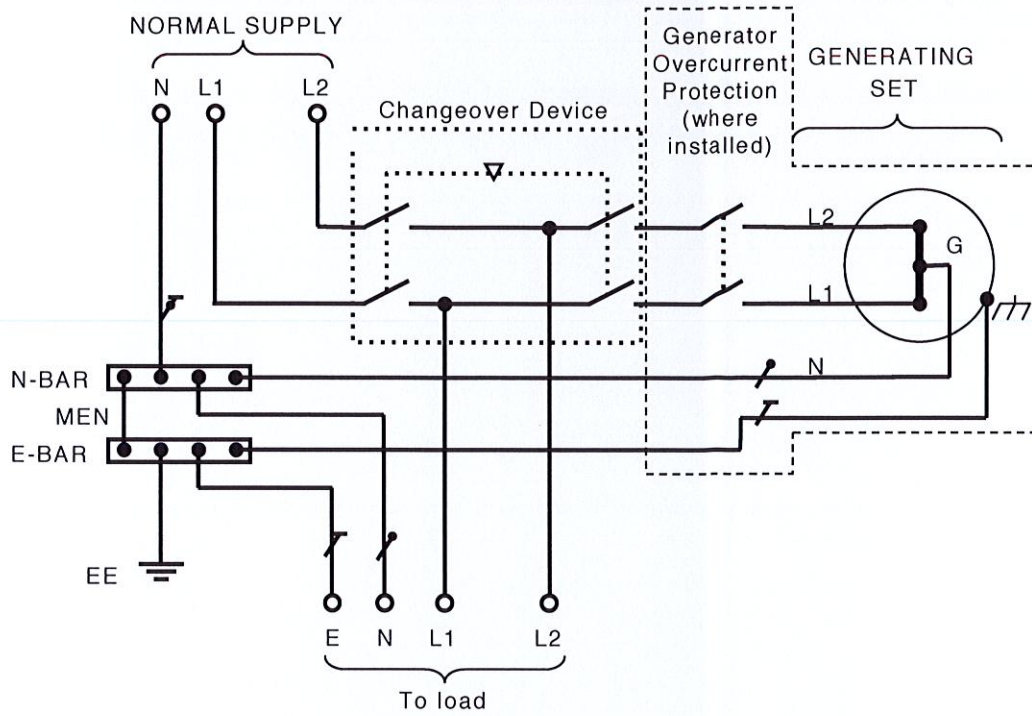
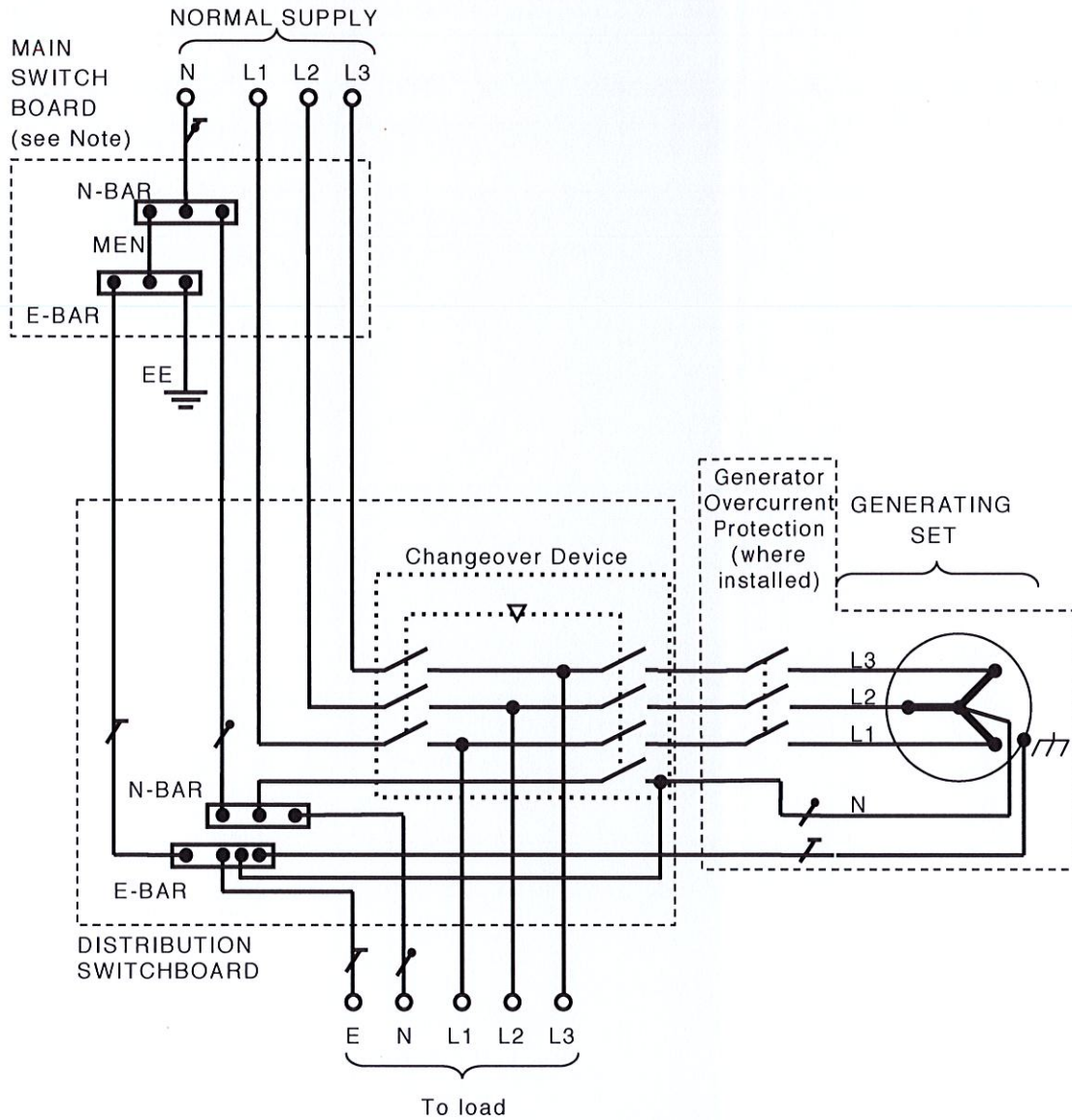


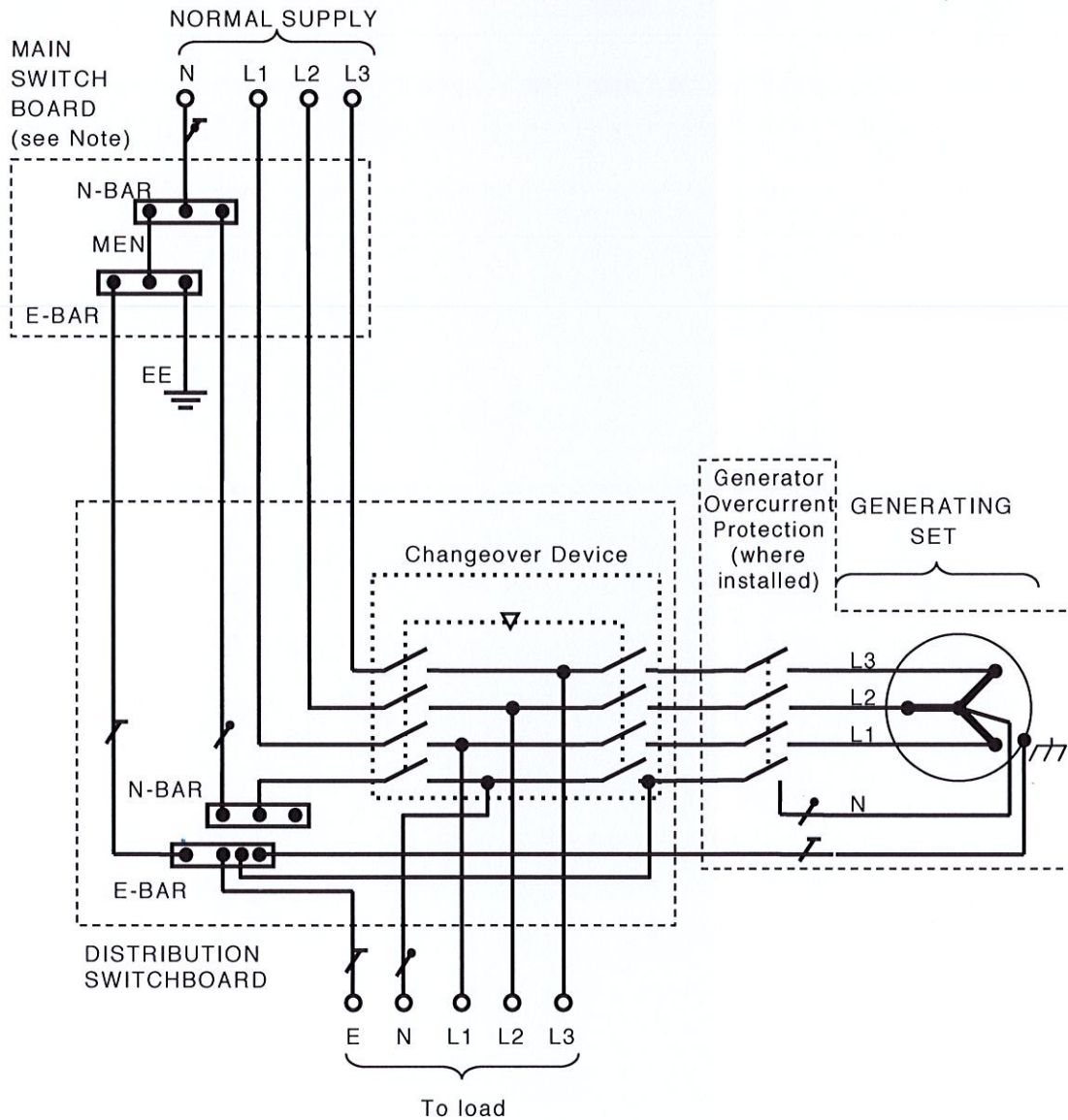
FIGURE 2.7 TWO POLE/TWO POLE CHANGEOVER ARRANGEMENT FOR A SINGLE-PHASE CENTRE-TAPPED GENERATING SET INSTALLED ON A SWITCHBOARD WITH AN MEN LINK



NOTES:

- 1 For guidance on the sizing of the neutral and earth conductors, see Clause 2.5.4(e).
- 2 The generator and normal supply should both be isolated when undertaking repair or maintenance of the main switchboard.

FIGURE 2.8 THREE POLE/FOUR POLE CHANGEOVER ARRANGEMENT FOR A THREE-PHASE GENERATING SET INSTALLED ON A SWITCHBOARD WITHOUT AN MEN LINK



NOTES:

- 1 For guidance on the sizing of the neutral and earth conductors, see Clause 2.5.4(e).
- 2 The generator and normal supply should both be isolated when undertaking repair or maintenance of the main switchboard.

FIGURE 2.9 FOUR POLE/FOUR POLE CHANGEOVER ARRANGEMENT FOR A THREE-PHASE GENERATING SET INSTALLED ON A SWITCHBOARD WITHOUT AN MEN LINK

2.5.6 Earthing and bonding

2.5.6.1 Generating set bonding system

The following parts of the generating set shall be electrically bonded together to form the generating set bonding system:

- (a) The engine frame.
- (b) The generator frame.
- (c) All exposed conductive parts enclosing electrical equipment or wiring.
- (d) The 'earth' terminals of any socket-outlets.

- (e) The frame connection.
(marked \perp or 'FRAME').

2.5.6.2 *Generating set windings*

2.5.6.2.1 *Multiphase and single-phase centre-tapped generating sets*

In general, the following points of the generating set windings, where appropriate, shall be connected to the generating set bonding system:

- (a) The neutral or star point of a three-phase winding.
- (b) The neutral point of a two-phase winding.
- (c) The centre-point of a single-phase centre-tapped winding.

This requirement shall not apply where, in accordance with Clause 2.5.6.3.2 (a), the above points are connected to the earthing system of an electrical installation.

NOTE: The generating set may be fitted with a removable link for the purpose of disconnecting the points in Items (a) to (c) from other bonded parts.

2.5.6.2.2 *Single-phase (other than centre-tapped) generating sets*

In general, no point of a single-phase winding, other than the centre-tapped type referred to in Clause 2.5.6.2.1(c), shall be connected to the generating set bonding system.

This requirement shall not apply where a generating set supplies one or more items of electrical equipment—

- (a) by individual attachment; or
- (b) as a part of an electrical installation that does not incorporate an earthing system;

and the connection is required for a protection system that ensures the disconnection of the electrical installation, or the individually attached appliances, as appropriate, in the event of an earth fault.

NOTE: The generating set may be fitted with a removable link for the purpose of disconnecting the points of the winding from other bonded parts.

2.5.6.3 *Generating sets used with electrical installations with an earthing system*

2.5.6.3.1 *Connection of generating set bonding system*

Where a generating set supplies an electrical installation that incorporates an earthing system, the bonding system of the generating set (see Clause 2.5.6.1) shall be earthed by connection to the earthing system of the electrical installation.

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

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

2.5.6.3.2 *Connection of generating set windings*

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

- (a) The generating set winding connections referred to in Clauses 2.5.6.2.1(a), (b) and (c).
- (b) One side of an otherwise unpolarized single-phase generating set winding.

Alternatively, the generating set windings referred to in Items (a) and (b) above may be arranged through a protection system in a manner that ensures the disconnection of the electrical installation in the event of an earth fault.

2.5.6.4 *Generating set used with other arrangements*

Where a generating set supplies one or more items of electrical equipment—

- (a) by individual attachment; or
- (b) as a part of an electrical installation that does not incorporate an earthing system;

the exposed conductive parts of each item of equipment being supplied shall be effectively connected to the generating set bonding system described in Clause 2.5.6.1.

2.5.7 **Switchboards**

2.5.7.1 *Arrangement of equipment*

Switchboards for the control of a generating set or its outgoing circuits, in addition to complying with AS/NZS 3000, shall be equipped with such instruments, relays and control equipment as may be necessary for safe and correct operation. All starting and shutdown devices, isolating switches, changeover devices and other devices that may require reading or adjustment, shall be accessible.

2.5.8 **Switchgear**

2.5.8.1 *Rating*

Switches, circuit-breakers, fuses, contactors, reclosers and other switchgear shall be selected with appropriate regard to the rated values of voltage, service duty and continuous and instantaneous current of the circuits on which they are installed.

All protective devices shall be capable of safely interrupting the prospective short-circuit current at the point where the devices are installed.

All switchgear used to break load current shall be marked with the rated breaking and making current capacity of the device. Switches that are not rated to interrupt the full-load current of the circuit shall be interlocked with load-breaking devices to prevent the possibility of the switches being opened under load.

2.5.8.2 *Provisions for securing isolating devices*

Where isolating devices are installed in accordance with Clause 2.4.2.3(b), means shall be provided to secure the device in the open position.

Where the accidental opening of devices may cause a hazard, similar means are recommended for retaining the device in the closed position.

NOTE: This recommendation may apply to manual changeover switches or some switches associated with the security of supply to emergency systems.

2.5.8.3 *Indication of switch position*

Where any equipment or circuit that operates at greater than extra-low voltage could be required to be worked on while activated, an isolating switch shall be provided in each unearthed conductor supplying the equipment. Such switches shall be of the visible-break type or be marked or provided with a device to indicate clearly whether the switch is open or closed. In addition means shall be provided for securing the device in the open position.

Where withdrawable switchgear equipment is used, the withdrawn position of the switchgear, where clearly indicated, constitutes a visible break for this purpose.

NOTE: Provision for protective earthing of equipment during repair or maintenance is recommended. See Clause 3.4 for the requirements for high voltage generating sets.

2.5.8.4 High voltage switchgear containing liquid dielectrics

Circuit interrupting devices containing liquid dielectrics shall be adequately segregated from other equipment and buildings to limit damage in the event of an explosion or fire. Segregation may be provided by spacing, by fire-resistant barrier walls or by metal cubicles. Gas relief vents should be equipped with oil-separating devices or piped to a safe location. Means should be provided to contain discharges from vents or tank rupture.

NOTE: Guidance on the containment of discharges by absorption beds, curbed areas, pits, drains, or by any combination of these is provided in AS/NZS 3000.

2.5.9 Starting batteries and battery charging

Batteries associated with prime movers shall be suitable for continuous float charging and the starting duty of the generating set.

The charging of batteries is to be effected by—

- (a) the generating set when it is operating; or
- (b) the normal or other supply in an emergency or standby supply system when the generating set is not operating.

NOTES:

- 1 Suitable batteries include the lead-acid and nickel-cadmium type.
- 2 Attention is drawn to the additional requirements for batteries for emergency supply systems in other Australian Standards.
- 3 Attention is drawn to the provisions of the AS 2676 series and AS/NZS 3011 series for the installation and maintenance of batteries.

2.5.10 Lightning protection systems

Depending on the geographical location, it may be necessary to protect equipment against lightning or excessive overvoltages. Where employed, lightning protection shall be located as close as practicable to the equipment it protects.

NOTE: Information on the protection of equipment against lightning is contained in AS/NZS 1768.

SECTION 3 ADDITIONAL REQUIREMENTS FOR PERMANENTLY CONNECTED GENERATING SETS

3.1 GENERAL

This Section gives particular requirements for generating sets that are permanently connected to electrical installations, specific equipment or services. These provisions are to be applied in addition to the general requirements for generating sets given in Section 2 of this Standard.

3.2 LOCATION

3.2.1 General

Permanently connected generating sets shall be located and installed in accordance with Clause 2.2 and, in addition, means shall be provided to prevent the entrance of, or interference by, unauthorized persons by the erection of suitable fences, screens, partitions, walls or similar barriers. Such barriers shall not impede the access required for authorized persons for maintenance, testing or inspection as provided in Clause 3.2.2.

This shall not preclude the installation of a generating set in an enclosure or room with other equipment for which access is similarly restricted to authorized persons.

3.2.2 Access space for generating sets

Adequate space shall be provided around a generating set on all sides where persons are to pass, to enable all equipment to be safely and effectively operated and adjusted.

NOTE: Attention is drawn to additional requirements that may be specified by relevant Regulatory Authorities.

3.2.3 Exit from generating set area

3.2.3.1 General

Where a permanently connected generating set is installed in a room or enclosure the requirements of Clauses 3.2.3.2 to 3.2.3.4 shall apply.

3.2.3.2 Number of openings

At least one door or opening shall be provided to enable a person to leave the vicinity of a generating set. However, where any generating set—

- (a) has a rated output exceeding 25 kVA; or
- (b) is driven by a petrol engine;

not less than two openings or doorways, spaced well apart, shall be provided.

3.2.3.3 Opening and locking of doors

All barriers or doors provided to prevent the entry of unauthorized persons to any room or enclosure containing a generating set shall open outwards away from the generating set without the use, on the generating set side of the door, of a key or tool and shall be capable of being locked from the outside.

3.2.3.4 Size of doors and openings

Doors and openings providing entrance to and exit from a generating set area shall have a height of not less than 1.98 m from the floor or walked-on surface and a width of not less than 0.75 m.

3.2.4 Ventilation

Any room or enclosure containing a permanently connected generating set shall be adequately ventilated so that—

- (a) the room or enclosure temperature rise, associated with the running of the generating set, is limited to 10°C; and
- (b) dangerous concentrations of toxic or explosive fumes and gases are prevented.

NOTE: See AS 1668.2 for the ventilation requirements associated with such equipment.

3.2.5 Lighting

Adequate lighting shall be provided to enable equipment and controls to be effectively and safely operated.

3.3 GUARDING OF LIVE PARTS

3.3.1 General

In addition to complying with the general requirements of Clause 2.4, the requirements of Clause 3.3.2 and 3.3.3 shall apply to permanently connected generating sets.

3.3.2 Walked-on surfaces

Walked-on surfaces that are located above exposed live parts shall have no openings. Kickboards at least 0.15 m high and handrails shall be provided at all edges of the walked-on surfaces.

3.3.3 Outdoor locations

Exposed live parts in outdoor locations shall be enclosed by security fences or walls not less than 2.5 m high and provided with danger notices complying with the provisions for outdoor substations in AS 1319.

3.4 EARTHING OF HIGH VOLTAGE GENERATING SETS

A combined earthing system shall be used for both high voltage and low voltage systems as shown for substation earthing arrangements in AS/NZS 3000.

Where it is necessary to perform maintenance or repairs on electrical equipment operating at high voltage and such equipment is only separated from the source of supply by a switch or switches, means for earthing shall be provided. Such means may include connection facilities for a portable earthing conductor, a switch or link arrangement that connects the equipment to an earthing conductor, or similar means.

3.5 TRANSFORMERS

3.5.1 Transformers and substations

Transformers and substations shall be installed in accordance with the relevant requirements of AS/NZS 3000.

3.5.2 Earthing

Transformer tanks and enclosures shall be earthed in accordance with the requirements of AS/NZS 3000.

3.5.3 Instrument transformers

The secondary circuits of instrument transformers shall be effectively earthed except where functional requirements do not permit earthing of such circuits.

Current transformers shall have provision for short-circuiting the secondary winding.

3.6 ADDITIONAL REQUIREMENTS FOR GENERATING SETS FOR EMERGENCY SUPPLY SYSTEMS AND ESSENTIAL SAFETY SERVICES

3.6.1 General

Generating sets providing an emergency supply system to ensure the continuation of the electrical supply to emergency systems (such as fire and smoke control equipment, evacuation equipment, and lifts as outlined in AS/NZS 3000), life preserving equipment, airport safety equipment, airport traffic control and other essential safety services shall comply with the additional requirements of Clauses 3.6.2 to 3.6.7.

NOTE: Whether an emergency supply system is required for any electrical installation or equipment is outside the scope of this Standard.

3.6.2 Type

The emergency generating set, its auxiliaries and associated equipment shall comply with the following requirements:

- (a) Where required, be capable of maintaining an adequate supply for a period sufficient to enable the evacuation of all persons to an area of safety.
- (b) Be provided with sufficient fuel for the running of the generating set long enough to satisfy the immediate emergency purpose.
- (c) Be provided with protection ensuring fire resistance for an adequate duration either by construction or installation.
- (d) Be permanently connected to the electrical installation.
- (e) Not be adversely affected by the failure of the normal supply.
- (f) Not be used for purposes other than the supply of emergency systems or essential safety services except as permitted in Clause 3.6.5.

NOTE: The consequences of extended losses of normal supply may also have to be taken into consideration.

3.6.3 Overcurrent protection

Overcurrent protective devices shall be selected and installed to avoid an overcurrent in one circuit impairing the correct operation of other circuits.

3.6.4 Paralleling sources of supply

Sources of supply not intended to be connected and operated in parallel shall be prevented from being so connected, e.g. by switching or mechanical interlocks.

3.6.5 Supply of other than emergency systems or essential safety services

A single generating set shall not be used for purposes other than the supply of emergency systems or essential safety services described in Clause 3.6.1 unless suitable precautions are taken to ensure that the supply to the emergency systems or essential safety services will not be affected by the additional loading under any conditions of operation.

Where more than one emergency supply system provides a source of supply, such sources may be used for the supply of other than emergency systems or essential safety services provided that, in the event of failure of one source, the supply remaining available will be sufficient for the operation of all emergency systems or essential safety services.

NOTE: This requirement generally necessitates the automatic load-shedding of circuits not supplying emergency systems or essential safety services.

3.6.6 Automatic changeover to an emergency supply system

The time taken for automatic changeover to an emergency supply system shall not be greater than that permitted by safety considerations for the type of load supplied.

Changeover times are classified as follows:

- (a) *No-break* An automatic supply that can ensure a continuous supply within specified conditions during the period of transition, e.g. as regards variations in voltage and frequency.
- (b) *Short break* An automatic supply available within 1 s.
- (c) *Medium break* An automatic supply available within 30 s.
- (d) *Long break* An automatic supply available in more than 30 s.

NOTE: Where no break in supply can be tolerated, it is not uncommon for the generating set to be run continuously as the normal supply and the electricity distribution system used as the alternative supply system. As stated in Clause 1.1, such forms of supply are not covered in this Standard except for minimum requirements that affect safety.

3.6.7 Switchgear

With the exception of any alarm devices, all switchgear and controlgear controlling the output of a generating set or the remote control of a generating set providing supply for emergency systems or essential safety services, shall be clearly identified and grouped in locations accessible only to authorized persons.

SECTION 4 ADDITIONAL REQUIREMENTS FOR PLUG AND SOCKET-OUTLET CONNECTED GENERATING SETS

4.1 GENERAL

This Section gives particular requirements for generating sets that are connected to an electrical installation or electrical equipment by means of a detachable plug and socket-outlet connection. Such connections are generally of a temporary nature where an independent or standby supply is required and where the installation of a permanently connected generating set is not justified.

NOTES:

- 1 An example of connecting a generating set to a switchboard is shown in Figure 4.1.
- 2 Examples of generating sets providing supply for electrical equipment by plugs and socket-outlets are shown in Figures 4.2 and 4.3.

These provisions are to be applied in addition to the general requirements for generating sets given in Section 2 of this Standard.

4.2 EARTHING AND BONDING

4.2.1 General

The earthing and equipotential bonding requirements for plug and socket-outlet connected generating sets shall be as specified in Clause 2.5.6.

Particular attention is drawn to the provisions of Clauses 2.5.6.3.1 and 2.5.6.4, which require the generating set bonding system to be connected to the exposed conductive parts of any equipment being supplied by the generating set and, in certain circumstances, connected to the earthing system of the electrical installation.

4.2.2 Connection of generating set windings

4.2.2.1 *Multiphase and single-phase centre-tapped generating sets*

The neutral or centre-point of the generating set windings shall be connected to—

- (a) the generating set bonding system in accordance with Clause 2.5.6.2.1; or
- (b) the neutral conductor of the electrical installation in accordance with Clause 2.5.6.3.2.

4.2.2.2 *Single-phase (other than centre-tapped) generating sets*

The connection of the generating set winding to the generating set bonding system shall be in accordance with Clause 2.5.6.2.2. This does not preclude an indirect connection occurring between one side of the generating set winding and the generating set bonding system where—

- (a) the generating set winding is connected to the neutral of an electrical installation in accordance with Clause 2.5.6.3.2; and
- (b) the earthing system of the electrical installation is permitted to be connected to the neutral of the electrical installation.

4.2.3 Earth electrode

The connection of a generating set bonding system to the general mass of earth through an earth electrode is not required or recommended.

4.3 CONNECTION TO AN ELECTRICAL INSTALLATION

4.3.1 General

Where a generating set is to be connected to an electrical installation through an appliance inlet and socket-outlet arrangement, the arrangement shall provide facilities for connection of the corresponding active, neutral, protective earthing and bonding conductors of the generating set and the electrical installation respectively.

4.3.2 Enclosure of live parts

The appliance inlet and socket-outlet connection shall not expose live parts to direct contact whilst disconnected or in the normal process of plug insertion or withdrawal.

4.3.3 Marking

Any socket-outlet, appliance inlet or changeover device provided for the connection of a generating set shall be legibly and indelibly marked to indicate its purpose.

4.4 CONTROL OF SOCKET-OUTLETS

Any single-phase socket-outlet installed on the generating set shall be provided with an isolating switch that operates in all live conductors.

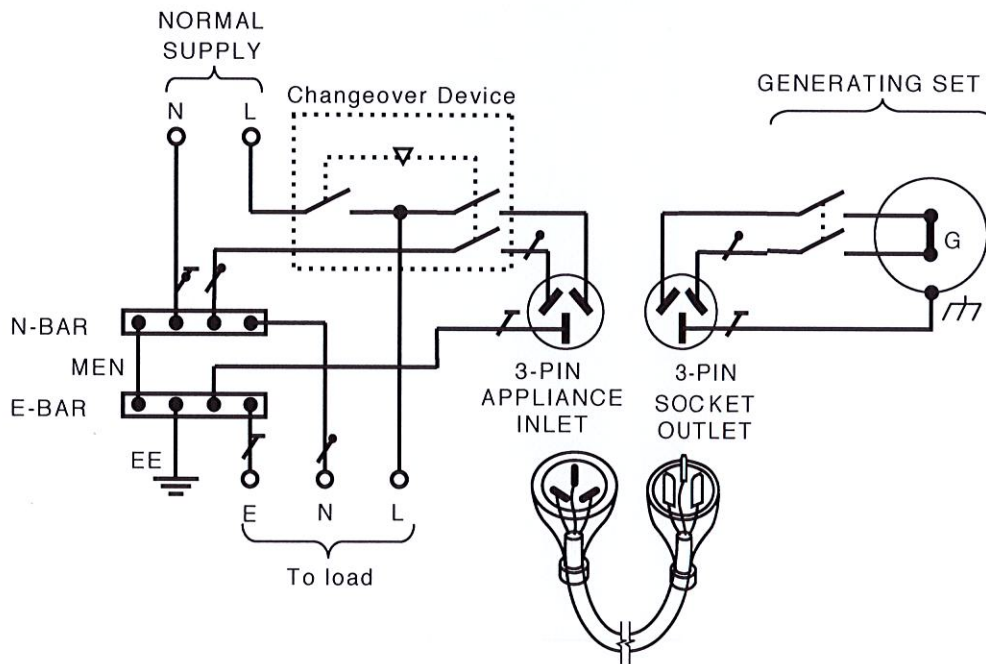


FIGURE 4.1 CONNECTION OF TRANSPORTABLE GENERATING SET TO AN ELECTRICAL INSTALLATION USING A 3-PIN APPLIANCE INLET AND SOCKET-OUTLET ARRANGEMENT

Generating set complying with the principles of AS 2790

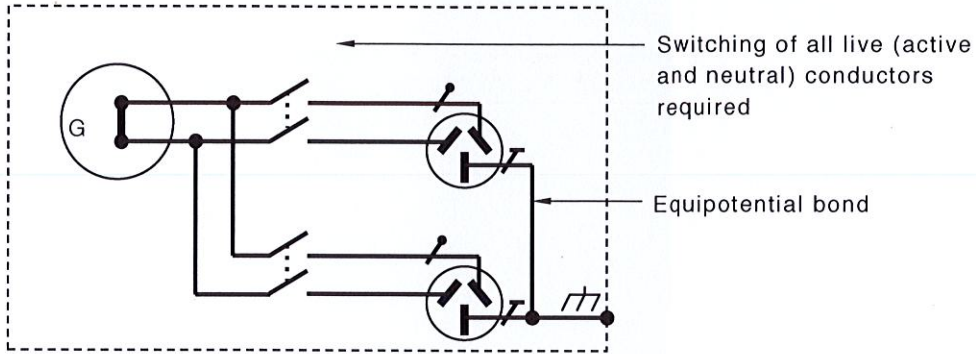
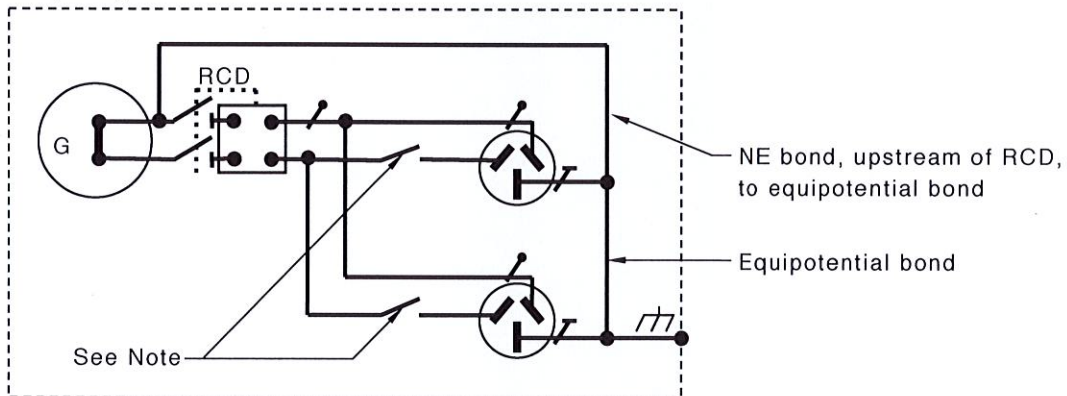


FIGURE 4.2 STAND ALONE ISOLATED WINDING SINGLE-PHASE GENERATING SET WITH INTEGRAL SOCKET-OUTLETS

Generating set complying with the principles of AS 2790



NOTE: Switching of active conductor(s) only of socket-outlets is permitted because of the upstream RCD.

FIGURE 4.3 STAND ALONE SINGLE-PHASE GENERATING SET WITH INTEGRAL SOCKET-OUTLETS PROTECTED BY A FIXED RESIDUAL CURRENT DEVICE

NOTES

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