Section 4: Selection and Installation of Electrical Equipment

## GENERAL

* + 1. **Application**

**This Section specifies the minimum requirements for the selection and installation of electrical equipment, including appliances and accessories that shall be achieved to satisfy Part 1 of this Standard.**

* + 1. **Selection and installation**

**Electrical equipment shall be selected and installed to perform the following functions or to have the following features:**

1. **Enable the electrical equipment to function properly under external influences to which it is expected to be exposed.**
2. **Prevent any adverse effects that the electrical equipment might cause on the electrical installation.**
3. **Operate safely when properly assembled, installed and connected to supply.**
4. **Ensure that there is no danger from electric shock, fire, high temperature or physical injury in the event of reasonably expected conditions of overload, abnormal operation, fault or external influences.**
5. **Installed in accordance with the requirements of this Section, and the additional requirements as specified in the manufacturer’s instructions.**

This Standard requires certain electrical equipment to satisfy these provisions through compliance with nominated Australian/New Zealand Standards or other relevant Standards.

The requirements of this Section relate to the following:

* 1. External influences and environmental conditions.
  2. Adverse effects on the electrical installation and the supply.
  3. Protection against thermal effects.
  4. Methods of connection of electrical equipment.
  5. Installation of socket-outlets, lighting and heating equipment.
  6. Electricity converters including UPS systems.
  7. Control, overload and overtemperature protection of motors.
  8. Transformers.
  9. Capacitors.
  10. Electrical equipment containing liquid dielectrics.
  11. Smoke and fire detectors.

NOTES:

1 Electrical equipment may be remotely switched. In particular, appliances, such as water heaters, room heaters or airconditioning systems may constitute a ‘controlled hours’ load. Therefore, care should be taken to ensure isolation of any circuit or equipment switched by an automatic or remote control system when working on such equipment, as electricity supply could be connected without warning.

* 2 Refer to Clause 4.7.3 and Figure 4.17 for clearance of socket-outlets and switches from open cooking surfaces.

3 Refer to Section 6 for where electrical appliances and accessories are installed in locations containing a bath, shower or other fixed water

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container.

* 4 In New Zealand, attention is drawn to the requirements of NZECP 55 for wiring and fittings located near conductive thermal insulation.

**NZ**

### External influences

**All electrical equipment shall have characteristics appropriate to the conditions to which it is likely to be exposed, to ensure that the electrical equipment is able to function properly at the intended point of installation.**

The characteristics may comprise—

1. suitable design and construction properties of the electrical equipment; or
2. additional means, provided as part of the electrical installation that do not adversely affect the operation of the electrical equipment, to effectively protect against the presence and extent of relevant environmental and other influences.

Damage from external influences may include, but is not limited to, that arising from exposure to one or any combination of the following, as appropriate:

* 1. Mechanical damage.
  2. Weather, including rain, snow, ice and sunlight (UV radiation).
  3. Water, including splashing, spraying, submersion or high humidity.
  4. Flora, including vines, weeds, flowers and plants of all types.
  5. Fauna, including cats, dogs, horses, cattle, etc.
  6. Excessive dampness, including wet areas and poorly sealed underground cellars, etc.
  7. Corrosive fumes, liquids or polluting substances, particularly those used in a sanitization process associated with the food industry.
  8. Galvanic action.
  9. Accumulation of dust or solid foreign bodies.
  10. Steam.
  11. Oil.
  12. Temperature, including both high and low temperatures.
  13. Solar radiation.
  14. Explosive atmospheres (often referred to as ‘hazardous areas’).
  15. Vibration.
  16. Seismic activity (earthquakes and tremors).

NOTES:

1 AS 60529 provides an IP classification and marking system for electrical equipment and enclosures that provide different degrees of protection against the entry of water and solid objects.

* 2 Purpose-made, anti-condensation and water drains that maintain the IP rating of the enclosure may be used.
* 3 Drilling a drain hole in the bottom of the enclosure alone destroys the IP rating of the enclosure.
* Electrical accessories not having any specific degree of protection marked on the product are considered to be protected from the weather when installed within the space contained by the soffit (the edge of the eave, verandah or similar overhang) and a plane from the outer edge of the soffit, at an angle of 30 degrees, continuing to the exterior wall.
* Electrical accessories installed outside that area shall have a minimum degree of protection of IP33. Refer to Figures 4.1 and 4.2.

NOTE: Refer to local service rules for any additional requirements.

*Exceptions:*

* *1 Metering enclosures and overhead line connector boxes complying with AS 3124 installed in the unprotected areas shown in Figures 4.1 and 4.2 need to have a minimum degree of protection of IP23.*

*2 Electrical accessories installed within metering enclosures need not comply with the requirements for unprotected areas shown in Figures 4.1 and 4.2.*

### Adverse effects and interference

**All electrical equipment shall be selected so that, during normal operation, including switching, it will not cause harmful effects to other equipment.**

Factors that may need to be considered include the following:

1. Power factor.
2. Excessive voltage fluctuation.
3. Severe distortion of current waveforms.
4. Electromagnetic emission.

## PROTECTION AGAINST THERMAL EFFECTS

### General

**The selection and installation of electrical equipment shall be such that the temperature characteristics of the electrical equipment, when properly installed and operated, do not adversely affect the electrical equipment, the electrical installation itself, or any other installation, whether electrical or not.**

Adequate ventilation shall be provided, where necessary, in order to maintain operating temperatures within the rated or specified limits of the affected equipment if heat is generated in normal operation.

NOTE: Account should be taken of the influence that temperature might have on the operational or characteristic values of the electrical equipment.

### Prevention of fire hazard

* + - 1. *Installation of electrical equipment*

Electrical equipment shall not be installed in a position where it might cause a fire hazard.

* + - 1. *Storage of flammable materials*

Where there is a likelihood that an area will be used to store flammable materials, measures shall be taken to prevent ignition of such materials by sparks or high temperature sources.

NOTE: See Clause 7.7 for requirements for hazardous areas.

* + - 1. *Protection from high temperatures*

1. *High surface temperature* Where fixed electrical equipment could attain surface temperatures that would cause a fire hazard to adjacent materials, the electrical equipment shall be—
   1. mounted on or within materials that will withstand such temperatures and are of low thermal conductance;
   2. screened from combustible building elements by materials that will withstand such temperatures and are of low thermal conductance; or
   3. mounted at a sufficient distance from any material on which such temperatures could have deleterious thermal effects, any means of support being of low thermal conductance so as to allow safe dissipation of heat.
2. *High radiant temperature* Fixed electrical equipment causing a focusing or concentration of heat shall be placed at a sufficient distance from any fixed object or building element so that the object or element, in normal conditions, cannot be subjected to a dangerous temperature.

NOTES:

1. Some building materials can be affected by pyrolysis—the decomposition of organic material as a result of long-term exposure to elevated temperatures. Where exposed to high temperatures for a significant period of time such materials can degenerate and self-ignite.
2. Tungsten filament lamps, ELV halogen lamps, radiant heaters, infra-red lamps, ballasts and transformers are examples of high temperature sources.
3. Restriction of heat dissipation from electrical equipment, e.g. by thermal insulation, can result in high temperatures in the electrical equipment itself.
   * + 1. *Emission of arcs or sparks*

Where arcs or sparks might be emitted by permanently connected electrical equipment in normal service, the electrical equipment shall be—

1. totally enclosed in arc-resistant material;
2. screened by arc-resistant material from building elements on which the arcs could have deleterious thermal effects; or
3. mounted at sufficient distance from building elements on which the arcs or sparks could have deleterious thermal effects, to allow safe extinction of the arcs or sparks.
   * + 1. *Electrical equipment enclosures*

The materials of enclosures of electrical equipment shall withstand the highest temperature likely to be produced by the electrical equipment.

Flammable or readily combustible materials shall not be used for the construction of enclosures.

* + - 1. *Prevention of spread of fire*

Electrical equipment, including switches, socket-outlets and other accessories, shall be arranged to provide a separation of not less than

300 mm horizontally and 600 mm vertically from any opening or recess in the opposite side of a wall, ceiling or floor that is required to be fire-rated (e.g. a ‘fire-rated barrier’).

The openings made for electrical equipment installed in fire-rated barriers shall not penetrate beyond 50% of the thickness of the barrier.

Any gap between electrical equipment and a fire-rated barrier shall be sealed to the degree of fire-resistance prescribed for the barrier, in accordance with the relevant provisions of the national building codes.

NOTES:

1. Guidance on materials suitable for restoring fire-rated constructions is given in national building codes.
2. National building codes may have requirements for restoring acoustic insulation that has been penetrated by electrical equipment.
   * + 1. *Thermal insulation—New Zealand only*

In New Zealand only, appliances and accessories in domestic installations shall be installed on the assumption that thermal insulation in ceilings, walls and under floors, if not currently installed, will be installed in the future.

### Protection against burns

An accessible part of electrical equipment within arm’s reach shall not attain a temperature in excess of the appropriate limit stated in Table 4.1.

Each accessible part of the electrical installation that may, even for a short period, attain a temperature exceeding the appropriate limit in Table 4.1 under normal load conditions shall be guarded so as to prevent accidental contact.

*Exceptions:*

1. *This requirement need not apply to electrical equipment that complies with a limiting temperature specified in an appropriate Standard.*
2. *This requirement does not apply to items such as lamps.*
   1. **CONNECTION OF ELECTRICAL EQUIPMENT**

### General

Electrical equipment may be connected to the installation wiring by one of the methods detailed in Clauses 4.3.2 to 4.3.5.

In all cases, the point of connection to the installation wiring shall be as close as practicable to the electrical equipment and the connection shall be effectively protected against mechanical damage or interference.

Wiring within, and forming part of, an item of electrical equipment is considered to be equipment wiring. Such wiring shall be in accordance with the relevant product Standard or, where no relevant product Standard exists, AS/NZS 3100.

### Direct connection

* + - 1. *General*

The installation wiring of the electrical installation shall be directly connected to terminals provided on the electrical equipment for the purpose (see Figure 4.3).

* + - 1. *Installation coupler*

An installation coupler, enclosed or unenclosed, that meets the requirements of AS/NZS 61535 is a suitable method for the electrical connection of cables, including flexible cords, flexible cables and rigid (solid or stranded) cables.

NOTES:

1. Installation couplers are intended for permanent connection between sections of wiring, particularly in ‘soft’ wiring systems, in which case they are treated in the same manner as a junction box.
2. Installation couplers require a deliberate act to disengage the latching mechanism and are not intended to be engaged or disconnected under load or to be used as socket-outlets.

Wiring from an installation coupler to electrical equipment is regarded as installation wiring (see Figure 4.4).

*Exception: Where the manufacturer of an item of electrical equipment provides supply terminals for the equipment at a plug designed for connection to an installation coupler, the wiring between the plug and the equipment is regarded as equipment wiring (see Figure 4.5).*

### 4.3.3 Installation wiring connected by an installation coupler(s)

* **4.3.3.1** *General*

Cords or cables connected by an installation coupler shall be—

* 1. of heavy-duty sheathed type complying with AS/NZS 3191 and the requirements of Clause 3.9.7.4 or AS/NZS 5000;
  2. selected to suit the protection device;

*Exception: For sections of installation wiring that terminate within a single piece of electrical equipment, such as a luminaire, single socket-outlet or SELV socket-outlet, the cable may be reduced to suit the rating of that single piece of electrical equipment.*

* 1. adequately protected and installed to minimize the risk of mechanical damage in accordance with Clause 3.3.2.6;
  2. supported and fixed in position in accordance with Clause 3.3.2.8 and Clause 3.9.3.1; and
  3. as short as practicable.
* **4.3.3.2** *Socket-outlets*

Socket-outlets supplied by installation couplers shall meet the following requirements:

* 1. The socket-outlet shall be suitable for the intended application and comply with Clause 4.4.
  2. The socket-outlet shall be secured in position and installed in accordance with Clauses 4.4.2.1 and 4.4.2.2.
  3. When installed on a horizontal surface, socket-outlets shall be designed or arranged to prevent the accumulation of dust or water in accordance with Clause 1.5.4.
  4. Where installed in a location that is not readily accessible, the socket- outlet shall be securely fixed to a structure or support to ensure that no mechanical strain is placed on the installation wiring connections when inserting or removing a plug from the socket-outlet.

### Socket-outlets in installation wiring

The installation wiring of the electrical installation shall terminate at a suitable socket-outlet, the wiring to the electrical equipment being continued by means of a plug and flexible cord or cable (see Figure 4.6).

### Other connecting devices

Where wiring terminates at a suitable junction box, ceiling rose or terminating device for the connection of a specific item or items of equipment, the wiring from the connecting device to the electrical equipment is considered to be equipment wiring (see Figure 4.7).

### Equipment wiring

Equipment wiring shall comply with the following:

1. Be as short as practicable.

NOTE: A maximum flexible cord or cable length of 2.5 m is recommended.

1. Have a current-carrying capacity not less than the maximum load of the connected appliance or luminaire.

NOTE: The minimum cross-sectional area of 0.75 mm2 for flexible cords is recommended, other than those specified for portable or hand-held appliances and luminaires.

1. Be protected against short-circuit, in accordance with Clause 2.5.4.
2. Where earthing is required, be provided with a protective earthing conductor of suitable cross-sectional area that will ensure operation of the circuit protective device, in the event of a fault to earth, without damage to the protective earthing conductor.

* (e) Installation wiring connected within a luminaire or passing through a luminaire shall be so selected and erected that the wiring and any associated connections within the luminaire will not suffer damage or deterioration due to heat or UV radiation generated by the luminaire or its lamps.

*Exceptions:*

1. *Where an assessment is made of the effect of a fault in the electrical equipment and smaller conductors will meet the protection requirements, conductors with a cross-sectional area of not less than 20% of the rating of the circuit protective device may be used.*
2. *Wiring between a terminating device and a pendant socket-outlet is considered to be installation wiring (see Clause 3.9.7.4 and Figure 4.8).*

## SOCKET-OUTLETS

### Types

* + - 1. *General*
         1. *Socket-outlets—Application*

Socket-outlets shall be suitable for the intended application and location of installation and shall comply with the requirements of the following Standards or Standards equivalent thereto:

\* (a) AS/NZS 3112 or AS/NZS 60884.1.

1. AS/NZS 3123.
2. IEC 60309.
3. AS/NZS 3131.

* **4.4.1.1.2** *Socket-outlets—Alternative pin configurations*

Socket-outlets with alternative pin configurations, e.g. UK, French, German and USA types, shall only be used under the following conditions:

* 1. The socket-outlet shall be of the single set of apertures with an earthing contact and comply with the national Standard of the country, as shown in IEC/TR 60083. Single set of pin apertures of socket- outlets that accept multiple pin configurations shall not be used.

*Exception: Shaver socket-outlets complying with AS/NZS 3194.*

* 1. The installation of the socket-outlet shall comply with Clause 4.4.4.
  2. The socket-outlet shall be rated at the voltage of the electrical installation, unless supplied at a lower voltage, in which case it may be rated at that lower voltage.
  3. Socket-outlets with alternative pin configurations normally supplying a voltage less than that of the electrical installation shall be supplied at that lower voltage.
  4. The socket-outlet shall have been tested to the equivalent of the requirements of the Standards listed in Clause 4.4.1.1.1, Items (a), (b),

(c) and (d) above.

In New Zealand only, the following additional provisions apply.

* + 1. Socket-outlets with alternative pin aperture configurations shall be used only in—
       1. facilities directly associated with an international airport; or
       2. residential areas of non-domestic electrical installations providing accommodation for international visitors or guests.
    2. Socket-outlets with alternative pin configurations detailed in IEC TR 60083 as requiring a nominal voltage of 230 V supply, shall be protected by an RCD with a maximum rated residual current of 10 mA and by an AFDD.

NOTES:

1. These RCDs need not be Type 1 as used for electrical medical devices.
2. Requirements for installation of AFDDs are in Clause 2.9, and further guidance is in Appendix O.
   * 1. Socket-outlets with alternative pin configurations detailed in IEC TR 60083 as requiring a nominal voltage of 110 V supply shall be supplied at reduced low voltage.

NOTE: Reduced low voltage is defined in Clause 2.6.3.3.2.

* **4.4.1.1.3** *Low voltage fixed socket-outlet*

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.

NOTE: USB charging socket-outlets on the faceplate are acceptable.

* + - 1. *Different systems*

Where an ELV electrical installation and an electrical installation of greater than ELV are in the same premises, all socket-outlets supplied at ELV shall—

1. have their voltage conspicuously marked; and
2. be of a form that will prevent insertion of an ELV plug into a socket- outlet connected to a circuit of greater than extra-low voltage.

NOTE: AS/NZS 3112 contains a specific plug and socket-outlet arrangement recommended for ELV applications.

Plugs and socket-outlets for SELV and PELV systems shall not be provided with an earthing contact or pin and shall comply with Clause 7.5.10.

* **4.4.1.3** *Socket-outlets for electric vehicle charging*

NOTE: Information for the installation and location of socket-outlets for electric vehicle charging stations is provided in Appendix P.

In New Zealand only, requirements for the installation and location of socket-outlets for electric vehicle charging stations are provided in Clause 7.9.

### Location

* + - 1. *Accessibility*

Each socket-outlet shall be installed so that any plug intended to be used with the socket-outlet can be conveniently inserted and withdrawn and not cause damage to any flexible cord or cable connected to the plug.

Socket-outlets shall not be installed where the withdrawal of a plug from the socket-outlet is restricted by a permanent fixture or fitting within the installation.

The AS/NZS 5601 series requires that the means of electrical isolation for a gas appliance is accessible with the appliance installed.

* + - 1. *Protection of socket-outlets*

Socket-outlets shall be installed so that they will not be subjected to undue mechanical stress or damage in normal service.

In addition, the following applies:

1. Where installed in a floor or other horizontal surface, socket-outlets shall be designed or arranged to prevent the accumulation of dust or water therein.

* NOTE: AS/NZS 3112 and AS/NZS 60884.1 contain requirements for socket- outlets intended to be mounted in a floor.

1. Where installed within 75 mm of a floor, socket-outlets shall be installed so that any plug used with the socket-outlet is withdrawn in the horizontal plane.

*Exception: This requirement does not apply to a socket-outlet that complies with Items (a) and (d).*

1. Socket-outlets shall be so installed that a plug is not likely to become loose or to malfunction because of gravity, vibration or the weight of the flexible cord or cable.
2. Where installed in a location that is not readily accessible for the connection of a fixed or stationary appliance or a luminaire, the socket-outlet shall be securely fixed to a structure or support to ensure that no mechanical strain is placed on the installation wiring connections when inserting or removing a plug from the socket-outlet.

*Exceptions: The socket-outlet need not be fixed in position where the installation meets the following conditions:*

* 1. *Cable connections are not subject to undue mechanical stress on any connection in accordance with Clause 3.7.2.6.*
  2. *The wiring system, where likely to be disturbed, is supported in accordance with Clause 3.9.3.3.*
  3. *The wiring system, where installed in a suspended ceiling, is supported in accordance with Clause 3.9.3.2.*
  4. *Conductors are flexible or stranded type.*
  5. *Insulated, unsheathed cables, including exposed cores where sheathing is removed, are enclosed in accordance with Clause 3.10.1.1.*

1. The use and location of socket-outlets is restricted in a number of particular situations, including adjacent to damp situations, in accordance with Section 6 and hazardous areas and other situations, in accordance with Section 7.
2. Where socket-outlets are installed in building surfaces that are required to provide fire-resistance or acoustic properties, measures shall be taken to ensure that these properties are maintained.

NOTE: Clause 4.2.2.6 and the national building codes have requirements for the installation of socket-outlets in building surfaces providing fire-resistance or acoustic properties.

### Earthing contacts

Every socket-outlet shall be provided with an earthing contact.

NOTE: See Clause 5.4.2 for earthing requirements.

*Exception: In accordance with Clause 7.5.10, socket-outlets for SELV and PELV systems shall not be provided with an earthing contact.*

### Switching device

* + - 1. *General*

### Each socket-outlet shall be individually controlled by a separate switch that complies with either AS/NZS 3133, AS/NZS 60669.1 or AS/NZS 60947.3 and operates in all active conductors.

**Switches controlling socket-outlets shall comply with Clauses 4.4.4.2 and 4.4.4.3.**

*Exceptions:*

1. *A single switch may be used for the control of two socket-outlets located immediately adjacent to each other.*
2. *A socket-outlet that is rated at not more than 10 A, installed for the connection of a fixed or stationary appliance or a luminaire and that is not readily accessible for other purposes, need not be controlled by a switch.*
3. *A socket-outlet that is switched by the insertion and withdrawal of the plug is deemed to meet the requirements of this Clause.*
   * + 1. *Rating*

Each switch shall have a current rating, at its operating voltage, not less than the current rating of the socket-outlet it controls.

Where a single switch is used to control two socket-outlets, as permitted by Exception 1 to Clause 4.4.4.1, the current rating of the switch shall be not less than—

1. the total current rating of the socket-outlets; or
2. the current rating of the overcurrent protective device on the circuit, whichever is the lesser value.
   * + 1. *Location and marking*

Each switch, or means of operating the switch, for a socket-outlet shall be—

1. as close as practicable to the socket-outlet; and
2. marked to indicate the socket-outlet(s) or the connected electrical equipment that it controls.

*Exception: Marking is not required where the socket-outlet controlled is obvious because of the location of the switch.*

Where the switch is located remote from the socket-outlet—

* 1. it shall be installed in a convenient and readily accessible position as close as practicable to the socket-outlet;
  2. the location of the switch shall be clearly and permanently marked at the socket-outlet; and
  3. both the switch and the socket-outlet shall be provided with legible, indelible and uniform labels indicating their relationship.

*Exception: Marking is not required where the socket-outlet is—*

* + 1. *located more than 2.5 m above the ground, floor or platform; and*
    2. *provided for the connection of a specific lamp, luminaire or appliance; and*
    3. *not accessible for general use.*
       1. *Pendant-type socket-outlet*

A switch incorporated in a pendant-type socket-outlet attached to a flexible cord shall interrupt all live (active and neutral) conductors.

*Exception: Pendant-type multiphase outlets with switching only in the active conductors may be used where—*

1. *the outlet is not dependent on the supply cable for support; and*
2. *additional mechanical protection is provided where necessary; and*
3. *the supply cable or cord is selected to take into account any likelihood of vibration and movement expected during operation.*

### Polarization and phase sequence

Where socket-outlets of the same type form part of an electrical installation, the order of connection of the socket-outlets shall be the same.

All socket-outlets that accommodate three-pin/flat-pin plugs shall be connected so that, when viewed from the front of the socket-outlet, the order of connection commencing from the slot on the radial line shall be earth, active, neutral in a clockwise direction.

## LIGHTING EQUIPMENT AND ACCESSORIES

### \* 4.5.1 Lampholders, including lampholders incorporated in a luminaire

* + - 1. *Location*

### All lampholders shall be located to be adequately protected against damage that might reasonably be expected.

In order to protect against inadvertent contact with live parts, low voltage lampholders shall be located to minimize the risk of—

1. direct contact with live parts of a lampholder when the lamp is removed; and
2. mechanical damage to the lamp or lampholder. These requirements may be satisfied by—
   1. installation not less than 1.8 m above the ground, floor or platform; or
   2. provision of a suitable guard for the lamp and its lampholder.

A pendant lampholder shall not be exposed to the effects of significant movement of air, e.g. outdoors or where exposed to the operation of fans, etc.

* + - 1. *Edison screw lampholders*

Every low voltage Edison screw lampholder shall be connected to the supply so that, where a neutral conductor is required, it is connected to the outer contact.

*Exception: This requirement need not apply where an Edison screw lampholder is incorporated in an appliance in a manner permitted by the AS/NZS 60335 series or the AS/NZS 3350 series, or the luminaire and the lampholder is provided with a shroud or skirt that prevents contact with the outer contact.*

* + - 1. *Festoon lighting*

Festoon lighting shall be located and supported so that no lamp will be within—

1. 0.15 m of flammable materials or structural metalwork; or
2. arm’s reach of the ground or any other place on which a person is likely to stand.

*Exception: Festoon lighting may be within arm’s reach where installed immediately below a ceiling.*

### Lamps and luminaires

* + - 1. *General*

**Lamps, luminaires and their associated ancillary gear shall be installed so as not to cause undue temperature rise, ignition or deterioration of the materials—**

1. **on which they are mounted; or**
2. **that they illuminate.**

Luminaires shall—

* 1. be suitable for the highest temperatures to which they are likely to be subjected by external influences; and
  2. be installed in accordance with the manufacturer’s instructions, taking account of the highest rating of lamp to be used.

NOTES:

* + 1. Some building materials can be affected by pyrolysis—the decomposition of organic material as a result of long-term exposure to elevated temperatures. Where exposed to high temperatures for a significant period of time, such materials can self-ignite.
    2. Attention is drawn to the high temperatures that can be generated in luminaires. Cables with suitable insulation temperature ratings should be selected.
       1. *Lamps near flammable materials*

Where lamps are located near flammable materials—

1. lamps shall be suitably shielded by a shade, reflector, guard or enclosure to prevent contact with the material; and
2. lamps, such as spotlights, that generate heat in the illuminated surface, shall be separated by such a distance that the material will not attain excessive temperature.

Where information is not otherwise provided with products, the minimum separation distances given in Table 4.2 shall be used.

Flammable shades shall not be installed where they are liable to come in contact with any lamp.

* + - 1. *Recessed luminaires*
         1. *General requirements*

1. Recessed luminaires and their auxiliary equipment shall be installed in a manner designed to prevent—
   1. excessive temperature rise of the luminaire and auxiliary equipment; and
   2. the risk of fire from ignition of combustible materials.
2. The requirement in (a) shall be satisfied by one of the following methods:
   1. The installation of a luminaire designed and certified by the manufacturer as being suitable for operation—
      1. in contact with combustible materials; or
      2. in contact with, or enclosed/covered by, thermal insulation material.
   2. The installation of a luminaire in combination with a barrier tested and classified in accordance with AS/NZS 5110 as being suitable for the installation conditions.
   3. The installation of a luminaire with separation from thermal insulating materials, combustible building elements and loose combustible materials not less than—
      1. the minimum clearance specified by the manufacturer of the luminaire, which may require a barrier or guard constructed of fire-resistant materials; or
      2. the default clearances as specified in Figure 4.9, which may require a barrier or guard constructed of fire-resistant materials.

*Exception: This requirement need not apply to appliances that comply as a whole with an appropriate Standard.*

### Where an appliance has no free outlet, it shall also be provided with a device that limits the water pressure.

* + 1. **Water heaters**
       1. *Access to easing equipment of pressure-relief and terminals of protective devices*

**Every unvented water heater shall be installed so that the following are readily available for operation, inspection and adjustment:**

1. **Easing equipment of pressure-relief devices.**
2. **All terminals of the protective devices.**

NOTE: An unvented water heater is one that is intended to operate at the pressure of the water system and the flow of the water being controlled by one or more valves in the outlet system.

* + - 1. *Protective devices fitted to unvented water heaters*

Overtemperature cut-outs and similar protective devices fitted to unvented water heaters shall—

1. operate directly in the circuit wiring to the heater elements; and
2. not be arranged for control through relays or contactors.

* **4.8.2.3** *Isolating switch*

Every water heater that is fixed wired shall be provided with an independent, isolating switch (lockable) in accordance with Clause 2.3.2.2. The isolating switch shall be—

* 1. additional to any automatic switch incorporated in the heater structure; and
  2. installed adjacent to but not on the water heater.

Where a water heater is supplied by two or more final subcircuits, all of the final subcircuits for that water heater shall be capable of being isolated by a single isolating switch.

## ROOM HEATERS

* + 1. **General**

**Where a permanently connected room heater, or a number of permanently connected room heaters, are installed in one room, an individual isolating switch and an individual functional switch shall be provided for each room heater or for each group of room heaters.**

**Where a number of permanently connected room heaters are installed in one room and are supplied by the one final subcircuit, a single isolating switch may be used for the room heaters in that room.**

* + - * 1. *Warning sign*

Where recessed luminaires are installed in an accessible roof space, a permanent and legible warning sign shall be installed in the roof space adjacent to the access point, in a position that is visible to a person entering the space. The sign shall contain the words shown in Figure 4.10 with a minimum size of lettering of 10 mm.

\* *Exception: Where all recessed luminaires installed in an accessible roof space are of either IC or IC-4 classification the warning sign is not required.*

* **4.5.2.3.3** *Installation*
  1. The following requirements shall be undertaken for the installation of recessed luminaires:
     1. Suitably designed and certified recessed luminaires have installation classifications and shall be marked accordingly. The manufacturer’s instructions shall provide all details in regard to restrictions for installation in certain applications.
     2. Unmarked light fittings shall be treated as ‘Do-not-cover’. For these typical fittings, the installation method shall be to provide barriers [see method in Clause 4.5.2.3.1(b)(ii)] or clearances [see method in Clause 4.5.2.3.1(b)(iii)] during installation, so as to prevent contact with materials that may impede airflow (e.g. thermal insulation) or that may be affected by the high temperature (e.g. combustible building elements and insulation).
     3. Where building insulation is already fitted and recessed luminaires are retrofitted, added or altered, precautions shall be taken during the installation of the luminaire so as not to compromise the safety of the installation.

NOTES:

* + - 1. In New Zealand, under the New Zealand Building Code, building insulation is required.

**NZ**

* + - 1. Instructions for insulation installers in relation to clearances from recessed luminaires and other types of electrical equipment that may be adversely affected by lack of cooling air circulation are included in AS 3999 in Australia and in New Zealand NZS 4246.
    1. The presence of bulk thermal insulation, particularly over the rear of a ceiling-mounted recessed luminaire, can readily impair cooling air circulation.

Unless the recessed luminaire manufacturer specifies otherwise [see method in Clause 4.5.2.3.1(b)(i)] or the barrier is classified to permit insulation coverage [see method in Clause 4.5.2.3.1(b)(ii)], the space above the luminaire shall remain clear. This space is shown as dimension HCB in Figure 4.9.

* + 1. Where clearances are to be applied [see method in Clause 4.5.2.3.1(b)(iii)] and bulk thermal insulation is not fixed in position, one of the following means shall be provided and secured in position to maintain the clearances:

1. A barrier complying with AS/NZS 5110.
2. A guard complying with AS 3999.
3. A barrier or guard constructed of fire-resistant materials.
   * 1. Unless the auxiliary equipment instructions permit otherwise, any auxiliary equipment operating at a high temperature shall be installed above any insulation as illustrated in Figure 4.9.
     2. If the recessed luminaire is supplied with a detachable barrier, the complete luminaire, including its barrier, shall be installed.
     3. For recessed luminaires with lamps of wattage higher than

100 W, only the methods in Clause 4.5.2.3.1(b)(i) or 4.5.2.3.1(b)(iii), shall be used.

* + 1. Combustible materials shall be prevented from being in close proximity or contacting hot surfaces of the recessed luminaires. This includes structural timber which may be affected by pyrolysis which over a long exposure can result in increased susceptibility to ignition.

Where extraneous material, such as leaves, vermin debris or combustible materials stored in a roof space, are present in proximity to the recessed luminaire, the precautions shall include the use of a suitably designed and certified recessed luminaire [see method in Clause 4.5.2.3.1(b)(i)] or a barrier [see method in Clause 4.5.2.3.1(b)(ii)].

* + 1. Bulk thermal insulation may also be retrofitted, added or altered, in which case precautions shall be applied by the insulation installer, where recessed luminaires are present, or the luminaire installer, where insulation is present.
  1. The following precautions should be considered for the installation of recessed luminaires:
     1. The heat generated from lamps should be dissipated in order to prevent overtemperature damage to the luminaire or to adjacent materials. Cooling air circulation through or around the equipment is a requirement for the typical range of recessed luminaires.

AS/NZS 60598.1, AS/NZS 60598.2 and AS/NZS 5110 detail the test method and the maximum surface temperatures permitted for recessed luminaires or barriers. Those standards permit a maximum temperature of adjacent materials to be no more than 90°C.

* + 1. Under National Construction Code requirements, bulk thermal insulation is prevalent in modern building construction within roofs, ceilings, walls and floors depending on the type of building and its climate zone.

AS 3999 (in Australia) and NZS 4246 (in New Zealand) include instructions for insulation installers in relation to clearances from recessed luminaires and other types of electrical equipment that may be adversely affected by lack of cooling air circulation.

* **4.5.2.3.4** *Classifications of recessed luminaires*

Recessed luminaires are classified as follows by AS/NZS 60598.2.2:2016, Appendix ZZ:

* 1. *Non-IC luminaire* A recessed luminaire that cannot be abutted against or covered by normally flammable materials or used in installations where building insulation or debris are, or may be, present in normal use.

Non-IC luminaires shall not be installed in residential installations. Refer to Clause 4.5.2.3.5.

Non-IC luminaires complying with AS/NZS 60598.2.2 are marked with the symbol shown in Figure 4.11.

* 1. *Do-not-cover luminaire* A recessed luminaire that can be used where normally flammable materials, including building insulation, are, or may be, present, but cannot be abutted against any material and cannot be covered in normal use.

In New Zealand only, ‘Do-not-cover’ luminaires shall not be installed in residential installations. Refer to Clause 4.5.2.3.5.

‘Do-not-cover’ luminaires complying with AS/NZS 60598.2.2 are marked with the symbol shown in Figure 4.12.

* 1. *CA90 luminaire* A recessed luminaire that can be abutted against normally flammable materials, including building insulation, but cannot be covered in normal use. Building elements, building insulation or debris have limited access to the heated parts of the luminaire.

CA90 luminaires complying with AS/NZS 60598.2.2 are marked with the symbol shown in Figure 4.13.

1. *CA135 luminaire (New Zealand only)* A recessed luminaire that can be abutted against normally flammable materials, including building insulation, but cannot be covered in normal use. Building elements, building insulation or debris have some access to the heated parts of the luminaire.

In New Zealand only, CA135 luminaires complying with AS/NZS 60598.2.2 are marked with the symbol shown in Figure 4.14.

1. *IC luminaire* A recessed luminaire that can be abutted against normally flammable materials, including building insulation, and can be covered in normal use. Building elements, building insulation or debris have access to the heated parts of the luminaire.

IC luminaires complying with AS/NZS 60598.2.2 are marked with the symbol shown in Figure 4.15.

1. *IC-4 luminaire* A recessed luminaire that can be abutted against normally flammable materials, including building insulation, and can be covered in normal use. Building elements, building insulation or debris have restricted access to the heated parts of the luminaire. This classification of recessed luminaire is effectively a sealed unit that has a restricted flow of air between the habitable room the luminaire emits light into and the void/space where the main body of the luminaire is located.

IC-4 luminaires complying with AS/NZS 60598.2.2 are marked with the symbol shown in Figure 4.16.

**4.5.2.3.5** *Requirements for specific classifications*

Recessed luminaires of classifications compliant to Appendix ZZ of AS/NZS 60598.2.2 shall be installed as per the following:

1. In Australia only:
   1. In residential installations, Do-not-cover, CA90, IC or IC-4 luminaires shall be installed.
   2. In non-residential installations, Non-IC, Do-not-cover, CA90, IC or IC-4 luminaires shall be installed.

CA135 luminaires shall not be installed in residential or non-residential installations.

1. In New Zealand only:
   1. In residential installations, CA90, CA135, IC or IC-4 luminaires shall be installed.
   2. In non-residential installations, Non-IC, Do-not-cover, CA90, CA135, IC or IC-4 luminaires shall be installed.

NOTE: Table 4.3 provides information and guidance on the classifications, symbols, applications and general restrictions on recessed luminaires.

* + - 1. *Suspended ceilings*

Luminaires that are supported by a ceiling panel shall not—

1. present a mechanical loading that exceeds the capacity of the ceiling panel; and
2. operate at a temperature that would cause deformation, discolouration or other forms of deterioration of the ceiling panel.

NOTE: AS/NZS 2785 states that rigid infill panels or independent supports may be required for some panels. Refer to manufacturer’s information for limitations on particular ceiling systems.

## \* 4.6 SMOKE ALARMS

National building codes and state legislation have requirements for installation of smoke alarms including location, number required and interconnection for alarm purposes.

Where mains-powered smoke alarms are fitted, such alarms may be directly connected to the lighting final subcircuit or to an individual final subcircuit.

NOTES:

1. Use of the lighting final subcircuit provides indication that the mains power supply is available, as a loss of supply to smoke alarms in an electrical installation would be indicated by the non-operation of lighting.
2. Smoke alarms are not considered to be safety services for the purposes of this Standard.

## COOKING APPLIANCES

### Switching device

**A circuit for a fixed or stationary cooking appliance having an open cooking surface incorporating electric heating, e.g. a cooktop, deep fat fryer, barbecue griddle or similar, shall be provided with a switch, operating in all active conductors, mounted near the appliance in a visible and readily accessible position.**

NOTE: This requirement need not apply to enclosed cooking appliances, such as built-in ovens and microwave ovens.

In Australia only, where the appliance has an open cooking surface incorporating both gas and electric cooking, the switching device shall operate in all live (active and neutral) conductors.

In New Zealand only, where the appliance has an open cooking surface incorporating both gas and electric cooking, the switching device shall operate in all active conductors.

A single switch is permissible for the control of associated cooking appliances that are in the same room.

\* The switch shall not be mounted on the cooking appliance.

NOTE: The switch should be mounted within 2 m of the cooking appliance.

The switch shall not be mounted in such a position that the user must reach across the open cooking surface to operate it.

Switches for cooking appliances, including the combined gas/electric cooking appliances specified in Clause 4.18.1, shall not be installed in the prohibited location specified in Clause 4.7.3 and Figure 4.17.

Switches shall be marked to identify the appliance controlled.

*Exception: Where an electric cooking surface is installed in a public park or other open area, to prevent damage by vandalism, the switch may be installed under a lockable cover that is located so that it is able to be operated as required for servicing and maintenance purposes of the cooking surface.*

### Connection—New Zealand only

In New Zealand only, a freestanding cooking appliance shall be connected to the electrical installation wiring by a socket-outlet or an installation coupler.

NOTE: This requirement need not apply to built-in hobs and ovens.

### \* 4.7.3 Clearance from open cooking surfaces

Socket-outlets and switches shall not be installed in the prohibited location shown in Figure 4.17, on any wall, cupboard or other surface within 150 mm of the edge of an open gas or electric 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, or 2.5 m above the floor that is directly below the cooking surface, whichever is the lower.

## APPLIANCES PRODUCING HOT WATER OR STEAM

* + 1. **General**

**All appliances producing hot water or steam shall be protected against overheating, by design or installation, in all service conditions.**

* + 1. **Protection shall be provided by means of an appropriate non-self- resetting device, functioning independently of the thermostat.Isolating switches**

In accordance with Clause 2.3.2.2, isolating switches shall be—

1. installed immediately adjacent to an entrance to, or within, the room where the room heater is located; or
2. installed on the switchboard at which the room heater final subcircuit originates.

Isolating switches may be incorporated in temperature-control devices, provided that they have a definite ‘OFF’ position.

### Functional switches

In accordance with Clause 2.3.7, functional switches shall be installed in a readily accessible position in the same room, or immediately adjacent to an entrance to the room, in which the room heater or room heaters are located.

A functional switch may be—

1. an appliance switch or switches with an ‘OFF’ position incorporated within the room heater; or
2. an isolating switch provided in accordance with Clause 4.9.2(a).

## ELECTRIC HEATING CABLES FOR FLOORS AND CEILINGS AND TRACE HEATING APPLICATIONS

* + 1. **General**

**Cables for electric heating systems in floors and ceilings and trace heating applications shall be of a type specifically designed for the purpose. The heating equipment shall be installed in accordance with the manufacturer’s instructions.**

* + 1. **Heating cables**

Heating cables shall be so installed that they are not in contact with flammable materials and where designed to be embedded—

1. are completely and adequately embedded in the substance they are intended to heat; and
2. do not suffer any detrimental effect because of flexing or movement of the substance in which they are embedded.

Alternatively, where designed as trace heating cables, heating cables shall provide adequate heat transfer to the surface or material to which they are fixed.

\* In New Zealand only, in-floor and ceiling heating cables shall be installed in accordance with NZS 6110.

### Isolating switches

Cables or groups of cables that comprise the heating system shall be provided with an isolating switch or switches in accordance with Clause 2.3.2.2.

Isolating switches may be incorporated in temperature-control devices, provided that they have a definite ‘OFF’ position.

Isolating switches shall be—

1. installed immediately adjacent to an entrance to, or within, the room or area in which the heating system is located; or
2. installed on the switchboard at which the heating system final subcircuit originates.

*Exception: Where the heating system is provided for trace heating applications, the isolating switch need not be located as specified in this Clause.*

### Functional switches

Cables or groups of cables that comprise the heating system shall be provided with a functional switch or switches, in accordance with Clause 2.3.7.

Functional switches shall be installed in a readily accessible position immediately adjacent to an entrance to, or within, the room or area in which the heating system is located.

A functional switch may be an isolating switch in accordance with Clause 4.10.3(a).

*Exception: Where the heating system is provided for trace heating applications, the functional switch need not be located as specified in this Clause.*

### Additional protection

All heating cables shall be provided with additional protection by an RCD with a fixed rated residual current not exceeding 30 mA, and—

1. in the case of heating units fitted with a conductive covering, this covering shall be earthed;
2. in the case of under-floor heating units without a conductive covering, an earthed metallic grid with a spacing not exceeding 30 mm shall be provided above the under-floor heating cable; and
3. heating units shall be provided with adequate mechanical protection to prevent damage.

### Signs

Where heating cables are installed, suitable signs drawing attention to their existence shall be provided in each location.

Where appropriate, signs warning of the danger of covering embedded heating equipment with furnishings or building materials that might cause excessive temperatures shall be provided.

This requirement may be satisfied by—

1. clearly and permanently marking the functional switch or switches in the heated room or area; or
2. providing suitable labelling at the relevant distribution board.

## ELECTRIC DUCT HEATERS

The electrical portion of any electric duct heater installation shall comply with the requirements of this Standard.

NOTE: Attention is drawn to the fact that—

1. such installations are within the scope of AS/NZS 1668.1;
2. safety requirements are contained in AS/NZS 3102; and
3. compliance therewith may be required by the relevant regulatory authorities.

## ELECTRICITY CONVERTERS

### General

For the purpose of this Clause, an electricity converter includes both static and dynamic equipment designed to stabilize the supply voltage, or to change the voltage or frequency of an electricity supply, or to maintain a continuous electricity supply for a limited period of time when the primary source of electricity supply is interrupted.

Examples include the following:

1. Uninterruptible power systems (UPS).
2. Semiconductor power converters (and inverters).
3. Voltage stabilizers.
4. Motor-generator sets.
5. Rotary converters.

Transformers and engine-driven generating sets that comply with AS/NZS 3010 shall not be considered as electricity converters.

NOTE: Requirements for alternative, stand-by and stand-alone systems are set out in Clause 7.3.

### Selection and installation

NOTE: Guidance on the selection and installation of electricity converters is contained in—

1. for uninterruptible power systems (UPS) ......................... AS/NZS 62040 series;
2. for semiconductor power converters............................................ AS 60146 series;
3. for batteries .................................................................................. AS 3011 series; and

* (d) for rotating electrical machines ..................................................... AS 60034 series.

### Control

Where an electrical installation, or part thereof, is supplied through an electricity converter, the converted supply shall be controlled by an isolating switch, or switches, at the output of the converter, or at the switchboard to which the output is connected.

Each electricity converter shall be controlled by switches or devices suitable for starting and stopping the converter. Where there is more than one switch or device for this purpose, they shall be grouped together and clearly identified.

An electricity converter shall be so arranged that it cannot supply energy upstream of the point of connection to the installation either directly or indirectly.

*Exception: Electricity converters may be arranged to supply energy upstream of the point of connection to the installation subject to any additional conditions required by the electricity distributor.*

Provision shall be made to ensure that all necessary connections for protection in the installation remain intact when supply is available from the output of the electricity converter.

### Isolation

* + - 1. *General*

Each electricity converter shall be provided with an independent isolating switch in accordance with Clause 2.3.2.2.

The isolating switch shall—

(a) be installed adjacent to or on the electricity converter so that a person operating the switch has a clear view of any person working on the converter;

* (b) be provided with a means of securing the device in the isolated position that requires a deliberate action to engage or disengage it;

1. comply with Clause 4.13 when the electricity converter incorporates an electric motor;
2. be under manual control only; and
3. not be capable of being overridden or bypassed by programmable control systems or the like.
   * + 1. *Electricity converters incorporating batteries*

Where batteries are incorporated in an electricity converter, a switch capable of interrupting the supply from such batteries shall be installed adjacent to the batteries and shall be clearly identified to indicate its purpose.

A single switch that incorporates both a.c. and d.c. switching functions outlined in Clause 4.12.4.1 and this Clause may be used.

### Overcurrent protection

* + - 1. *Electricity converter protection*

Electricity converters shall be provided with overcurrent protection.

*Exception: Overcurrent protective devices shall not be provided where the unexpected interruption of the supply could cause a greater danger than overcurrent.*

Overcurrent protective devices shall be located as close as practicable to the output terminals of the electricity converter so that the unprotected interconnecting conductors are as short as practicable and, in no case, exceed 15 m in length.

The unprotected interconnecting conductors shall be completely enclosed by metal or other material that is not flammable.

*Exception: Overcurrent protection may be provided by—*

1. *an overcurrent protective device within the electricity converter itself; or*
2. *the characteristics of the electricity converter being unable to support the fault current.*

Where an electricity converter is intended to operate in parallel with a network or other source, circulating harmonic currents shall be limited so that the current-carrying capacity of conductors is not exceeded.

NOTE: The effects of circulating harmonic currents may be limited as follows:

* 1. The selection of generating sets with compensated windings.
  2. The provision of a suitable impedance in the connection to generator star points.
  3. The provision of switches that interrupt the circulatory circuit but that are interlocked so that at all times fault protection is not impaired.
  4. The provision of filtering equipment.
  5. Other suitable means.
     + 1. *Circuit protection*

\* **4.12.5.2.1** *General*

Every submain or final subcircuit outgoing from an electricity converter shall be individually protected in accordance with Clause 2.5 and shall also include additional protection, where required, by Clause 2.6.

*Exceptions:*

1. *This requirement need not apply where protection on the incoming side (if any) provides protection against an overcurrent condition on the outgoing side.*
2. *Overcurrent protective devices shall not be provided where the unexpected interruption of the supply could cause a greater danger than overcurrent.*

\* **4.12.5.2.2** *RCDs*

The possible waveform of a fault current to earth can affect the operation of RCDs and shall be taken into account for the selection of the type of RCD.

Where an electricity converter includes an inverter, the RCD shall be of a type suitable for the waveform of the particular inverter, and in accordance with the inverter manufacturer’s recommendations.

NOTE: Requirements for types of RCDs are set out in Clause 2.6.2.2.

### Earthing

The output of an electricity converter shall be provided with the same type of earthing system used for the associated electrical installation.

Protective earthing conductors shall not be switched.

Provision shall be made to ensure that all necessary connections for protection, such as the MEN connection, remain intact when supply is available from the output of the system.

NOTE: See Clause 4.12.2 for information regarding Standards applicable to various devices.

### Neutral continuity

Electricity converters, particularly static converters, such as UPS, shall be arranged to ensure that the continuity of the neutral conductor to the load is not interrupted during bypass or maintenance switching.

### Electrical equipment connected to output

All electrical equipment connected to the output side of an electricity converter shall be suitable for the voltage, current and frequency of the output of the unit.

NOTES:

1. The values of current-carrying capacity and voltage drop specified in the AS/NZS 3008.1 series are only valid for conductors operating at 50 Hz.
2. For the type of RCD to be used where additional protection is required for circuits or equipment supplied by an electricity converter, refer to Clause 2.6.2.2.

## MOTORS

### Protection against injury from mechanical movement

* + - 1. *Switching devices*

**Every motor shall be provided with a switching device capable of performing all of the following functions:**

1. **Starting and stopping the motor.**
2. **Emergency stopping, in accordance with Clause 2.3.5.**
3. **Isolating the motor for mechanical maintenance, in accordance with Clause 2.3.6.**

*Exceptions:*

1. *Where a number of motors are required to function as a group, or operate in a coordinated manner, e.g. a split system airconditioning unit, a single switching device may be used to control more than one motor.*
2. *A switch suitable for disconnection of supply in accordance with Item (c) need not be provided for motors that are—*
   * *connected by a plug and socket-outlet; or*
   * *incorporated in an appliance having no exposed moving parts; or*
   * *rated at not greater than 150 VA.*

NOTES:

1. Refer to Clause 2.3 for the location and function of the switching device.
2. AS/NZS 1668.1 requires provision for locking air-handling and smoke-spill motor-isolating switches in the ON position.
   * + 1. *Rating of switches*

The isolating switch shall have a rating of not less than—

1. the full-load current of the motor when installed directly in the motor- supply circuit; or
2. the control-circuit current when installed in the motor-starter circuit.

Any switch operating directly in the motor-supply circuit shall be capable of safely interrupting the locked-rotor or stall current of the motor. In the absence of any specific information supplied by the manufacturer, the locked-rotor or stall current shall be taken as—

* 1. eight times the full-load current for a.c. motors; or
  2. four times the full-load current for d.c. motors.

NOTE: Switches suitable for this application include the following:

* + 1. Switches complying with AS/NZS 3133 or AS/NZS 60669.1, marked with the letter ‘M’ and with the nominated locked-rotor current.
    2. Switches complying with AS/NZS 3947.3, marked with the utilization category ‘DC 23’ or ‘AC 23’ and with a rated operational current which is equal to or greater than the full-load current of the motor.
    3. Switches incorporated with and supplying a socket-outlet intended for use with a plug complying with AS/NZS 3112 or AS/NZS 60884.1.

Where one switch is used to isolate more than one motor, in accordance with Clause 4.13.1.1, the switch shall be capable of interrupting the sum of the following currents:

1. The locked-rotor or stall current of the largest motor in the group.
2. The full-load current of all other motors in the group.
   * + 1. *Devices for starting and stopping*

Starting-and-stopping devices shall be so located as to be easily operated by the person in charge of the motor.

A stopping device or isolating switch shall be provided where danger is likely to occur because of the presence of moving parts.

The stopping device shall remain effective in the event of a fault in a motor- control circuit.

Where electrical equipment is remotely controlled, devices shall be provided for stopping the motors at all points where danger is likely to occur.

NOTE: Arrangements for emergency stopping of motors should comply with Clause 2.3.5.

* + - 1. *Protection against restarting or reversal*

Where unexpected restarting of a motor might cause danger, each electric motor shall be provided with means to prevent automatic restarting after stopping.

NOTE: Such means need not be provided where a suitable method of avoiding danger by warning of automatic restarting is given. Alternatives include enclosure of moving parts, warning sirens, etc.

Where safety might be impaired by incorrect direction of rotation of a motor, suitable measures shall be taken to prevent danger from reversal of the direction of rotation.

NOTE: This applies particularly where reverse-current braking is used.

### Protection against overload

Each electric motor having a rating exceeding 370 W shall be provided with control equipment incorporating means of protection against overload of the motor.

*Exception: This Clause (Clause 4.13.2) does not apply to motors incorporated in an item of electrical equipment that complies with an appropriate Standard.*

### Protection against overtemperature

* + - 1. *General*

Electric motors shall be provided with overtemperature protective devices complying with Clause 4.13.3.3 where they—

1. may be required to run unattended (see Note) and have a rating greater than—
   1. for shaded-pole type motors .................................................. 480 VA; or
   2. for other unattended motors ........................................................ 240 VA.
2. have a rating greater than 2250 W.

*Exception: This Clause does not apply where overtemperature protection is not permitted or required in accordance with Clause 4.13.3.2.*

NOTE: A continuously running motor or a motor under automatic control in non-domestic premises, where no person is normally in attendance in the vicinity of the motor, is deemed to be unattended. Consideration should be given to the presence of a caretaker, or other person who may be responsible for the inspection of motors, in which case it may be appropriate not to regard motors as unattended.

*Examples of unattended motors are motors that—*

1. *operate refrigerators in shops; or*
2. *are in a remote portion of a building, such as a drainage sump in a basement; or*
3. *operate a communal refrigerator in a block of flats.*
   * + 1. *Protection prohibited*

Overtemperature protection shall not be provided in either of the following circumstances:

1. In accordance with Clause 7.2.9, protection shall not be provided for motors associated with a fire-protection service.
2. Protection shall not be provided where the opening of the motor circuit could create a hazard.

Overtemperature protection need not be provided for unattended submersible pump motors immersed in water that have a rating not greater than 2250 W.

* + - 1. *Overtemperature protective devices*

Overtemperature protective devices shall comply with the following:

1. *Protection* Protection of motor windings against excessive temperatures shall be provided by—
   1. thermal overload protective devices complying with AS/NZS 60947.4.1;
   2. built-in thermal protection, in accordance with AS/NZS 60947.8; or
   3. a device that affords an equivalent degree of protection.
2. *Operation* The protective device shall disconnect, directly or indirectly, not less than the following number of supply conductors to the motor:
   1. For single-phase a.c. motors and d.c. motors supplied from a two-wire supply with one line earthed and single-phase a.c. motors: one.
   2. For three-phase a.c. motors and d.c. motors supplied from two unearthed lines: two.
3. *Additional requirements for unattended motors* Where thermal protective devices for unattended motors are of the automatic reset type, the device shall protect the motor windings against attaining excessive temperatures under continued tripping conditions.

## TRANSFORMERS

### General

Transformers shall be installed in accordance with Clauses 4.14.2 to 4.14.5.

*Exception: The following transformers need not comply with this Clause:*

1. *An instrument transformer.*
2. *An extra-low voltage transformer.*
3. *A luminous discharge tube transformer.*
4. *A transformer incorporated in a motor starter or other similar electrical equipment.*

### Secondary circuit

* + - 1. *General*

The wiring and electrical equipment connected to the secondary winding of a transformer shall comply with the requirements of this Standard for extra- low, low or high voltage, as appropriate to the nominal secondary voltage.

* + - 1. *Control and protection*

The conductors connected to the secondary windings of a transformer shall be—

1. considered as submain or final subcircuit conductors, as appropriate; and
2. controlled and protected in accordance with the appropriate requirements of Clauses 2.3 and 2.5.

*Exception: This requirement need not apply where—*

1. *the transformer secondary winding supplies only one submain or final subcircuit; and*
2. *the secondary circuit conductors have a current-carrying capacity not less than the rated load current of the transformer primary winding multiplied by the ratio of the transformer primary voltage to the secondary voltage.*

### Low voltage transformer supply

* + - 1. *Isolating transformers*

Electrical equipment may be supplied through an isolating transformer, in accordance with Clause 7.4.

* + - 1. *Other transformers*

Electrical equipment shall be earthed as required by Clause 5.4.

*Exception: Where the low voltage transformer output complies with the requirements of the AS/NZS 61558 series, earthing is not required on the secondary side.*

### Autotransformers

An autotransformer shall not be used to supply electrical equipment, including circuit wiring, having a voltage rating of less than the highest input or output voltage of the autotransformer.

### Step-up transformers

Where a transformer is used to raise the voltage above that at which electricity is supplied at the point of supply, no connection shall be made between the primary and secondary windings.

*Exception: A connection may be made between primary and secondary windings, using a protective earthing conductor, to provide an earth- reference supply.*

## CAPACITORS

### General

Capacitors shall be installed in accordance with Clauses 4.15.2 and 4.15.3.

*Exception: The requirements of this Standard do not apply to capacitors that are fitted as an integral part of other electrical equipment, such as luminaires.*

### Electrical equipment

* + - 1. *General*

Electrical equipment and wiring for connection to capacitors shall be suitable for the highest voltages, currents and temperatures that are likely to occur.

Adequate means shall be provided to ensure the dissipation of heat from the electrical equipment.

* + - 1. *Rating of circuit-breakers, switches or contactors*

Any circuit-breaker, switch or contactor controlling a capacitor shall be suitable for the purpose of switching capacitors and shall be of appropriate rating for the reactive component.

An example of an appropriate contactor would be a utilization category AC-6b device to AS/NZS 60947.4.1.

* + - 1. *Current-carrying capacity of supply conductors*

Where a capacitor is controlled by a circuit-breaker as required by Clause 4.15.3.3(a), the conductors connected to the capacitor shall have a current-carrying capacity not less than the greater of—

1. 135% of the rated current of the capacitor; or
2. the setting of the circuit-breaker.

Where a capacitor is permanently connected to a motor circuit, the conductors shall have a current rating of not less than the greater of—

* 1. one-third of the rating of the motor-circuit conductors; or
  2. 135% of the rated current of the capacitor.

### Provision for discharge and control

* + - 1. *General*

Capacitors with values greater than 0.5 F shall be provided with a discharge path.

These capacitors shall be controlled in accordance with one of the methods set out in Clauses 4.15.3.2 and 4.15.3.3, as appropriate.

The voltage between capacitor terminals shall be not more than 50 V after the capacitor has been disconnected from the supply for the following period, as applicable:

1. Where the capacitor is rated up to and including 650 V 1 min.
2. Where the capacitor is rated above 650 V 5 min.

Capacitors and electrical equipment containing capacitors shall be provided with a warning notice containing information similar to the following:

**WARNING: ENSURE THAT CAPACITORS ARE COMPLETELY DISCHARGED BEFORE WORKING ON EQUIPMENT.**

* + - 1. *Capacitors connected in parallel with individual appliances*

A capacitor connected in parallel with an individual appliance shall comply with the following requirements:

1. The capacitor shall be connected so that the windings of the appliance form a permanent discharge path for the capacitor.
2. No switch or fuse shall be inserted between the capacitor and the appliance.

*Exception: The requirements of Items (a) and (b) need not apply where the capacitor incorporates a permanently connected discharge device.*

1. The capacitor shall be deemed to be controlled by the controlgear of the appliance.
   * + 1. *Capacitors not connected in parallel with individual appliances*

A capacitor not connected in parallel with an individual appliance shall comply with the following requirements:

1. The capacitor shall be controlled by a circuit-breaker fitted with an overcurrent release.

Provision shall be made for the discharge of the capacitor by the use of—

* 1. auxiliary contacts of the circuit-breaker that automatically connect a discharge device to the capacitor immediately when it is disconnected from the supply; or
  2. a permanently connected discharge device in parallel with the capacitor.

*Exception: Where either—*

* + 1. *the capacitor is rated at not more than 100 kVAr (reactive power); or*
    2. *each capacitor in a bank of shunt-connected capacitors is rated at not more than 100 kVAr (reactive power),*

*the capacitor may be controlled by a quick make-and-break switch or contactor and protected by fuses, provided that the following requirements are met:*

* + - 1. *Such switching shall incorporate a means of manual operation to provide for the individual isolation of each capacitor, or for the capacitor bank as a whole.*
      2. *Provision shall be made for the discharge of the capacitor by the use of a permanently connected discharge device in parallel with the capacitor.*

1. No fuse or switch shall be connected between—
   1. the auxiliary contacts of the circuit-breaker and the discharge device referred to in Item (a)(i); or
   2. the permanently connected discharge device and a capacitor referred to in Item (a)(ii).

## ELECTRICAL EQUIPMENT CONTAINING LIQUID DIELECTRICS

### General

Wherever electrical equipment, such as oil-filled transformers or capacitors, contains flammable liquid in significant quantity, precautions shall be taken to prevent burning liquid and the products of combustion of the liquid (flame, smoke, toxic gases) spreading to other parts of the premises.

### Liquid dielectrics having a flashpoint not exceeding 250°C

Where electrical equipment is filled with a liquid dielectric having a flashpoint not exceeding 250°C and has a total liquid capacity exceeding 50 L in any unit or group of adjacent units, precautions shall be taken to prevent the spread of fire.

Such precautions may include the provision of enclosures consisting of fire- resisting dykes, bunds, curbed areas, basins, trenches filled with coarse crushed stone or, where necessary, trapped drains.

NOTES:

1. *Examples of such precautions are—*
   1. *a drainage pit to collect leakages of liquid and ensure their extinction in the event of fire; or*
   2. *installation of the electrical equipment in a chamber of adequate fire- resistance and the provision of sills or other means of preventing burning liquid spreading to other parts of the premises, such chamber being ventilated solely to the external atmosphere.*
2. For less than 50 L, it is generally sufficient to take precautions to prevent the escape of liquid.
3. It may be desirable to switch off the supply to the electrical equipment automatically at the onset of a fire.

## BATTERIES

Information on the selection and installation of batteries is contained in AS 3011.1 and AS 3011.2.

## GAS APPLIANCES AND EQUIPMENT

### Gas appliances

* + - 1. *General*

A gas appliance connected to the 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.

For cooking appliances, the means of isolation shall not be mounted in the prohibited location specified in Clause 4.7.3 and Figure 4.17 for clearance from open cooking surfaces.

If the appliance has an open cooking surface incorporating both gas and electric cooking, it shall also comply with Clause 4.7.

* + - 1. *In Australia only*
* One of the following means of isolation shall be provided for the gas appliance:
  1. A plug to an accessible switched socket-outlet.

*or*

* 1. A plug to a socket-outlet that may be located in an inaccessible position but has a separate switch operating in all live (active and neutral) conductors that is located in an accessible position.

*or*

* 1. An accessible isolating switch (lockable) operating in all live (active and neutral) conductors.
     + 1. *In New Zealand only*

One of the following means of isolation shall be provided for the gas appliance:

1. A plug to an accessible switched socket-outlet.

*or*

1. A plug to a socket-outlet that may be located in an inaccessible position but has a separate switch operating in all active conductors that is located in an accessible position.

*or*

1. An isolating switch (lockable) operating in all active conductors.

### Gas cylinders containing heavier-than-air gases—Outdoors

* + - 1. *Sources of ignition*

Electrical equipment that is a source of ignition, such as socket-outlets, switches, luminaires, switchboards, meter boxes and airconditioners, shall not be installed within the hazardous areas shown in Figure 4.18 by dimensions A and B. Dimensions A and B are shown in Figure 4.18 for both exchange and in-situ fill gas cylinders.

*Exception: Approved combined gas and electrical meter enclosures are exempted from these requirements.*

NOTES:

* + - * 1. Electrical equipment selected and installed in accordance with Clause 7.7.2.4 is not considered an ignition source.
        2. Refer to Clause 7.7 for requirements in hazardous areas.

\* **4.18.2.2** *Hot particles and surfaces*

Refer to Clause 7.7 and AS/NZS 60079.14 for exclusion zones in hazardous areas.

* **4.18.2.3** *Electrical equipment and gas supply—NZ only*

In New Zealand domestic installations only, only electrical equipment that is directly associated with the gas supply may be installed in the hazardous area shown in Figure 4.18.

A compartment located indoors provided for a gas cylinder shall not contain electrical equipment or connections in wiring that is a source of ignition, such as socket-outlets, switches, dishwashers or waste disposal units.

NOTE: For further information refer to AS/NZS 5601.1.

* **4.18.4 Gas relief vent terminal—Natural gas, LP Gas or Biogas** Electrical equipment that is a source of ignition, such as socket-outlets, switches, luminaires, switchboards, meter boxes and airconditioners, shall

not be installed within the hazardous areas shown in Figure 4.19 for gas

relief vent terminals.

NOTE: Equipment, according to AS/NZS 60079.14 for Zone 2, is not considered a source of ignition. (See Clause 7.7.)

### 4.18.5 Reticulated lighter-than-air gas system, metering system and regulators—New Zealand only

In domestic installations, only electrical equipment that is directly associated with the gas supply may be installed in the hazardous area shown in Figure 4.20.

## AIRCONDITIONING AND HEAT PUMP SYSTEMS

Airconditioning and heat pump systems incorporating a compressor shall be provided with an isolating switch (lockable) in accordance with Clause 2.3.2.2, installed adjacent to but not on the unit, which isolates all parts of the system, including ancillary equipment, such as head units, from the same location.

For split system airconditioning units, where the manufacturer requires the airconditioning system to be connected to the electricity supply by means of a plug and socket at the internal unit, the isolating switch installed at the external unit shall control the socket-outlet located at the internal unit.

* For airconditioning systems (including room heaters incorporating a compressor) where the internal unit (or units) are supplied from a circuit separate to that of the compressor, a warning sign shall be permanently fixed on or adjacent to the compressor isolator indicating that the isolator does not isolate the ancillary equipment. Where the internal unit (or units) are not connected by plug and socket, an independent isolating switch (lockable) in accordance with Clause 2.3.2.2 shall also be installed adjacent to each separately supplied internal unit (or units).

*Exceptions:*

*1 The isolating switch may be installed at the switchboard supplying the system if the switchboard is dedicated to the equipment (e.g. an airconditioning plant room).*

* *2 This Clause need not apply to unitary window or through-wall airconditioners, nor to heat pump hot water services that are supplied by a plug and socket-outlet installed adjacent to the unit.*

## 4.20 LIFTS

### General

The electrical installation of lifts shall be in accordance with the appropriate requirements of this Standard.

Lifts covered by this Standard include the following:

1. Electric lifts.
2. Electrohydraulic lifts.
3. Goods lifts.
4. Motor-room-less lifts (MRLs).
5. Passenger lifts.

Lifts shall be installed in accordance The National Construction Code of Australia or the New Zealand Building Code.

Lifts that are installed as emergency lifts, shall comply with the additional requirements for safety services in Clause 7.2.

NOTE: Regulatory authorities may have additional requirements.

### Lift supply arrangement

Lifts shall be supplied by a dedicated circuit.

### Labelling

Lift circuits shall be clearly identified by contrasting colouring or other suitable means, in accordance with Clause 2.3.3.4.

**WARNING: LIFT CIRCUIT—DO NOT SWITCH OFF.**

### Motor-room-less lifts (MRLs)

* + - 1. *General*

Lifts classified as motor-room-less lifts (MRLs) are lifts that due to their design have no need for a traditional lift motor room.

MRLs that are installed as emergency lifts, shall comply with the additional requirements for safety services in Clause 7.2.

NOTE: Regulatory authorities may have additional requirements.

* + - 1. *MRL switchboards*

An MRL switchboard shall not be located in the lift shaft.

A switchboard located remote from the main switchboard and dedicated to supplying individual MRL switchboards shall be readily accessible.

* + - 1. *Switchgear*

The protective and control device(s) of an MRL shall be located in a readily accessible position.