

AS/NZS 3100:2022



Australian/New Zealand Standard™

Approval and test specification – General requirements for electrical equipment



AS/NZS 3100:2022

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- Association of Accredited Certification Bodies
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- Australian Retailers Association
- Better Regulation Division (Fair Trading, Safework NSW, TestSafe)
- Business New Zealand
- Consumer Electronic Suppliers Association, Australia
- Consumers' Federation of Australia
- Electrical Regulatory Authorities Council, Australia
- Electrical consultants
- Engineers Australia
- JAS-ANZ
- New Zealand Electric Fence Energizer Manufacturers' Standards Group
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Australian/New Zealand Standard™

Approval and test specification – General requirements for electrical equipment

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-002 - Safety of Household and Similar Electrical Appliances and Small Power Transformers to supersede AS/NZS 3100:2017 and its amendments from the date of publication.

This Standard is one of a series of Approval and test specifications issued by Standards Australia and Standards New Zealand, whose objective is to provide manufacturers and regulatory bodies with minimum safety requirements for equipment not covered by other standards. This standard is designed to give the user protection against hazards that might occur during normal operation and abnormal operation of the equipment, and which may be used as the basis for approval for sale or for connection to supply in Australia and New Zealand.

This Standard contains general requirements for electrical equipment and can be applied to equipment for which no particular Approval and test specification exists. It also forms the basis of general requirements where an Approval and test specification exists for a piece of equipment. Only safety matters and related conditions are covered.

This Standard was revised to introduce editorial changes and the following technical change:

- (a) Editorial corrections have been to Clause 1.3 "IEC", Clause 8.15.9 and Annex B;
- (b) Clause 6.1 and Annex A have been corrected and updated to align with each other and to delete reference to the 1994 edition of AS/NZS 3100.
- (c) Clause 8.8 has been corrected and updated to use the IEC impact hammer;

For appliances, where conflict or uncertainty arises between the requirements detailed in this Standard and those detailed in AS/NZS 60335.1, those in AS/NZS 60335.1 shall take precedence. Where an interpretation of the requirements in AS/NZS 3100 is needed, the interpretation made shall be based upon the requirements detailed in AS/NZS 60335.1.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the Annex to which they apply. A 'normative' Annex is an integral part of a Standard, whereas an 'informative' Annex is only for information and guidance

Standards Australia/Standards New Zealand

Approval and test specification – General requirements for electrical equipment

SECTION 1: SCOPE, APPLICATION AND REFERENCED DOCUMENTS

1.1 Scope

This Standard specifies the general safety requirements for, or with respect to, equipment (including fittings, accessories, appliances and apparatus) of classes and types that are used in, or intended for use in, or in connection with, electrical installations in buildings, structures, and premises. It is not applicable to an appliance within the scope of AS/NZS 60335.1 or a part 2 of this Standard, except where an approval and test specification makes reference to this Standard.

Guidelines covering design and testing of electrical equipment to ensure safety and protection against electric shock, including the principles and application of double insulation, are contained in Annex D. Users of this Standard may find it helpful to study Annex D before reading the main body of this Standard.

1.2 Application

As and when an individual Standard dealing with specific features of the design and construction, and the testing, of any particular class or type of equipment is issued, it shall supersede those general requirements of this Standard that are specifically dealt with in those individual Standards.

Any material, fitting, cable, accessory, appliance or apparatus used in, or in connection with, an electrical installation shall comply with the appropriate individual Standard. In the absence of any such Standard, the appropriate provisions of this Standard shall apply.

NOTE Where an individual Standard makes reference to the appropriate clauses of this Standard, it is taken to mean that Clauses 3, 4, 5, 6.1, 6.2, 6.3, 7 and 8.15.8 of this Standard are applicable to the individual Standard. The remaining tests of Clause 8 are only applicable if referred to by Clauses 3, 4, 5, 6.1, 6.2, 6.3 or 7 of this Standard or if directly referred to in the individual Standard.

Should any requirement of an individual Standard differ from any of the general requirements of this Standard, the requirement of the individual standard shall prevail.

Where the words 'National Wiring Rules' have been used throughout the text of this Standard, it shall be taken to mean AS/NZS 3000.

1.3 Referenced documents

The following documents are referred to in this Standard:

NOTE Where no relevant joint Australia/New Zealand Standard is listed, the referenced Australian Standard is deemed to be appropriate for the purpose of this Standard. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards

AS

1834.1 Material for soldering – Solder alloys

1834.2	Material for soldering – Flux-cored solders
60529	Degrees of protection provided by enclosures (IP Code)
AS/NZS	
1020	The control of undesirable static electricity
1125	Conductors in insulated electric cables and flexible cords
3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
60065	Audio, video and similar electronic apparatus – Safety requirements
60335.1	Household and similar electrical appliances – Safety – Part 1: General requirements
60950.1:2015	Information technology equipment – Safety – Part 1: General requirements
60990	Methods of measurement of touch current and protective conductor current
61558 (all parts)	Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V
62368.1:2017	Audio/video, information and communication technology equipment – Part 1: Safety requirements
IEC	
60068-2-1:2007	Environmental testing - Part 2-1: Tests - Test A: Cold
60068-2-2:2007	Environmental testing - Part 2-2: Tests - Test B: Dry heat
60068-2-75	Environmental testing: Tests – Test Eh: Hammer tests
60068-2-78: 2012	Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state
60086-2	Primary batteries - Part 2: Physical and electrical specifications
60112	Method for the determination of the proof and the comparative tracking indices of solid insulating materials
60252-1	A.C. motor capacitors – Part 1: General – Performance testing and rating – Safety requirements – Guidance for installation and operation
60384-14:2013 A1: 2016	Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains
60695-2-10	Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure

60695-2-11	Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products (GWEPT)
60695-11-5	Fire hazard testing – Part 11.5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance
60695-11-10	Fire hazard testing - Part 11-10: Test flames - 50 W horizontal and vertical flame test methods
61051-1:2007	Varistors for use in electronic equipment - Part 1: Generic specification
61051-2	Varistors for use in electronic equipment - Part 2: Sectional specification for surge suppression varistors
61180	High-voltage test techniques for low-voltage equipment - Definitions, test and procedure requirements, test equipment
UL	
746C	Polymeric materials – Use in Electrical Equipment Evaluations

Approval and test specifications

AS

3158	Electric cables – Glass fibre insulated for working voltages up to and including 0.6/1 kV
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AS/NZS

3112	Approval and test specification - Plugs and socket-outlets
3122	Approval and test specification - Socket-outlet adaptors
3133	Approval and test specification - Air break switches
3191	Electric flexible cords

SECTION 2: DEFINITIONS

2.1 General

For the purpose of this Standard, the definitions below apply.

NOTE Where the terms 'voltage' and 'current' are used, they imply r.m.s. values unless otherwise specified.

2.1.1

Accessory

any device such as a switch, fuse, plug, socket-outlet, lampholder, fitting, adaptor, or ceiling rose, which is associated with wiring, luminaires, switchboards or appliances; but not including the lamps, luminaires, appliances or switchboards themselves.

2.1.2**Active (or active conductor)**

any one of those conductors of a supply system, which is maintained at a difference of potential from the neutral or earthing conductor. In a system that does not include a neutral or earthing conductor, all conductors are considered to be active conductors.

2.1.3**Appliance**

a consuming device, other than a lamp, in which electricity is converted into heat, motion, or any other form of energy, or is substantially changed in its electrical character.

2.1.4**Cable**

an insulated solid or stranded conductor or two or more such conductors laid together, either with or without bare conductors, fillings, reinforcements, or protective coverings.

2.1.5**Cable core**

the conductor with its insulation or dielectric, but not including the mechanical protective covering.

NOTE Two, three or more cores may be laid up together to form a twin, three-core, or multicore cable.

2.1.6**Cable flexible**

a cable, the conductors, insulation and covering of which are such as to afford flexibility.

2.1.7**Circuit-breaker**

a switch suitable for opening a circuit automatically, as a result of predetermined conditions such as those of overcurrent or undervoltage, or by some form of external control.

2.1.8**Class I equipment**

equipment in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution in that accessible conductive parts are connected to the protective earthing conductor in the fixed wiring of the installation in such a way that accessible parts cannot become live in the event of a failure of the basic insulation.

NOTE 1 Class I equipment may have parts with double insulation or parts operating at safety extra-low voltage.

NOTE 2 For equipment intended for use with a flexible cord or cable, this provision includes a protective conductor as part of the flexible cord or cable.

2.1.9**Class II equipment**

equipment in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as double insulation or reinforced insulation are provided, there being no provision for protective earthing or reliance upon installation conditions. Such equipment may be one of the following types:

(a) Equipment having durable and substantially continuous enclosures of insulating material which envelops all metal parts, with the exception of small parts, such as nameplates, screws and rivets, which are isolated from live parts by insulation at least equivalent to reinforced insulation; such equipment is called insulation-encased Class II equipment.

(b) Equipment having a substantially continuous metal enclosure, in which double insulation is used throughout, except for those parts where reinforced insulation is used, because the application of double insulation is manifestly impracticable; such equipment is called metal-encased Class II equipment.

(c) Equipment that is a combination of the types described in Items (a) and (b).

NOTE 1 The enclosure of insulation-encased Class II equipment may form part of the whole of the supplementary insulation or of the reinforced insulation.

NOTE 2 If the equipment with double insulation or reinforced insulation throughout has an earthing terminal or earthing contact, it is considered to be of Class I construction.

NOTE 3 Class II equipment may be provided with means for maintaining the continuity of protective circuits, insulated from accessible conductive parts by double insulation or reinforced insulation.

NOTE 4 Class II equipment may have parts operating at safety extra-low voltage.

2.1.10

Class II construction

equipment for which protection against electric shock relies upon double insulation or reinforced insulation.

2.1.11

Class III equipment

equipment in which protection against electric shock relies on supply at safety extra-low voltage and in which voltages higher than those of safety extra-low voltage are not generated.

NOTE Equipment intended to be operated at safety extra-low voltage and which have internal circuits that operate at a voltage other than safety extra-low voltage are not included in the classification and are subject to additional requirements.

2.1.12

Clearance

the shortest distance between two conductive parts, or between a conductive part and the bounding surface of the equipment, measured through air.

NOTE The bounding surface of the equipment is the outer surface of the enclosure, considered as though metal foil were pressed into contact with accessible surfaces of insulating material.

2.1.13

Conductor

a wire, cable, or other form of metal suitable for carrying current, but not including wires, cables or other metallic parts directly employed in converting electrical energy into another form of energy.

2.1.14

Conductor, bare

a conductor not covered with insulating material.

2.1.15

Cord, flexible

a flexible cable, no wire of which exceeds 0.30 mm in diameter and no conductor of which exceeds 4 mm² in cross-sectional area, and having not more than five cores.

2.1.16

Cord, power supply

a flexible cable or cord, for supply purposes, fixed to, or assembled with, the equipment according to one of the following methods:

(a) *Type X attachment*

a method of attachment of the power supply cord such that it can be easily replaced.

NOTE 1 The power supply cord may be specially prepared and only available from the manufacturer or its service agent.

NOTE 2 A specially prepared cord may also include a part of the equipment.

(b) *Type Y attachment*

a method of attachment of the power supply cord such that any replacement is intended to be made by the manufacturer, its service agent or similar qualified person.

NOTE Type Y attachment may be used either with an ordinary flexible cord or with a special cord.

(c) *Type Z attachment*

a method of attachment of the power supply cord such that it cannot be replaced without breaking or destroying the equipment.

2.1.17

Creepage distance

the shortest path between two conductive parts, or between a conductive part and the bounding surface of the equipment, measured along the surface of the insulating material.

2.1.18

Disruptive discharge

failure of insulation under electrical stress including the associated phenomena that occurs when a discharge completely bridges or punctures the insulation under test so that the voltage between the electrodes is reduced to zero or nearly to zero.

2.1.19

Earthed

connected to the general mass of earth in accordance with the appropriate requirements of the National Wiring Rules, and in such manner as will ensure the isolation of any defective equipment through the operation of protective devices.

2.1.20

Earthing conductor

a conductor connecting any portion of the earthing system to the portion of the installation or equipment required to be earthed, or to any other portion of the earthing system.

2.1.21

Equipment

any accessory, appliance, apparatus, device, luminaire, fixture, material or the like used or intended for use as part of, or in connection with, an electrical installation.

2.1.22

Equipment wiring

wiring connecting component parts of equipment.

2.1.22.1

Equipment wiring, internal

equipment wiring that is not accessible to personal contact except by the removal or opening of a cover or the like (with or without the use of tools), such removal or opening being required for no more than infrequent adjustment or maintenance of the equipment.

2.1.22.2

Equipment wiring, accessible

equipment wiring that is enclosed or partially enclosed but which is accessible to personal contact during a function performed in the normal operation of the equipment.

2.1.22.3

Equipment wiring, external

equipment wiring that is at all times accessible to personal contact.

Example Wiring between the base and motor of certain types of electric fan.

2.1.23

Exposed metal

all metal parts of electrical equipment which can be touched with the standard test finger but which exclude the following:

- (a) Live parts.
- (b) Parts separated from live parts by double insulation or reinforced insulation.
- (c) Metal nameplates, screw-heads, covers or plates
 - (i) which are supported on or attached or connected to substantial non-conductive material in such a manner that they cannot become alive in the event of failure of insulation of live parts; and
 - (ii) whose means of fixing cannot come into contact with any internal metal, other than earthed metal or parts referred to in Item (d), or be exposed to arcing contact with live parts.

NOTE 'Failure of insulation' in this context is taken to include accidental bridging of an insulating gap by metal or partially conducting material such as carbon dust or moisture, as well as break down in the conventional sense.

- (d) Parts that are separated from live parts by other metal parts which are themselves earthed or have double insulation or reinforced insulation.
- (e) Parts within an enclosure, the cover of which requires the use of a tool for its removal.

NOTE A key is not considered to be a tool except where special circumstances prevail; for example, the use of the key is restricted to technical personnel having an appropriate level of electrotechnical training.

- (f) Parts within equipment, the configuration and mass of which are such that the parts are not accessible during normal use and movement of the equipment; for example, some types of washing machine.

NOTE Non-metallic material which is conductive to a degree which may contribute to a hazardous condition arising is deemed to be exposed metal, subject to the above provisions.

2.1.24

Fault-current limiter

a fuse or other circuit-opening device, expressly designed or selected to limit the instantaneous fault current imposed on equipment.

2.1.25

Fixed equipment

equipment that is fastened to a support, or otherwise secured in a specific location.

NOTE Adhesives are not recognized as a means of fastening fixed equipment to a support unless specifically allowed in an individual Standard.

2.1.26

Fuse (fusible cut-out)

a device for protecting a circuit against damage from an excessive current flowing in it by opening the circuit on the melting of a fuse-element by such excessive current. It comprises all the parts that form the complete device.

2.1.27

Heating element

the actual electrical conducting medium in any device which, designedly, is heated by an electric current.

2.1.28

Insulated

separated from adjacent conducting material or protected from personal contact by a non-conducting substance or air space, or both, permanently providing resistance to the passage of current or to disruptive discharges through or over the surface of the substance or space, to obviate danger of shock or injurious leakage of current.

2.1.29

Insulation system

one, or a combination of, the following:

- (a) *Basic insulation*

the insulation applied to live parts, to provide basic protection against electric shock.

NOTE Basic insulation does not necessarily include insulation used exclusively for functional purposes.

(b) *Supplementary insulation*

an independent insulation applied in addition to basic insulation in order to ensure protection against electric shock in the event of a failure of the basic insulation.

(c) *Double insulation*

insulation comprising both basic insulation and supplementary insulation.

(d) *Reinforced insulation*

a single insulation system applied to live parts, which provides a degree of protection against electric shock; equivalent to double insulation under conditions specified in this Standard.

NOTE The term 'insulation system' does not imply that the insulation has to be one homogenous piece. It may comprise several layers that cannot be tested singly as supplementary or basic insulation.

2.1.30

Lamp holder, all insulated

one of the following:

- (a) A lamp holder for an incandescent lamp having no exposed metal of either lamp holder or lamp after the lamp has been inserted.
- (b) A lamp holder for a fluorescent lamp having no exposed metal both before and after the lamp has been inserted.

2.1.31

Live (alive)

a part is live (alive) when a difference of potential exists or would exist between it and earth under normal conditions of operation. With the exception of earthing conductors and neutral busbars, or links, in installations where the multiple earthed neutral system is employed, all metal which may be connected to the neutral conductor of the supply system, even if such neutral be earthed at the source of supply, shall be deemed to be live for the purpose of the National Wiring Rules.

A part is not considered to be live if

- (a) The part is supplied from a safety isolating transformer, provided that
 - (i) for a.c., the r.m.s. value of the potential does not exceed 32 V;
 - (ii) for d.c., the potential does not exceed 115 V; or
- (b) The part is separated from live parts by protective impedance.

2.1.32

Luminaire (lighting fitting)

a complete lighting assembly intended to distribute, filter, or transform the light from one or more lamps together with such components as ancillary and auxiliary equipment, shades, diffusers, reflectors, and accessories, including the means of connection to supply circuit wiring, internal and interconnecting wiring, and any associated housings. A lampholder that is not incorporated in an assembly is not regarded as a luminaire.

2.1.33

Neutral (Neutral conductor)

the conductor of a three-wire or multi-wire system which is maintained at an intermediate and approximately uniform potential in respect to the active or outer conductors.

2.1.34

Non-hygroscopic

Not tending to absorb moisture from the air.

2.1.35**Operating conditions**

conditions applying to the operation of equipment, when connected to the supply, according to the following:

(a) *Continuous operation*

normal operation for an unlimited period.

(b) *Intermittent operation*

operation in a series of specified identical cycles, each cycle being composed of a period of normal operation followed by a rest period with the equipment running idle or switched off.

(c) *Normal operation*

conditions under which the equipment is operated in normal use when connected to the supply.

(d) *Rated operating time*

the operating time assigned to the equipment by the maker.

(e) *Short-time operation*

normal operation for a specified period, starting from cold, the intervals between each period of operation being sufficient to allow the equipment to cool down to approximately room temperature.

2.1.36**Polyphase (multi-phase)**

three-phase, unless otherwise stated.

2.1.37**Portable equipment**

equipment that is moved while in operation or equipment that can easily be moved from one place to another while connected to the supply.

2.1.38**Protective impedance**

impedance connected between live parts and accessible conductive parts of Class II construction such that the current, in normal use and under likely fault conditions in the equipment, is limited to a safe value.

2.1.39**Safeguarded (guarded)**

provided with protective guards or shielded by virtue of location.

2.1.40**Safety extra-low voltage supply**

a supply obtained from a source that is independent of the supply mains, or from the supply mains through a safety isolating transformer or converter with separate windings, this supply being such that the no-load voltage does not exceed 40 V between conductors.

2.1.41**Safety isolating transformer**

a transformer, the input of which is electrically separate from the output windings by an insulation at least equivalent to double insulation or reinforced insulation, and which is designed to supply safety extra-low voltage circuits.

2.1.42**Stationary equipment**

either fixed equipment or equipment having a mass exceeding 18 kg and not provided with a carrying handle.

2.1.43**Screwless terminal**

a reusable connecting terminal for the connection of one or more conductors by means of springs, wedges, eccentrics, cones, or the like.

NOTE The following are not regarded as screwless terminals:

- (a) Terminals requiring the fixing of special devices to the conductors before clamping them into the terminal, for example quick-connect terminations.
- (b) Terminals requiring wrapping of the conductors, for example those with wrapped joints.
- (c) Terminals providing direct contact to the conductors by means of edges or points penetrating the insulation.

2.1.44**Switch, Category 1**

a multi-pole switch that has as its prime function the interruption of electricity to all live parts on the load side of the switch.

2.1.45**Switch, Category 2**

a switch that is required to interrupt the supply of electricity to that component of equipment which activates a part which could cause injury to a person (for example an interlock).

NOTE A particular Standard may require that a Category 2 switch operate in all poles.

2.1.46**Switch, Category 3**

a switch that is required to control equipment or any component thereof, except as set out in definitions for Category 1 and Category 2 switches.

2.1.47**Switch, single-pole**

a switch suitable for making or breaking a circuit in one conductor only.

2.1.48**Switch, multi-pole**

a switch suitable for making or breaking a circuit in two or more conductors simultaneously.

2.1.49**Temperature limiter**

a temperature-sensing device, the operating temperature of which may be either fixed or adjustable and which, during normal operation, operates by opening or closing a circuit when the temperature of the equipment, or of parts of it, reaches a predetermined value.

NOTE It does not make the reverse operation during the normal duty cycle of the equipment. It may or may not require manual resetting.

2.1.50**Thermal cut-out**

a device that, during abnormal operation, limits the temperature of the equipment, or of parts of it, by automatically opening the circuit or by reducing the current, and which is so constructed that its setting cannot be altered by the user.

2.1.51**Thermal cut-out, non-self-resetting, Type A**

a thermal cut-out that requires resetting by hand, or replacement of a part, in order to restore the current.

2.1.52**Thermal cut-out, non-self-resetting, Type B**

a voltage or current-dependent non-self-resetting thermal cut-out that requires de-energizing of the device in order to reset it. Type B devices are not to be used as a protective device unless specifically allowed in an individual Approval and test specification.

2.1.53**Thermal cut-out, self-resetting**

a thermal cut-out that automatically restores the current after the relevant part of the equipment has cooled down sufficiently.

2.1.54**Thermostat**

a temperature-sensing device, the operating temperature of which may be either fixed or adjustable and which, during normal operation, keeps the temperature of equipment, or of parts of it, between certain limits by automatically opening and closing a circuit.

2.1.55**Tool**

a screwdriver, a coin or any other object that may be used to operate a screw or similar fixing means.

2.1.56**Trip-free operation**

an operation where the automatic release of a circuit switching device, which can function independently of the mechanism to close the device and cannot be held closed against a condition where tripping should occur.

2.1.57**Voltage**

potential difference between conductors.

2.1.57.1**Voltage, extra-low**

normally not exceeding 32 V a.c. or 115 V d.c.

2.1.57.2**Voltage, low**

normally exceeding 32 V a.c. or 115 V d.c., but not exceeding 1000 V a.c. or 1500 V d.c. in either case.

2.1.57.3**Voltage, high**

exceeding low voltage.

2.1.58**incorporated power supply**

power supply designed to be built into specific equipment, or into a part of them, and the enclosure of which provides protection against electric shock

SECTION 3: DESIGN AND CONSTRUCTION

3.1 General

All equipment shall comply with the provisions of this Standard in respect of selection of materials, design, and construction, and with the tests specified herein.

The selection and application of materials, and the design and construction of all equipment shall be such as will ensure, as far as is reasonably possible and economically practicable, that when the equipment is standing, supported, or fixed in a normal position and operating in a normal manner, and account being taken of ordinary wear and tear and other depreciating factors that can reasonably be anticipated, no person will be exposed to risk of injury or electric shock, and there will be no unwarrantable risk of fire either

- (a) through the functioning of the equipment under conditions required by its use at rated loading; or
- (b) through the mechanical or electrical failure of any material or of the equipment itself or of any part thereof.

This Standard does not, in general, take into account the use of equipment by young children or infirm persons without supervision, or playing with the equipment by young children.

3.2 Equipment to be suitable for conditions of use

All equipment shall be of a type, design, and construction that will enable it to be installed in accordance with the National Wiring Rules and will provide protection against mechanical and electrical failure which can reasonably be expected to result from mechanical failure, or from exposure to weather, water or dampness, corrosive fumes, dust, steam, oil, high temperature or any other deleterious influences to which it will be exposed under the conditions of its use.

Non-hygroscopic insulating materials shall be used where required in individual Standards. In other cases, hygroscopic materials may be used for insulation, provided that the materials are suitably impregnated or treated if liable to exposure to dampness. The position and fixing of the insulation shall be such as will maintain creepage distances and clearances during the normal life of the equipment. In general, timber shall not be acceptable as an insulating material except that it may be recognized in special cases where a particular grade is used for a specific purpose.

NOTE Non-hygroscopic material is taken to be material that does not, after being conditioned in an oven at $50\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for $24\text{ h} \pm 1\text{ h}$ and then cooled in a desiccator, absorb greater than 5% by weight of moisture during a 48 hour treatment in a humidity of 95% at a temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

3.3 Selection of materials and parts

Any material or part used in, or in the construction of, any equipment shall comply with any specific requirements set out in respect thereto in this Standard or in an individual Approval and test specification dealing with such materials or parts.

Where any standard prescribes, for or in any equipment, the use of a particular kind of material or part, a material or part of another kind may be used instead, provided that its use will not introduce any risk of electric shock or fire and will not render the equipment less resistant to mechanical or electrical failure than would the use of a material or part of the kind prescribed.

3.4 Selection of components

Any component part that is used in or in the construction of any equipment and which is depended upon for safety shall comply with the appropriate requirements of any relevant individual Approval and test specification.

3.5 Workmanship

All fabrication and construction shall be carried out in a thoroughly workmanlike fashion complying with the appropriate requirements of this Standard and the generally accepted principles of sound and safe practice.

3.6 Fuses

3.6.1 Accessibility and shrouding

This Clause shall not apply to internal fuses where the arrangement and enclosure of the fuses is such that they are not intended and are unlikely to be replaced other than by appropriate servicing personnel. For all other fuses, the following provisions shall apply:

- (a) Every fuse incorporated in equipment shall be exposed to view or have its location clearly indicated by suitable visible marking or by instructional literature provided with the equipment.
- (b) Every fuse shall be in an accessible position.
- (c) Every fuse shall be so arranged that a person is not subject to the risk of inadvertent contact with
 - (i) any part of a fuse that is mounted in a compartment accessible for normal routine cleaning; or
 - (ii) live parts, when covers are removed to gain access to any fuse. Fuse carriers shall remain in position for the purpose of assessing this requirement.
- (d) Fuse-links, fuse-contacts and fixed contacts shall be so shielded as to protect a person from accidental contact with live metal while the fuse-carrier is being inserted or withdrawn in the normal manner.

3.6.2 Mounting

A semi-enclosed fuse that is incorporated in equipment and is marked with the letter 'R' shall be mounted in such a manner that no earthed metal is introduced in, or adjacent to, the fusing chamber.

3.7 Identification of wiring

For equipment other than that having a Type Z attachment insulated or covered conductors used as earthing conductors shall be coloured

- (a) green; or
- (b) green and yellow in the proportions specified in AS/NZS 3191.

The colour green in combination with colours other than yellow shall be acceptable for live conductors, provided that the other colour covers not less than 30% of the surface of the conductor in any 15 mm length.

The single colour green shall not be used to identify any live conductor except where

- (i) the conductor forms portion of the complex wiring of equipment; or
- (ii) it is specified by an individual Approval and test specification.

3.8 Regulating devices and switches

3.8.1 Fixing and mounting

All regulating devices and switches shall be securely fixed in position.

Rotary regulating devices and rotary switches shall be so fixed or located that they cannot turn bodily during operation.

No regulating device or switch shall be mounted in a position or be marked in such a manner as to incorrectly indicate the intended contact position.

NOTE See Clause 5.2.2 concerning clearances between terminals and exposed conductive parts.

3.8.2 Visual indications of positions

Notwithstanding the requirements of an individual Approval and test specification, the different positions of regulating devices and the different positions of switches may be indicated by figures, letters or other visual means which clearly indicate the intent. If figures are used for indicating the different positions, the 'off' position shall be indicated by the figure '0' or 'OFF' and the position of any energized state shall be indicated by a higher figure. The figure '0' shall not be used for any other indication.

NOTE It is intended that individual Approval and test specifications be amended to line up with the requirements of the above paragraph as the opportunity arises.

Any marking provided to indicate the position of a regulating device or switch shall be visible when the device or switch is in the corresponding position.

3.8.3 Voltage and current limitation

No regulating device or switch shall control a normal operating voltage or current when the voltage with which the device or switch is supplied is more than 15% in excess of the voltage at which the device or switch is rated.

3.8.4 Switches for transportable machinery

Transportable machinery, with moving parts that may cause injury to persons, shall be fitted with a switch that operates in all live conductors so that it isolates the entire equipment from the supply.

3.8.5 Switches

Any switch incorporated in equipment shall be a Category 1, 2 or 3 switch, as appropriate or comply with AS/NZS 61058 series, in accordance with the conditions occurring in the equipment. A Category 1 switch shall comply with the relevant requirements of AS/NZS 3133, and its 'off' position shall be marked in accordance with Clause 3.8.2 herein.

A Category 2 switch shall comply with the relevant requirements of AS/NZS 3133, and its 'off' position need not be marked.

A Category 3 switch shall satisfy the test requirements of Clauses 13.1.10, 13.3 and 13.4 of AS/NZS 3133, and its 'off' position need not be marked. In addition it shall be subjected to 50 operations of making and breaking the normal load current of the circuit it controls, in accordance with Clause 13.5.4 and Table 3 of AS/NZS 3133, except that where appropriate for circuits including motors, the test current and power factor shall be the equivalent current and power factor of the circuit which the switch controls, with the rotors locked.

In addition, where Category 1 and 2 switches control circuits containing motors, these switches shall be subjected to a further 50 operations. The test current and power factor shall be equivalent to the current and power factor of the circuit with rotors locked and the rate of operation shall be in accordance with Clause 13.5.4 of AS/NZS 3133.

A Category 1 switch shall be used when

- (a) the equipment is intended for connection to the supply by a plug and flexible cord;
- (b) notwithstanding Clause 5.1, it is not usual or possible to guard live parts completely against personal contact, because of the intended use and generally accepted practice with any particular equipment; and

- (c) the equipment is of a type that is usually left connected to the outlet socket indefinitely, and which has not been provided with a means to indicate whether it is energized or not.

NOTE 1 The specification of a particular category of switch in an individual Standard does not necessarily preclude the use of a switch with a lower category number.

NOTE 2 A Category 3 switch, tested to the above requirements, would not automatically qualify for an 'M' rating in accordance with AS/NZS 3133.

For accessories, any single pole switch shall be in the active conductor.

3.8.6 Electronic regulating devices and switches

Electronic thermostats and electronic switches without a mechanical switch in the main circuit may not provide a reliable off-state. Therefore the circuit on the load side shall be considered to be live.

3.9 Socket-outlets

Socket-outlets shall not be permitted in equipment intended for connection by flexible cord except in the following circumstances:

- (a) In those cases where there is little likelihood of cascading of similar equipment which could result in circuit overloading and extension of fault conditions.
- (b) Where permitted by an individual Approval and test specification or by National Wiring Rules.
- (c) Where the equipment is basically providing a switching or control function.

This does not preclude the use of socket-outlets or other facilities for connections within the equipment.

3.10 Equipment intended to be supported by contacts of socket-outlets

Equipment having integral pins for insertion into socket outlets shall comply with Appendix J of AS/NZS 3112.

3.11 Static charge in equipment

Attention is drawn to the hazard of shocks caused by the build-up of electrostatic charge in equipment such as hand-held tools. AS/NZS 1020 gives guidance on the control of undesirable static electricity.

3.12 Control methods

For equipment suitable for connection to the supply mains, asymmetrical control of the input current is prohibited in normal use. However, half-wave rectification directly on the supply mains may be used where the controlled active input power does not exceed 100 W or, where the controlled equipment is class II, portable equipment which, in normal use, is only operated for short periods of time and for which the rated power input does not exceed 1200 W.

NOTE Asymmetrical control means control by a device designed to operate in a different manner on the positive and negative half cycles of an alternating voltage or current.

Compliance is checked by inspection and by measurement.

3.13 Stability

Freestanding equipment intended to be used on a surface such as a floor or a table shall have adequate stability and shall be tested in accordance with Clause 8.14.

3.14 Equipment connected to supply by a plug

Equipment intended to be connected to the supply mains by means of a plug shall be constructed so that in normal use there is no risk of electric shock from charged capacitors having a rated capacitance exceeding 0,1 μF , when the pins of the plug are touched.

Compliance is checked by the following test.

The equipment is supplied at rated voltage. Any switch is then placed in the off position and the equipment is disconnected from the supply mains at the instant of voltage peak. One second after disconnection, the voltage between the pins of the plug is measured with an instrument that does not appreciably affect the value to be measured.

The voltage shall not exceed 34 V.

3.15 Capacitors

Capacitors in appliances or accessories likely to be permanently subjected to the supply voltage and used for radio interference suppression or for voltage dividing shall comply with IEC 60384-14. If they have to be tested, they are tested in accordance with Annex G.

NOTE Examples of capacitors likely to be permanently subjected to the supply voltage are capacitors incorporated in appliances or accessories which are likely to be operated unattended

3.16 Varistors

Varistors connected to live parts incorporated in equipment shall comply with the following requirements.

NOTE Varistors connected to live parts are those connected between phases (between actives and between actives and neutral) and those connected between phases and earth (actives to earth) and neutral to earth.

- (a) Varistors shall comply with IEC 61051-2. The characteristics as defined within IEC 61051-1 for any such varistor shall be at least:
 - Lower category temperature: -10°C ; Duration 2 h (Test A IEC 60068-2-1);
 - Upper category temperature: $+85^{\circ}\text{C}$; Duration 1 000 h (Test B IEC 60068-2-2);
 - Damp heat steady state severity: Duration 21 days; Temperature $(40 \pm 2)^{\circ}\text{C}$; Relative Humidity $(85 \pm 3)\%$ (Test Cab IEC 60068-2-78);
 - Over voltage category II.
- (b) Varistors shall have a continuous voltage rating of at least:
 - 1.25 times the rated voltage of the equipment; or
 - 1.25 times the upper limit of the rated voltage range of the equipment.
- (c) The body of the varistor shall have a flammability classification of at least V-1 in accordance with IEC 60695-11-10.
- (d) Equipment shall be protected against sudden failure of a varistor.

Protection shall be provided by:

- a fuse having a current rating not exceeding 10 A and a breaking capacity of not less than 1500 A. The fuse being connected in series with the varistor; or

- a protective device connected in series with the varistor. The protective device varistor combination shall be subjected to a short-circuit test, with the varistor short-circuited.

The short-circuit test is carried out by connecting the equipment to a supply source at the rated voltage of the equipment. If the equipment has a rated voltage range the supply source shall be at the upper voltage of the rated voltage range. The supply source shall have a prospective short-current of at least 1500 A at the test voltage. The circuit can be closed at any angle of the voltage.

The test result shall be assessed against the criteria of clause 8.15.10.

- (e) Equipment shall be protected against gradual failure of any varistor.

Compliance is checked by the test of clause 8.15.9.

- (f) A varistor shall not be connected to protective earth except in series with a Gas Discharge Tube (GDT) provided that the GDT complies with the following:

- the electric strength test for basic insulation; and
- the external CLEARANCE and CREEPAGE DISTANCE requirements for basic insulation.

Note: Communication and Telecommunications (ICT) components in equipment such as telephone, data and TV aerial connections, with varistors connected only to the protective earth, the requirements for varistors of the relevant ITC standard apply.

Compliance is checked by inspection, measurement and test.

3.17 Incorporated power supplies

3.17.1 General

Incorporated power supplies supplying Universal Serial Bus (USB) outlets shall comply with one of the following:

- (a) the appropriate part of the AS/NZ 61558 series of standards; or
- (b) AS/NZS 60950.1:2015; or
- (c) AS/NZS 62368.1:2017.

After 28 June 2024 component transformers for incorporated power supplies shall comply with the appropriate part of the AS/NZ 61558 series of standards.

Other incorporated power supplies shall comply with the requirements of the appropriate part of the AS/NZS 61558 series of standards.

3.17.2 Single Fault Conditions

In addition to conforming with 3.17.1 (b) or (c), for incorporated power supplies under single fault conditions, the output voltage of the power supply shall not be greater than 3 V or 10 % of the nominal rated output voltage, whichever is higher.

Incorporated power supplies that can deliver a range of different nominal output voltages via negotiation with the connected device shall be tested at each of the output voltages that can be negotiated with the connected device.

The output voltages under single fault conditions are measured with the output supply unloaded. Transient voltages of less than 1s are ignored provided the transient voltages are below 120 V Peak.

3.17.3 Temperature Consideration

In addition to conforming to 3.17.1 (a), (b) or (c), the assembly (of an electrical accessory and the incorporated power supply) shall conform to the following temperature rise test:

Tested in accordance with the relevant end product standard with the loads applied to the power supply and the end product connected simultaneously. The load for the power supply is its rated load.

Temperature limits of this Standard or the relevant end product standard shall not be exceeded, whichever is more unfavourable.

3.17.4 Over voltage category

- a) Incorporated power supplies in equipment in the installation wiring shall comply as overvoltage Category III equipment in accordance with relevant Power Supply Standards. For example socket outlets and switch panels.
- b) Incorporated power supplies in all other equipment supplied from the installation wiring shall comply as overvoltage Category II equipment in accordance with relevant Power Supply Standards.

3.17.5 Capacitors Bridging Reinforced Insulation

For overvoltage Category II accessories, accessible conductive parts separated by double or reinforced insulation from live parts may be bridged by a single Y1 capacitor with qualification approval in accordance with IEC 60384-14 (Clause 3.4.2 - Qualification Approval).

For overvoltage Category III equipment and overvoltage Category II equipment other than accessories, if double or reinforced insulation separating accessible conductive parts from live parts is bridged by capacitors, at least two Y1 capacitors shall be used.

3.17.6 Determination of Ignitibility and Combustion Propagation

Incorporated power supplies shall conform to the Ignitibility and Combustion Propagation requirements of this Standard and the relevant end product standard whichever is more onerous.

SECTION 4: PROTECTION AGAINST MECHANICAL AND ELECTRICAL FAILURE

4.1 Prevention of short-circuit and arcing

4.1.1 General

All terminals, contacts and other live parts shall be so arranged that short-circuit or destructive arcing, either between live parts or between any live part and other conductive material, cannot take place, and that no part other than an easily replaceable contact can be appreciably damaged by an arc or overheating arising from the normal operation of the equipment.

Holes for fixing screws shall be so placed that no such short-circuit or arcing can occur when the screws are in position.

4.1.2 Segregation of internal wiring

Where extra-low voltage (see Clause 5.5) and low voltage equipment wiring is within the one enclosure and the extra-low voltage wiring or parts connected thereto are accessible to the standard test finger without the use of tools, either of the following requirements, or a combination thereof, shall apply:

- a) The extra-low voltage wiring and associated connections shall be effectively separated from low voltage wiring by means of rigidly fixed screens or barriers or by other effective means such as lacing or enclosure in insulating sleeving.
- b) The extra-low voltage wiring and exposed parts shall be insulated for the highest voltage present in any low voltage conductor and shall be so arranged or fixed that, in the event of a conductor breaking away or becoming detached from a terminal, bare extra-low voltage parts cannot come into contact with uninsulated low voltage parts or vice versa.

Parts of one voltage system provided with basic insulation shall not come into contact with live parts of other systems.

The requirements of Clauses 5.1, 5.2 and 5.3 shall not be applicable to extra-low voltage wiring complying with the requirements of this Clause.

Where separate external equipment, operating at extra-low voltage, is supplied from the enclosure in which cables and wiring of different systems are terminated, the extra-low voltage wiring and connections shall be effectively separated from low voltage wiring as in Item (a), unless all parts of external equipment and associated wiring are installed and protected in accordance with the low voltage requirements of the National Wiring Rules.

4.1.3 Creepage distances and clearances for appliances

Creepage distances and clearances for appliances shall be not less than the values in millimetres shown in Table 4.1. The way in which creepage distances and clearances are measured is indicated in Annex C.

If a resonance voltage occurs between the point where a winding and a capacitor are connected together, and metal parts separated from live parts by basic insulation only, the creepage distance and clearance shall be not less than the values specified for the value of the voltage imposed by the resonance, these values being increased by 4 mm in the case of reinforced insulation.

Compliance is checked by inspection and if necessary by measurement.

For appliances provided with an appliance inlet, the measurements are made with an appropriate connector inserted; for appliances with Type X attachment, they are made with supply conductors of the appropriate current rating, and also without conductors; for other equipment, they are made on the equipment as delivered.

For appliances provided with belts, the measurements are made with the belts in place and the devices intended for varying the belt tension adjusted to the most unfavourable position within their range of adjustment, and also with the belts removed.

Movable parts are placed in the most unfavourable position; nuts and screws with non-circular heads are assumed to be tightened in the most unfavourable position.

The clearances between terminals and accessible metal parts are also measured with the screws or nuts unscrewed as far as possible, but the clearances shall then be not less than 50% of the values shown in Table 4.1.

Distances through slots or openings in external parts of insulating material are measured to metal foil in contact with the accessible surface; the foil is pushed into corners and the like by means of the standard test finger shown in Figure 8.10 but it is not pressed into openings.

If necessary, a force is applied to any point on bare conductors, other than those of heating elements, on uninsulated capillary tubes of thermostats and similar devices and to the outside of metal enclosures, in an endeavour to reduce the creepage distances and clearances while taking the measurements.

The force is applied by means of a test finger having a tip as shown in Figure 8.10 and has a value of

- (a) for bare conductors and for uninsulated capillary tubes of thermostats and similar devices 2 N;
- (b) for enclosures 30 N.

NOTE 1 If a barrier is interposed and if it is in two parts that are not cemented together, the creepage distance is also measured through the joint.

NOTE 2 For appliances having parts with double insulation where there is no metal between basic insulation and supplementary insulation, the measurements are made as though a metal foil were present between the two insulations.

NOTE 3 If a barrier is interposed, clearances are measured over the barrier or, if the barrier is in two parts with mating surfaces that are not connected together, through the joint.

NOTE 4 When assessing creepage distances and clearances, the effect of insulating linings of metal enclosures or covers is taken into consideration.

NOTE 5 Internal conductors are considered to be bare conductors, unless their insulation withstands an electric strength test made between the conductor and metal foil wrapped round the insulation, a test voltage of 2000 V being applied for 15 min.

NOTE 6 Means provided for fixing the equipment to a support are considered to be accessible.

NOTE 7 A component incorporated in an appliance and which may comply with an individual Approval and test specification is to also comply with the creepage distances and clearance specified in this Clause.

4.1.4 Additional requirements for appliances

4.1.4.1 General

The requirements in Clauses 4.1.4.2 to 4.1.4.5 are applicable only to appliances.

4.1.4.2 Printed circuit boards

For conductive patterns on printed circuit boards, except at their edges, the values in Table 4.1 between parts of different potential may be reduced as long as the peak value of the voltage stress does not exceed either

- (a) 150 V per millimetre with a minimum distance of 0.2 mm, if protected against the deposition of dirt; or
- (b) 100 V per millimetre with a minimum distance of 0.5 mm, if not protected against the deposition of dirt.

For peak voltages exceeding 50 V, the reduced creepage distances apply only if the proof tracking index (PTI) of the printed circuit board is greater than 175 when measured in accordance with Paragraph B4, Annex B.

These distances may be reduced further provided that the appliance complies with the requirements of Clause 8.15 when the distances are short-circuited in turn.

NOTE When the limits specified above lead to higher values than those of Table 4.1, the values of the table apply.

Creepage distances and clearances within optocouplers are not measured.

For live parts of different potential separated by basic insulation only, creepage distances and clearances smaller than those specified in Table 4.1 are allowed provided the requirements of Clause 8.15 are met if these creepage distances and clearances are short-circuited in turn.

4.1.4.3 *Distances through insulation*

The distance through insulation between metal parts for working voltages up to and including 250 V shall be not less than 1.0 mm if they are separated by supplementary insulation and be not less than 2.0 mm if they are separated by reinforced insulation.

Compliance is checked by inspection and by measurement.

NOTE 1 This does not imply that the distance has to be through solid insulation only. The insulation may consist of solid material plus one or more air layers.

NOTE 2 For appliances having parts with double insulation where there is no metal between basic insulation and supplementary insulation, the measurements are made as though there is a metal foil between the two insulations.

NOTE 3 The specified distances through insulation do not apply to the insulation of internal wiring.

4.1.4.4 *Insulation in sheet form*

The requirement in Clause 4.1.4.3 does not apply if the insulation is applied in thin sheet form, other than mica or similar scaly material, and

- (a) for supplementary insulation, consists of at least two layers, provided that each of the layers withstands the electric strength test of Clause 8.4 for supplementary insulation; or
- (b) for reinforced insulation, consists of at least three layers, provided that any two layers together withstand the electric strength test of Clause 8.4 for reinforced insulation.

Compliance is checked by inspection.

4.1.4.5 *Supplementary insulation and reinforced insulation*

The requirement in Clause 4.1.4.3 does not apply if the supplementary insulation or the reinforced insulation is inaccessible and meets one of the following conditions:

- (a) The maximum temperature rise determined during the tests of Clause 8.15 does not exceed the value specified in Table 5.7.
- (b) The insulation, after having been conditioned for 168 h in an oven maintained at a temperature equal to 75 °C in excess of the maximum temperature rise determined during the tests of Clause 8.15, withstands the electric strength test of Clause 8.4, this test being made on the insulation both at the temperature occurring in the oven and after cooling to approximately room temperature.

Compliance is checked by inspection and by test.

For optocouplers the conditioning procedure is carried out at a temperature of 50 °C in excess of the maximum temperature rise measured on the optocoupler during the tests of Clauses 8.12 or 8.15, the optocoupler being operated under the most unfavourable conditions which occur during these tests.

Table 4.1 - Creepage distances and clearances

1	2	3	4	5	6	7	8	9
Distances	Class III appliances		Other appliances					
			Working voltage up to 130 V ^a		Working voltage over 130 up to 250 V		Working voltage over 250 up to 500 V	
	Creepage distance	Clearance	Creepage distance	Clearance	Creepage distance	Clearance	Creepage distance	Clearance
1 Between live parts of different potential ^b								
(a) if protected against deposition of dirt	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0
(b) if not protected against deposition of dirt	2.0	1.5	2.0	1.5	3.0	2.5	4.0	3.0
(c) if lacquered or enamelled windings	1.0	1.0	1.5	1.5	2.0	2.0	3.0	3.0
2 Between live parts and other metal parts over basic insulation								
(a) if protected against deposition of dirt ^c								
(i) if of ceramic material or pure mica and the like	1.0	1.0	1.0	1.0	2.5 ^d	2.5 ^d	—	—
(ii) of other material	1.5	1.0	1.5	1.0	3.0	2.5 ^d	—	—
(b) if not protected against deposition of dirt	2.0	1.5	2.0	1.5	4.0	3.0	—	—
(c) if the live parts are lacquered or enamelled windings	1.0	1.0	1.5	1.5	2.0	2.0	—	—
(d) at the end of tubular sheathed-type heating elements ^e	—	—	1.0	1.0	1.0 ^f	1.0 ^g	—	—
3 Between live parts and other metal parts over reinforced insulation								
(a) if the live parts are lacquered or enamelled windings	—	—	6.0	6.0	6.0	6.0	—	—
(b) for other live parts	—	—	8.0 ^h	8.0 ^h	8.0 ^h	8.0 ^h	—	—
4 Between metal parts separated by supplementary insulation	—	—	4.0	4.0	4.0	4.0	—	—
5 Between live parts in recesses in the mounting face of the appliance and the surface to which it is fixed	2.0	2.0	6.0	6.0	6.0	6.0	—	—

^a The values specified in these columns do not apply to printed circuits, for which values are under consideration.

^b The clearances specified do not apply to the air gap between the contacts of thermal controls, overload protection devices, switches of micro-gap construction and the like or to the air gap between the current-carrying members of such devices where the clearance varies with the movement of the contacts.

^c In general, the interior of an equipment having a reasonably dustproof enclosure is considered to be protected against deposition of dirt, provided that the equipment does not generate dust within itself, hermetic sealing is not required.

^d If the parts are rigid and located by mouldings, or if the design is otherwise such that there is no likelihood of a distance being reduced by distortion or movement of the parts, this value may be reduced to 2.0.

^e These values apply only to earthed equipment.

^f If over ceramic, pure mica and the like, protected against deposition of dirt.

^g If protected against deposition of dirt.

^h The value of 8 mm is not applicable for printed circuits. A value of 6 mm is considered adequate. 6 mm is also considered acceptable for separation across printed circuit boards between live parts and circuits connected to safety extra-low voltage.

NOTE 1 The requirement concerning distances through insulation between metal parts does not imply that the prescribed distance must be through solid insulation only; it may consist of a thickness of solid insulation plus one or more air layers.

NOTE 2 For live parts of different potential separated by basic insulation only, creepage distances and clearances smaller than those specified in the tables are allowed, provided that the appliance does not show any defect within the meaning of this Standard if these creepage distances and clearances are short-circuited consecutively and the creepage distances are over insulating material withstanding the test of Clause 6.3.

NOTE 3 The values specified in the table do not apply to cross-over points of coil windings.

NOTE 4 For the purposes of table 4.1, materials with a comparative tracking index (CTI) exceeding 600, in accordance with AS/NZS 60112, are considered to be materials that are similar to ceramic and pure mica.

4.2 Mechanical protection of conductors and cables

4.2.1 General

All conductors and cables shall be of such a type or be so located or protected that mechanical or electrical failure is not likely to occur under the conditions to which they may reasonably be subjected in service.

4.2.2 Adjacent material

All material immediately adjacent to or in contact with a conductor shall be so shaped that it will not cause such abrasion of the conductor or its insulation, braiding or sheathing as could lead to its mechanical or electrical failure.

4.2.3 Passage for conductors

Where conductors and cables (including flexible cables and flexible cords) are to be threaded through tubes or channels or passed through openings formed in metal work, the tubes, channels or openings shall be of ample size and, if not bushed, shall have no sharp angles or projecting edges which would be likely to damage a conductor or the insulation, braiding, or sheathing of a cable. Conduit ends and other open ends through which cables pass shall be bushed or so shaped that they will not cause abrasion of conductors or the insulation, braiding, or sheathing of the cables. Where bushes are used, they shall be fixed securely in position.

4.2.4 Protection near moving parts

Equipment wiring near moving parts shall be so located or arranged as to guard against the possibility of abrasion of the conductor, or its insulation, braiding or sheathing.

4.2.5 Unprotected conductors with fibrous insulation

Fibrous insulated cables, which are defined as 'unprotected' in AS 3158 shall be used only where they can be installed without damage, will not be subjected to undue bending and abrasion, and are protected from mechanical damage and other deleterious effects by virtue of their location and the general design of the equipment in which they are incorporated.

4.3 Terminals and connecting facilities for supply conductors

4.3.1 Connecting facilities required

All equipment shall be provided with facilities for the connection of supply conductors in one of the following forms:

- (a) Terminals.

- (b) Contact pins or spring contacts intended to engage with the corresponding contacts of a connector, socket-outlet or cord extension socket. For socket-outlets, the requirements of Clause 3.10 shall apply.
- (c) Connection of the conductors, flexible cord or flexible cable to internal leads, terminals, lugs or the like, by crimping or other similar suitable devices. This form of connection shall be permitted only in the following cases:
 - (i) Where equipment is connected by a Type Y attachment.
 - (ii) A Type Z attachment, where specifically allowed in an individual Approval and test specification. However, in the absence of an Approval and test specification, a Type Z attachment may be permitted where it is used to provide an essential safety feature and where replacement during the economic life of the equipment is unlikely.
 - (iii) Where equipment has Type Y or Type Z attachments in accordance with Clause 4.5.1 of this Standard.
 - (iv) For equipment not covered by individual Approval and test specifications, where the replacement of the flexible cord or cable by the user of the equipment is not intended or is unlikely having regard to the type of flexible cord and the method of use of the equipment, for example whether it is fixed or portable and the degree to which the supply cable or cord will be subjected to flexure and mechanical damage in service.

Twist-on connectors with suitable metal inserts may be used for live conductors but shall not be used for earthing connections.

- (d) Soldering may be used
 - (i) for Type X attachments in equipment having a rated input not exceeding 250 W; and
 - (ii) for Type Y and Type Z attachments;

and shall comply with Clause 4.3.5.

No portable equipment shall be provided with facilities for the connection of more than one supply flexible cord, unless permitted in an individual Approval and test specification.

Any equipment intended for permanent connection to fixed wiring shall be provided with terminals as specified in Item (a).

4.3.2 Design and construction of terminals

All terminals shall be inherently corrosion-resistant or suitably protected against corrosion, and shall be so designed and proportioned that a connection made thereto will not loosen or overheat under normal conditions of use.

NOTE For equipment that will be subjected to severe vibration in service, for example a percussion tool, it is generally necessary for special precautions to be taken to ensure that the connections made to the terminals will not slacken off under normal conditions of use. Devices such as self-locking nuts, self-clamping terminals, spring washers or reusable locking compounds are acceptable for the purpose.

All terminals shall be so designed that the conductors connected thereto can be rigidly and effectively clamped between metal surfaces and shall comply with Clause 4.6.1. Connecting plates associated with terminals and forming internal connections shall be in effective electrical contact with the associated terminal in accordance with Clause 4.6.1.

Terminals shall be either securely fixed in position within a terminal box or enclosure, or so arranged that movement of the connections is limited by location in a suitable enclosure, recess, housing or the like, provision being made for maintaining adequate clearance between live parts and exposed metal parts. Other arrangements are not precluded, provided that the terminals are suitably restrained.

Screws of tunnel-type terminals and other clamping devices, which are intended to clamp directly onto conductors, shall be so shaped and finished that strands of the conductor are not likely to be severed when the screw is tightened to the extent necessary to provide a satisfactory termination. The surfaces against which the terminated conductor is to be clamped shall have no sharp angles or projecting edges that would be likely to damage the conductor and, for tunnel-type terminals, the hole for any pinching screw shall not extend through the conductor-way beneath the clamped conductor.

Aluminium conductors shall not be clamped directly by screws in tunnel-type terminals other than special types designed to evenly distribute stress and to break the oxide film on the conductors.

Indirect clamping by means of suitable ferrules, plates and the like shall be acceptable, provided that the clamping means breaks the oxide film on the conductors.

In general, a self-tapping screw shall not be used as a terminal screw for conductors; the acceptability of self-tapping screws as terminal screws in any particular application will be judged on the circumstances of the case in accordance with Clause 4.8.

Die-cast terminal blocks made from zinc-base alloy shall not be used.

Terminals provided for direct connection to fixed wiring of an installation shall be so designed and located as to permit the supply cables (other than flexible cables and cables having fewer than seven strands) to be connected in accordance with one of the following methods:

- (a) Soldered into a cable-socket of appropriate size.
- (b) Clamped in a terminal or binding post.
- (c) Terminated in an approved solderless tag or terminating device.

4.3.3 Location of terminals

The live terminals shall be within a terminal box or an enclosure, and shall be grouped together. The earthing terminal, if any, shall be either within the terminal box or enclosure or on the external surface of the equipment adjacent to the terminal box or enclosure. If the earthing terminal is on the external surface of the equipment, provision shall be made for the earthing conductor of the supply flexible cord or cable to pass through an opening in the terminal box or enclosure to the earthing terminal. An earthing terminal of the quick-connect type shall not be acceptable on the external surface of the equipment.

In equipment, except for those which have Type Y or Type Z attachments in accordance with Clause 4.5.1, the terminal box or enclosure shall be such as will allow access to the terminals and replacement of the flexible cord without dismantling the equipment to such an extent as will disturb the assembly of internal wiring and internal live parts. This does not preclude the terminals of a switch being used as the supply terminals of an equipment, provided that if it is necessary to move the switch for the purpose of connecting the supply flexible cord, the equipment shall incorporate a suitable recess, channel, or space so that the switch and any associated internal wiring will readily return to their correct positions.

NOTE See Clause 5.2.2 concerning clearances between terminals and exposed conductive parts.

4.3.4 Terminal arrangements

Except for equipment that is provided with a Type Y or Type Z attachment, the following provisions shall apply:

- (a) The arrangement of the terminals shall be such as will allow the supply flexible cord or flexible cable to be disconnected and replaced without removing any internal wiring or connections from the terminals.

- (b) The clamping of the supply conductor at a terminal shall be independent of the clamping of any internal lead at that terminal. This does not apply where the internal lead is effectively anchored to the terminal by means other than the terminal screw or where the replacement of the flexible cord or flexible cable by the user of the equipment is not intended or is unlikely having regard to the type of flexible cord and the method of use of the equipment, for example whether it is fixed or portable and the degree to which the supply cable or cord will be subjected to flexure and mechanical damage in service.
- (c) Screwless terminals that require special preparation of the conductors shall not be acceptable for the connection of supply flexible cords.

4.3.5 Soldered connections

Where facilities for soldered connections are provided, they shall comply with the following requirements:

- (a) The soldering terminals, lugs or the like shall be so designed that the conductors are held in position independently of the soldering.
- (b) They shall be so located and arranged as to minimize the likelihood of insulation being bridged by excess solder and so that essential insulation will not be damaged during soldering.

NOTE See Clause 4.6.

4.3.6 Prevention of slipping or spreading of conductors

All terminals shall be of a form that will prevent slipping or spreading of conductors or conductor strands; for example, by providing for the clamping of conductors either in a cylindrical hole by means of a suitable binding screw or screws, or between the head of a screw and a base so arranged that it will prevent the conductors from slipping or spreading, or by providing solderless tags or washers or other suitable devices to prevent such slipping or spreading.

Except for equipment with Type Y or Type Z attachments, a device shall not be acceptable as a means of preventing spreading of conductor strands on the terminals of portable equipment, unless it can be readily re-used when connection of the supply flexible cord is renewed.

NOTE Terminal washers and lugs having sections such as claws that are intended to fold over and contain strands of a flexible cord or conductor, or a device in which the conductors are held by clinching the shank of a solderless terminal lug, are not deemed to be readily re-usable.

The requirement is not applicable to connections made in equipment with Type Y or Type Z attachment.

4.3.7 Earthing conductors

Where the equipment includes an earthing terminal, provision shall be made by means of space within the terminal enclosure, the disposition of the terminals, a separate conductor way, suitable shielding, or other suitable means, to ensure that when correctly wired the connection is made without the earthing conductor of the flexible cord being held or pressed against live terminals or other live parts. In addition, where the equipment is intended to accommodate a supplementary earthing conductor of a supply flexible cord as part of an earth-circuit-monitoring arrangement, provision shall be made for adequate basic insulation of the supplementary earthing conductor.

NOTE Earth-monitoring equipment should be supplied with instructions describing how the equipment is to be correctly connected, including reference to the provision of basic insulation for supplementary earthing conductors, and a statement that the connection should be made by a suitably qualified person.