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(Incorporating Amendment No. 1)



Australian/New Zealand Standard™

Approval and test specification — Plugs and socket-outlets



AS/NZS 3112:2017

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Australian/New Zealand Standard™

Approval and test specification — Plugs and socket-outlets

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-004, Electrical Accessories to supersede AS/NZS 3112:2011.

A1 This Standard incorporates Amendment No. 1 (September 2021). The start and end of changes introduced by the Amendment are indicated in the text by tags including the amendment number 1. **A1**

A1 AS/NZS 3112:2017 in its unamended form will also remain current for 9 months from the date of publication of this document. After this time, it will be superseded by AS/NZS 3112:2017 incorporating Amendment 1. Regulatory authorities that reference this Standard in regulation may apply these requirements at a different time. Users of this Standard should consult with these authorities to confirm their requirements. **A1**

The objective of this Standard is to provide the Australian and New Zealand electrical industry, including manufacturers, test laboratories and regulators, with requirements and test methods for **A1** plugs, socket outlets or plug portions **A1**.

This Standard is one of a series of approval and test specifications to be read in conjunction with AS/NZS 3100, *Approval and test specification—General requirements for electrical equipment*. The purpose of this series is to outline conditions which need to be met to secure approval for the sale and use of electrical equipment. Only safety matters and related conditions are covered.

The essential safety requirements in AS/NZS 3820, *Essential safety requirements for electrical equipment*, which could be applicable to **A1** plugs, socket outlets or plug portions **A1**, are covered by this Standard, taken in conjunction with any other relevant requirements affecting safety.

Major changes in this edition are in the following:

- (a) [Clause 1.1](#) Scope. Updated and clarified.
- (b) [Clause 2.8.1](#) Ratings and dimensions.
- (c) [Clause 2.8.4](#) Dimensions of [Figure 2.1](#).
- (d) [Clause 2.13.3](#) High voltage test.
- (e) [Clause 3.1.2](#) Construction of terminals.
- (f) [Clause 3.10](#) Floor socket-outlets.
- (g) [Clause 3.12](#) Shuttered socket-outlets.
- (h) [Clause 3.14.1](#) Tests for socket-outlets.
- (i) [Clause 3.14.3](#) High voltage test.
- (j) [Figure 2.1](#).
- (k) [Figure 2.11](#).
- (l) [Figure 3.10](#).
- (m) [Appendix J](#). Change the title and include integral or detachable plug portions of equipment for insertion into socket outlets requirements.

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

- (i) Update referenced documents.
- (ii) Update and clarify the scope of the Standard.

- (iii) Update diagrams for clarity.
- (iv) Add new definition for insulation piercing terminal or connecting device.
- (v) Add a new [Appendix K](#), Non-detachable parts test (normative).

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

The term 'normative' has been used in this Standard to define the application of the appendix to which it applies. A 'normative' Appendix is an integral part of a Standard.

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Australian/New Zealand Standard

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Section 1 Scope and general

1.1 Scope

A1 This Standard specifies essential safety requirements for plugs and socket-outlets, as defined in [Clause 1.4](#), plug portions, as defined in Paragraph J2, and equipment incorporating plug portions, intended for use at a rated voltage not exceeding 500 V and a rated current not exceeding 32 A for household or similar purposes. **A1**

Plug and socket configurations listed in IEC 60083 other than Australian and New Zealand are excluded from this Standard, with the exception of travel adaptors covered in AS/NZS 3122 [Appendix A](#).

This Standard does not provide requirements on the following:

- (a) Appliance couplers (see AS/NZS 60320.1).
- (b) Installation couplers (see AS/NZS 3131 or AS/NZS 61535).
- (c) Plugs, socket-outlets and couplers for general industrial applications (see AS/NZS 3123).
- (d) Plugs and socket-outlets for stationary appliances (see AS/NZS 3131).

1.2 Application

1.2.1 General requirements of AS/NZS 3100

This Standard shall be read in conjunction with AS/NZS 3100. The relevant provisions of AS/NZS 3100 shall apply to the construction of a plug or socket-outlet and the insulation and safeguarding of parts that primarily carry current.

1.2.2 Specific requirements of this Standard

A plug or socket-outlet, including a special purpose plug or socket-outlet, shall be deemed to comply with this Standard only if it satisfies all the applicable requirements and passes the applicable tests specified in this Standard.

For special purpose plugs and socket-outlets small deviations from the dimensions as specified in [Figure 2.1](#), which give the impression of a standardized plug and socket-outlet and lead to confusion with standardized plugs and socket-outlets, are not allowed.

A1 For extra low voltage plugs and socket-outlets, refer to [Appendix E](#). **A1**

For protective dummy plugs, refer to [Appendix I](#).

A1 For plug portions and equipment incorporating plug portions, refer to [Appendix J](#). **A1**

1.2.3 **A1** Clause deleted **A1**

1.3 Referenced documents

The following documents are referred to in this Standard.

AS 1722.2, *Pipe threads of Whitworth form, Part 2: Fastening pipe threads*

AS 60068.2.30, *Environmental testing, Part 2.30: Tests—Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)*

AS 60068.2.32, *Environmental testing, Part 2.32: Tests—Test Ed: Free fall*

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

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

AS/NZS 3100, *Approval and test specification—General requirements for electrical equipment*

AS/NZS 3105, *Approval and test specification—Electrical portable outlet devices*

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

AS/NZS 3121, *Approval and test specification—Insulating mouldings*

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

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

AS/NZS 3133, *Approval and test specification—Air-break switches*

AS/NZS 60320.1, *Appliance couplers for household and similar general purposes, Part 1: General requirements (IEC 60320-1, Ed. 2.1 (2007) MOD)*

AS/NZS 60320.2.2, *Appliance couplers for household and similar general purposes, Part 2.2: Interconnection couplers for household and similar equipment (IEC 60320-2-2, Ed. 2.0 (1998) MOD)*

AS/NZS 61535, *Installation couplers intended for permanent connection in fixed installations (IEC 61535, Ed. 1.0 (2009) MOD)*

AS/NZS IEC 60670.23, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations, Part 23: Particular requirements for floor boxes and enclosures*

AS/NZS IEC 60998.2.3, *Connecting devices for low-voltage circuits for household and similar purposes, Part 2.3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units*

IEC 60695-10-2, *Fire hazard testing, Part 10-2: Abnormal heat—Ball pressure test*

IEC 61032, *Protection of persons and equipment by enclosures—Probes for verification*

1.4 Definitions

For the purpose of this Standard, the definitions in AS/NZS 3100 and those below apply.

1.4.1

aperture panel

a separate part of the faceplate with pin aperture set(s)

SEE: [Figure 3.8](#)

1.4.2

aperture set

active, neutral and earth pin apertures on a socket-outlet

Note 1 to entry: This does not preclude configurations with auxiliary pins.

1.4.3

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

1.4.4**faceplate**

escutcheon plate, flushplate, gridplate or cover of a socket-outlet incorporating an aperture set

1.4.5**fully recessed socket-outlet**

a socket-outlet provided with additional protection in accordance with [Clause 3.6.4](#)

1.4.6**insulated pin plug**

a plug with all live pins having an insulated portion in accordance with this Standard

Note 1 to entry: Both active and neutral pins are considered to be live.

1.4.7**insulation piercing terminal or connecting device**

a terminal or connecting device for the connection and possible disconnection of one conductor or the interconnection of two or more conductors, the connection being made by piercing, boring through, cutting through, removing, displacing or making ineffective in some other manner the insulation of the conductor(s) without previous stripping

Note 1 to entry: The removal of the sheath of the cable, if necessary, is not considered as a previous stripping.

1.4.8**non-rewireable plug**

a plug constructed so that it forms an integral unit with its flexible cable or cord so that—

- (a) the flexible cable or cord cannot be detached from the accessory without making it permanently useless; or
- (b) the flexible cable or cord cannot be replaced by hand or by using a general-purpose tool.

1.4.9**plug**

an accessory having pins designed to engage with the contacts of a socket-outlet and incorporating means for the electrical connection and mechanical retention of flexible cables or cords

1.4.10**plug, IP-rated, with threaded retaining device**

a plug complying with this Standard provided with an internal threaded retaining device complying with this Standard and suitable for joining with a socket-outlet, IP-rated, with threaded retaining device

1.4.11**rewireable plug**

a plug constructed so that the flexible cable or cord can be replaced

1.4.12**socket-outlet**

an accessory with socket contacts designed to engage with the pins of a plug and having terminals for the connection of cables or cords

1.4.13**socket-outlet, IP-rated, with threaded retaining device**

a socket-outlet complying with this Standard provided with an external threaded retaining device complying with this Standard and suitable for joining with a plug, IP-rated, with threaded retaining device

1.4.14**special purpose plugs and socket-outlets**

special purpose plugs and socket-outlets are based on a standard plug and socket with variations and provide a technical advantage and do not adversely affect the safety of the standard plug and socket-outlet, especially with regards to interchangeability and non-interchangeability

Note 1 to entry: Examples of a special purpose plug and socket-outlet are those with additional pins or with special shaped earth pins.

A1 1.4.15**Pitch diameter (PD)**

The simple effective diameter of screw thread, approximately halfway between the major and minor diameters. A1

Section 2 Plugs

2.1 Terminals and internal connections

2.1.1 Materials

Terminals and internal connections, intended primarily for carrying current shall be of a corrosion-resisting metal with sufficient hardness and rigidity for the intended application.

2.1.2 Construction of terminals

The terminals shall be of suitable size and form to accommodate the conductors of a flexible cord of current-carrying capacity corresponding to the marked current rating of the plug.

Facilities shall be provided to prevent slipping or spreading of the conductors or conductor strands. Where the facilities are such that the conductor is to be located around the shank of the terminal screw and clamped under the screw head, the following requirements shall apply:

- (a) When the terminal screw is screwed in to the limit of its thread, the clearance between the head of the screw and the washer or other means of retention of the conductor shall not exceed 0.4 mm.
- (b) The terminal screw shall be of sufficient length to enable it to be backed off sufficiently from the washer or other means of retention of the conductor so that the conductor can be located around the shank without difficulty.
- (c) Where the means of retention of the conductor is not continuous, e.g. prongs, there shall be at least three points of retention and the maximum angle between any two points shall not exceed 150°.
- (d) Where the means of retention of the conductor is continuous, e.g. a portion of the insulating moulding, the angle subtended by the arc of the means of retention shall be not less than 180°.

2.2 Plug pins

2.2.1 Material for pins

Current-carrying parts of plug pins shall be of metal with, under the conditions occurring in the plug, sufficient mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use. Conformance is checked by inspection and, where in doubt, by chemical analysis.

Examples of suitable materials, when used within the permissible temperature range and under normal conditions of chemical pollution, are—

- (a) copper;
- (b) copper alloy containing at least 58% copper for parts made from cold rolled sheet or at least 50% copper for other parts; or
- (c) stainless steel containing at least 13% chromium and not more than 0.09% carbon.

2.2.2 Assembly of pins

Where, during assembly, pins may become detached from the body of a plug yet remain attached to the conductors of a flexible cord, or have to be detached from the body to enable connection, it shall not be possible for a plug to be assembled with any pin located in a position other than that intended.

In a plug made of resilient insulating material, the pins and terminals shall be held securely in position.

NOTE See [Clause 2.8](#) for dimensions of flat pins.

2.2.3 Form of pin

The plug pins shall be adequately proportioned throughout, and the portion adjacent to the connection shall be designed to not introduce a stress concentration that may lead to a fracture of the pin, and shall be suitably shaped to prevent abrasion or cutting of conductor strands due to flexure in normal use.

The exposed ends of plug pins shall have a bevel or radius to facilitate entry into socket-outlets and to operate shutters.

Round pins shall have a semicircular end profile.

Flat pins with the following width and thickness profiles are deemed to comply:

- (a) Flat pins with a radius on the end with side bevels, as shown in [Figure 2.1\(h\)](#), having the following profiles:
 - (i) Width profile with an arc on the centre-line of the pin of—
 - (A) 6 mm for all pins of 10 A plugs and live pins of 15 A plugs; or
 - (B) 11 mm for earth pins of 15 A plugs and all pins of 20 A plugs.
 - (ii) Thickness profile with each corner bevelled 0.3 mm to 0.4 mm along the sides, finishing along the pin at 0.8 mm to 1.0 mm.
- (b) Flat pins square on the end with corner bevels and side bevels, as shown in [Figure 2.1\(i\)](#), having the following profiles:
 - (i) Width profile that is square and with each corner bevelled 0.6 mm finishing along the pin at 0.8 mm to 1.0 mm.
 - (ii) Thickness profile with each corner bevelled 0.3 mm to 0.4 mm along the sides, finishing along the pin at 0.8 mm to 1.0 mm.
- (c) Flat pins square on the end with corner bevels and a radius on the sides, as shown in [Figure 2.1\(j\)](#), having the following profiles:
 - (i) Width profile that is square and with each corner bevelled 0.6 mm finishing along the pin at 0.8 mm to 1.0 mm.
 - (ii) Thickness profile with a radius of approximately half the material thickness along the sides, finishing along the pin at 0.8 mm to 1.0 mm.

The contact portion of the pins shall be smooth and free from openings or indentations; however, for flat-pin plugs, a longitudinal seam or opening in the contact portion of one face up to 0.3 mm width is deemed to comply. The thickness of any pin at the seam is measured using a 0.3 mm thick blade, as indicated in [Figure 2.3](#) and shall not be less than 1.58 mm.

NOTE This is to ensure satisfactory mating with edge-type socket contacts.

The exposed portion of earthing pins and pins other than insulated pins shall be free from any non-metallic coverings or coatings.

2.2.4 Insulation of plug pins

Live parts of insulated pin plugs shall not be exposed when the plug is partially or fully engaged with the associated socket.

Conformance is checked by measurement to [Figure 2.4](#).

For the purpose of this Clause, lacquer, enamel or sprayed insulating coating is not considered to be insulation material.

All live pins on low voltage plugs except for those shown in [Figure 2.1\(a2\)](#), [Figure 2.1\(b\)](#) and [Figure 2.1\(g\)](#) shall be of the insulated pin type.

The colour green or a combination of green and yellow shall not be used for the insulation of insulated pins.

2.3 Insulating materials

2.3.1 General

Except for ceramics, all insulating materials of a plug shall comply with [Clause 2.13.11](#).

The moulding or encapsulating material shall be of even texture throughout and of suitable proportions to ensure adequate physical properties. It shall be free of voids, which may significantly lessen the mechanical strength or electrical properties of the plug.

2.3.2 Plug body

The insulating portion of a plug body shall consist of—

- (a) insulating material with properties not inferior to those specified in AS/NZS 3121 for insulating mouldings having a temperature class of 80°C; or
- (b) ceramic material of a type that, after 48 h immersion in water and after all visible drops of water have been removed from the surface using a clean dry cloth, shall not have increased in mass by more than 2%.

2.3.3 Plug cover

The insulating material of a plug cover shall have properties not inferior to those specified in AS/NZS 3121 for insulating mouldings with a temperature class of 60°C.

2.4 Non-rewireable plugs

A non-rewireable plug shall comply with the following requirements:

- (a) Each conductor shall be rigidly and effectively attached to the appropriate plug pin. Each plug pin, with the conductor attached to it, and the insulation of the conductor adjacent to the connection, shall be adequately supported and secured in position in the plug.
- (b) The conductors shall be attached to the plug pins by clamping, crimping, welding or soldering. Soldered connections shall comply with AS/NZS 3100. Soldering shall be used only to supplement a clamped or crimped connection unless the design of the plug is such that the soldered connection will not be subjected to flexure or undue mechanical stress during normal use of the plug and cord set.
- (c) The flexible cord, complete with any braid, cover or sheath, shall be taken into the body of the plug. The complete flexible cord shall be securely held in position in the plug by the moulding, encapsulation, cover or other suitable means that will effectively prevent any part of the flexible cord from moving out of the plug during normal use.

2.5 Means of entry and cord anchorage for flexible cord

2.5.1 General

Provision shall be made for entry of a flexible cord together with any protective covering, and for effective anchorage of the flexible cord or range of cords that the plug is intended to accommodate, so that any stress on the terminals will be substantially reduced. For rewirable plugs, the anchorage shall be effective for the range of flexible cords listed in [Table 2.1](#), except where—

- (a) there is a special aperture for the accommodation of only one type or size of flexible cord, a circular hole not being regarded as restricting the entry of cords having diameters smaller than that of the hole; or
- (b) the cord or range of cords as specified by the manufacturer is marked as required by [Clause 2.12.3\(d\)](#).

The cord anchorage shall comply with [Clause 2.13.4](#). In addition, except where the plug is specially designed to accept only parallel two-core unsheathed flexible cord, the following shall apply to rewirable resilient and thermoplastic plugs of the type referred to in [Figure 2.1\(a\)](#) and [Figure 2.1\(b\)](#).

Two means of cord grip shall be provided: one that anchors each insulated core by a pillar, post, grip, tortuous path or equally effective means; the second that grips or clamps the sheathing of the flexible cord. Both means may be incorporated in one device.

2.5.2 Side entry (of the flexible cord) plugs

In addition to complying with the general requirements of [Clause 2.5.1](#), low voltage flat pin side entry plugs having ratings up to and including 15 A, shall comply with [Figure 2.1\(d1\)](#) or [Figure 2.1\(d2\)](#), as appropriate.

NOTE [Figure 2.1\(d1\)](#) is primarily intended for general-purpose side-entry plugs, whereas [Figure 2.1\(d2\)](#) allows for side-entry plug in devices and special purpose side-entry plugs, the maximum size of which is not limited. Attention is also drawn to the requirements of [Clause 3.6.2](#) and [Notes 1 and 2 of Clause 3.6.3](#).

The angle of entry of the flexible cord for side entry plugs of the [Figure 2.1\(d2\)](#) type is not specified. However, for side entry plugs of this type, the edge of the flexible cord, including any protective covering or cord guard, closest to the plug face, shall be not less than 8.6 mm from the plug face.

Table 2.1 — Range of flexible cords

Plug rating A	Flexible cord	
	Conductor size, mm ²	Type
≤7.5	0.5, 0.75	Appropriate to design of plug
>7.5 ≤10	0.75, 1.0	Light duty Ordinary duty Heavy duty
>10	Maximum size appropriate to design of plug and next smallest size	Ordinary duty or heavy duty as appropriate

2.6 Capacitors

Where a capacitor is incorporated in a plug for the suppression of radio or television interference, the capacitor shall comply with the capacitor requirements of AS/NZS 3100.

2.7 Finger grip

A plug shall be provided with a functionally adequate finger grip to permit easy insertion into, or withdrawal from its corresponding sockets. Plugs complying with [Figure 2.1\(a1\)](#), [Figure 2.1\(c\)](#), [Figure 2.1\(d\)](#), [Figure 2.1\(f\)](#) or [Figure 2.1\(g\)](#) shall permit easy insertion, or withdrawal from, a fully recessed socket-outlet complying with [Figure 3.5](#).

Conformance shall be checked by inspection.

2.8 Ratings and dimensions of low voltage plugs

2.8.1 General

Plugs with ratings up to and including 20 A, shall conform to the appropriate dimensions shown in [Figure 2.1](#).

NOTE 1 In [Figure 2.1\(e1\)](#), the less than 21.9 mm and greater than 27 mm dimensions have been specified to give an exclusion zone to allow side-by-side use, without jamming, of plugs and equipment with integral plug portions in adjacent socket-outlets (refer to [Figure 2.11](#) for examples).

NOTE 2 In [Figure 2.1\(e\)](#), the 8.6 mm dimension on plugs or equipment with integral plug portions having an external enclosure projection greater than R21 mm is specified to ensure they fit in a recessed socket-outlet of [Figure 3.5](#) or a cord extension socket of AS/NZS 3120.

In addition to the dimensions of [Figure 2.1](#), the distance between a live pin of any plug and the edge of the moulding of the plug shall be not less than 9 mm. Where doubt exists regarding conformance with this requirement, the gauge of [Figure A1](#) in [Appendix A](#) or [Figure B1](#) in [Appendix B](#), or [Figure F1\(a\)](#) or [Figure F1\(b\)](#) in [Appendix F](#), as appropriate, shall be placed over the pins to ensure contact with the highest points associated with the plug face. Using a 1.5 mm feeler gauge of greater than 3 mm width and applied without undue force between the plug and the plug gauge, penetration to within 9 mm of the live pin shall not be possible.

No point on the front face of the plug shall protrude by more than 0.5 mm. The pin lengths shall be measured from a plane normal to the pins passing through the highest point on the front face of the plug, to the end of the pin.

NOTE Examples of protrusions are moulding irregularities and markings.

Dimensional requirements of [Figure 2.1\(e2\)](#) do not apply to plugs with greater than three pins as they will not engage with a standard socket-outlets complying with [Figure 2.1](#).

2.8.2 Integrally moulded plug and cord

A two-core flexible cord may be integrally moulded with a three-pin plug.

2.8.3 Two-pin flat-pin plugs with non-parallel pins

A low voltage, two-pin, flat-pin plug with pins arranged as in [Figure 2.1\(c\)](#) shall have a current rating not exceeding that of the cord to which it is connected. Such plugs shall be permitted only where the plug has a maximum rating of 10 A and is integrally moulded.

2.8.4 Conformance with dimensional requirements of [Figure 2.1](#)

Low voltage plugs shall be checked for conformance with the prescribed dimensions of [Figure 2.1](#) by any suitable means, except that conformance with the nominal dimensions covering disposition of pins, i.e. spacing from centre and angular orientation shall be checked by a gauge complying with [Appendix A](#), [Appendix B](#) or [Appendix F](#), as appropriate.

In addition, low voltage flat pin, or combination of flat and round pin plugs having ratings up to 15 A of the [Figure 2.1\(a1\)](#), [Figure 2.1\(c\)](#), [Figure 2.1\(d\)](#), [Figure 2.1\(f\)](#) or [Figure 2.1\(g\)](#) type, shall comply with the dimensional requirements of [Figure 2.1\(e1 and e2\)](#).

20 A plugs of the [Figure 2.1\(a2\)](#) type shall comply with the dimensional requirements of [Figure 2.1\(e2\)](#).

Plugs with insulated pins, complying with this Standard, need not comply with dimension $R20 \pm 1.0$ mm of [Figure 2.1\(e2\)](#) provided there is at least 9mm from the edge of the live pins to the edge of the plug face [Figure 2.1\(e3\)](#).

2.8.5 Plugs, IP-rated, with threaded retaining device

Where an IP-rated plug has a threaded retaining device, the dimensions of the retaining device shall comply with [Appendix H](#). ^(A1) The pitch diameter (PD) on the threaded retaining device shall be as shown in [Figure H1\(d\)](#). ^(A1)

2.9 Internal connections

The design and construction of a plug provided with earthing connections shall be such that when the plug is correctly wired and completely assembled—

- (a) a loose terminal screw or conductive material cannot bridge any live parts or earthing parts;
- (b) the earthing parts are effectively isolated from contact with a live conductor that may become detached; and
- (c) the live parts are effectively isolated from contact with any earthing conductor that may become detached.

Any connections for auxiliary devices, such as radio interference suppressors or visual indicators, shall comply with the above requirements.

2.10 Arrangement of earthing connections

The earthing pin of any low voltage, three-pin plug shall be that pin which is radial to the circle embracing the pins [see [Figure 2.1\(a\)](#), [Figure 2.1\(f\)](#) and [Figure 2.1\(g\)](#)].

2.11 Fuses

Plugs shall not include a fuse.

2.12 Marking

2.12.1 Required marking

The plug shall be marked with the following information in accordance with AS/NZS 3100:

- (a) The name, trade name, or mark of the manufacturer or of the supplier.
- (b) The current rating in amperes.
- (c) The voltage.
- (d) If not the only type of plug marketed by the manufacturer or supplier, the plug shall also be marked with a catalogue number, type number or name, or other marking that will distinguish it from any other plug marketed by that manufacturer or supplier.

Plugs of the same basic design incorporating identical components but with variations of pin arrangements, such as 10 A, 15 A or round earth pin, may have a common type marking.

- (e) Any IP rating greater than IP20, if claimed.

NOTE Manufacturers making a statement of conformance with this Australian/New Zealand Standard on a product, packaging or promotional material related to that product are advised to ensure that such conformance is capable of being verified.

2.12.2 Location of marking

The marking required by [Clause 2.12.1](#) shall be located as follows:

- (a) Items (a) and (d)—on any portion of the plug.
(b) Items (b), (c) and (e)—on the external body of the plug.

2.12.3 Additional requirements for rewirable plugs

A rewirable plug shall also be supplied with instructions detailing the following:

- (a) A diagram illustrating the method of connection of the conductors and, in particular, the earthing conductor and the cord anchorage. This diagram shall show the earthing conductor printed in green and yellow. The live conductors shall not be coloured.
(b) A full-scale diagram showing the length of sleeving and insulation to be stripped back.
(c) A description of the method of connection of each conductor giving the permissible alternative colours for the active, neutral and earthing conductors, respectively.
(d) The size and types of flexible cords with which it is intended to be used.

NOTE Plugs intended to be marketed in bulk, e.g. to equipment manufacturers, may be supplied with one set of instructions per package.

2.12.4 Earthing connections

Where a rewirable plug incorporates a pin intended to provide an earthing facility, the pin shall be distinguished by marking in accordance with the requirements for the marking of the earth connection in AS/NZS 3100 and located either on the pin or adjacent to the earthing terminal.

This marking shall be supplemented by the application of a conspicuous green colour on, or adjacent to, the earthing terminal, if the plug is of the rewirable type.

Where, during assembly, pins may become detached from the body of a plug yet remain attached to the conductors of a flexible cord, or are required to be detached from the body to enable connection, the above information shall be conspicuously marked on the earthing pin and on the body adjacent to the earthing pin position.

2.12.5 Live connections

2.12.5.1 General

The marking of live connections of rewirable plugs shall be as required by AS/NZS 3100, except that the active connection of plugs shall be indicated by the letter 'L', 'A' or 'P'. 'L' is the preferred letter.

2.12.5.2 Location of marking

Where pins may become detached from the body or are required to be detached to enable connection to the terminals, the marking shall be inside the body of the plug adjacent to the terminals.

In other cases, the marking may be on the terminals.

2.12.6 Configuration of plugs

A plug conforming to [Figure 2.1\(a\)](#), [Figure 2.1\(c\)](#), [Figure 2.1\(f\)](#) or [Figure 2.1\(g\)](#) shall have its pins disposed so that, when the pins are correctly connected, the pin configuration, viewed as from the pins, shall be earth, neutral and active in a clockwise direction.

Where there is no earthing pin, the live pins shall conform to this configuration.

2.13 Tests on plugs

2.13.1 General

Plugs shall be subjected to the tests specified in [Table 2.2](#), carried out in the stated order, and shall comply with the requirements specified for each test.

[A₁] The general test conditions described in AS/NZS 3100 shall be observed when carrying out the tests specified by this standard. **[A₁]**

Table 2.2 — Plugs—Tests to be applied and order of application

1	2	3	4
Test No.	Description of test	Reference for test procedure and criteria*	Sample identification
	General and dimensions	2.1 to 2.12	A
1	Insulation resistance test	2.13.2	A
2	High voltage test	2.13.3	A
3	Flexible cord anchorage test for rewirable plugs	2.13.4	A
4	Test of external nut or lamping ring	2.13.5	A
5	Screw threads and fixings	AS/NZS 3100	A
6	Attachment of covers	2.13.6	A
7	Mechanical strength of pin tests	2.13.7	
7a	Tumbling barrel test	2.13.7.1	BCD
7b	Pin bending test	2.13.7.2	EFG
8	Temperature rise test	2.13.8	H
9	Securement of pins	2.13.9	
9a	Movement of pins	2.13.9.1	I
9b	Fixing of pins	2.13.9.2	J
10	Determination of IP rating	2.13.10	K
11	Determination of ignitability and combustion propagation	2.13.11	any or L†
12	Tests on non-rewireable plug and cord sets	2.13.12	
12a	Attachment of flexible cord	2.13.12.2	M
12b	Attachment of insulated cores	2.13.12.3	N
12c	Attachment of sheathing (sheathed cords)	2.13.12.4	O
12d	Attachment of insulation (unsheathed cords)	2.13.12.5	O
12e	Attachment of conductors	2.13.12.6	Qu‡
13	Tests for plugs with insulated pins	2.13.13	
13a	Pressure test at high temperature	2.13.13.2	Pin _a §
13b	Static damp heat test	2.13.13.3	R
13c	Low temperature test	2.13.13.4	S
13d	Impact test at low temperature	2.13.13.5	Pin _b §
13e	Abrasion test	2.13.13.6	RS
Total number of samples required: Tests 1 to 9 10 (A, B, C, D, E, F, G, H, I, J) Test 10 1 (K) Test 11 1 (L) Test 12 4 (M, N, O and one un moulded Q) Test 13 2 (R, S) plus 2 (Pin _a and Pin _b) insulated pins			
* Clause numbers refer to this Standard. † Resistance to fire test may require a further sample in new and clean condition. ‡ Q _u is an un moulded sample. § Pin _a and Pin _b are samples of separate insulated pins only. The manufacturer may indicate that R and S are the same sample.			

2.13.2 Insulation resistance test

The insulation resistance of a plug shall be measured at a voltage of 500 V d.c. as follows:

- (a) Between all poles of the plug, taken in pairs.
- (b) Between live poles of the plug and any external metal, all live poles of the plug being connected together.
- (c) Between live poles of the plug and the earthing terminal of exposed metal, the live poles being connected together.
- (d) Between live poles and a flexible electrode applied to non-conducting parts normally handled in service, all live poles connected together.
- (e) For insulated pin plugs, between live poles and a metal foil applied around the insulation on each live pin for a distance of approximately 4 mm from plug face, all live poles being connected together.

The measured insulation resistance shall be not less than 5 M Ω .

2.13.3 High voltage test

The plug shall withstand without failure an a.c. voltage of the value indicated in [Table 2.3](#), applied between the parts set out in [Items \(a\) and \(c\) of Clause 2.13.2](#) for 1 min in each case.

The plug shall further withstand, without failure, a voltage of 3000 V a.c. applied between the parts set out in [Items \(b\) and \(d\) of Clause 2.13.2](#) for 1 min in each case.

The insulation of insulated pin plugs shall withstand a voltage of 1250 V a.c. for 1 min applied in accordance with [Clause 2.13.2\(e\)](#).

Table 2.3 — Test voltages for high voltage test

Working voltage (r.m.s.) between parts (see Note)		Testing voltage
	≤ 32 V	500 V
>32 V	≤ 250 V	1 000 V
>250 V	≤ 650 V	1 000 V + (2 $\times$ working voltage) with a maximum of 2 000 V
NOTE For example, a plug for connection to a system operating at 415 V between phases and 240 V to earth would require a test of 1000 + (2 $\times$ 415) V between live terminals but only 1 000 V between each live terminal and the earth terminal.		

2.13.4 Flexible cord anchorage test for rewirable plugs

The cord anchorage test for rewirable plugs shall be carried out in accordance with the following test method.

The cord anchorage shall be tested with the conductors connected to the appropriate terminals.

A direct pull of the values specified in [Column 4 of Table 2.4](#) shall be applied through the flexible cord in the direction in which it enters the plug.

Over a period of 10 s, the pull shall be increased uniformly to the appropriate value, maintained at that value for a further 10 s, and then released.

This test shall be performed three times.

The terminal screws of resilient and thermoplastic plugs shall be loosened as much as possible without removing the screws and a direct pull of the values specified in [Column 5 of Table 2.4](#) shall be applied through the flexible cord. Over a period of 10 s, the pull shall be increased gradually to the appropriate value, maintained at that value for a further 10 s, then released. This test shall be performed three times.

The number of cores in the flexible cord shall be appropriate to the number of pins of the plug. Notwithstanding [Column 3 of Table 2.4](#), if a plug has been designed to accommodate only a particular type of flexible cord in accordance with [Clause 2.5](#), the plug shall be tested only with that cord; however, an entry hole of a size corresponding to the diameter of a particular type of circular flexible cord shall not be considered as restricting the use of the plug to that flexible cord.

The cord anchorage shall be considered inadequate if the flexible cord parts from the terminals, if the terminals break away or are impaired or, if during the test with the terminal screws loosened, the flexible cord moves longitudinally by 2 mm in the anchorage, either before the direct pull reaches the specified value or during the time that the pull is maintained.

Table 2.4 — Loads for cord anchorage test

1	2	3	4	5
Plug rating	Flexible cord		Test force N	
A	Size, mm ²	Type	Conductors connected to terminals	Conductors connected; terminal screws loosened
≤3	0.5	Appropriate to design of plug	70 ±0.7	50 ±0.5
>3 ≤7.5	0.75	Appropriate to design of plug	110 ±1	50 ±0.5
>7.5 ≤10	0.75	Light duty* or ordinary duty		
>10 ≤15	1.0	Ordinary duty*		
>15	Next smaller size than maximum intended to be accommodated	Ordinary duty* or heavy duty if appropriate	110 ±1	65 ±0.7
* PVC insulated and sheathed.				

2.13.5 Test of external nut or clamping ring

Plugs that incorporate an external nut or clamping ring as a means of cord anchorage shall be subjected to the following test.

A plug shall be wired with a minimum sized cord, as specified by the manufacturer, and an axial force of 110 N shall be applied to the external nut or clamping ring for 60 s and the external nut or clamping ring shall not become detached.

2.13.6 Attachment of covers

A plug with a removable cover, which is not secured by screws and which, when removed, exposes live parts, shall, together with the test equipment, be heated to a temperature of 50 ±2°C for 1 h and shall be maintained at that temperature throughout the test. The test shall be conducted without a cord attached to the plug.

The base of the plug shall be securely held in position. A force which, over a period of 10 s, shall be increased steadily to 60 ±0.6 N and held at this value for a further 10 s, shall be applied evenly at the neck of the plug in a direction parallel to the pins. This procedure shall be conducted three times on the same plug, at intervals of 5 min, without disturbing the cover between tests.

During the test period, the cover shall not separate from the base to enable live parts to be accessible to the standard test finger.

2.13.7 Mechanical strength of pin tests

2.13.7.1 Tumbling barrel test

Three plugs, not subjected to any previous tests, shall be tested in a tumbling barrel as described in AS 60068.2.32. Rewireable plugs shall be fitted with a flexible cord as specified in [Table 2.1](#), having the smallest cross-sectional area of the lightest type and a length of approximately 100 mm, measured from the outer end of the guard (if any) or the plug.

Terminal screws and assembly screws shall be tightened with a torque equal to two-thirds of the torque specified in the test for screw threads and fixings of AS/NZS 3100.

Non-rewireable plugs shall be tested with the flexible cord as delivered, the cord being cut so that a free length of approximately 100 mm projects from the outer end of the guard or the plug (if any).

The samples shall be dropped from a height of 500 mm onto a steel plate, 3 mm thick. After each 100 drops the pins shall be inspected and straightened to pass through the gauge of [Figure A1](#) or [Figure F1](#). The total number of falls shall be 1 000.

The barrel shall be turned at a rate of 5 r/min, to yield 10 falls per minute. Only one sample shall be tested at a time.

After the test, the sample shall show no damage within the parameters of this Standard. In particular the following shall apply:

- (a) Live parts shall not have become exposed to the standard test finger.
- (b) For earth pins, the resistance of the plug/socket-outlet circuit shall be such that conformance with [Clause 3.14.7](#) is maintained.
- (c) Any other function affecting safety shall not be impaired.
- (d) No live part shall have become detached or loosened, to the extent that a hazardous situation is created (see [Clause 2.9](#)).
- (e) The pins shall be inspected with normal, or corrected to normal, vision. Insulation may be removed if necessary. Pins shall not be broken or show cracking.

NOTE 1 Special attention is paid to the connection of the flexible cord. Small pieces may be broken off without causing rejection, provided that the protection against electric shock is not affected.

NOTE 2 Slight damage to the finish and small dents are neglected.

NOTE 3 The specified free length of flexible cord of 100 mm may be reduced if the overall length of the plug and flexible cord approaches the width of the tumbling barrel test apparatus.

NOTE 4 Tests to ascertain conformance with Items (a), (b) and (c) are conducted only in case of doubt.

NOTE 5 Minor damage to plug pins is ignored.

2.13.7.2 Pin bending test

All flat pins of plugs rated up to and including 15 A shall be subjected to a pin bending test.

Three sample plugs not subjected to any previous tests shall be tested as follows:

- (a) Pins of assembled plugs shall be tested by clamping the plug in a rigid holding block and applying a bending force, as shown in [Figure 2.8](#), to the pin under test.

- (b) The pins shall be straight at the beginning of the test. If there is any doubt about the straightness of the pin, it shall be checked by the appropriate plug gauge shown in [Appendix A](#), [Appendix B](#) or [Appendix F](#).
- (c) The point of application of the force shall be 14 ± 0.5 mm from the face of the plug.
- (d) The direction of the force shall be along a line parallel to the face of the plug.
- (e) Active and neutral pins shall be forced towards the centroid of the plug and then back to the starting point. On the first sample plug, any earth pin shall be forced but in one direction only and then forced back to the starting point. On the second sample plug, any earth pin shall be forced in the opposite direction to that used for testing the first sample plug. On the third sample plug, any earth pin shall be forced in the direction that gave the least favourable result during testing of the first two sample plugs.

NOTE This is intended to simulate damage that may occur when a plug is walked on and bent pins are straightened.

- (f) The distance moved from the point of application shall be 7.5 ± 0.3 mm, and then the pin shall be forced back to the starting point. Any 'spring-back' is ignored.

NOTE 'Spring-back' means that the pin is allowed to move back to a position less than the travel distance, when the force is removed.

- (g) The travel from the starting point to the end point (7.5 mm) and back to the starting point is one cycle (i.e. one cycle is two separate movements).
- (h) The speed of deflections shall be a maximum of 50 mm/s, without intentional delay between consecutive movements within each cycle.
- (i) The interval between successive cycles shall be a minimum of 10 s.
- (j) The duration of one cycle shall be a maximum of 60 s.
- (k) The pins shall be tested for 20 complete cycles.
- (l) After the tests the pins shall be inspected with normal or corrected to normal vision.
- (m) The pin shall not be broken off.

NOTE Cracking of the pin, less than full thickness, is not deemed to be broken off.

- (n) If in doubt, pins shall be disassembled from the plug and any insulation removed.

NOTE In some cases the break may be below the face of the plug or the insulation may hold the broken pieces together, retaining electrical contact.

2.13.8 Temperature rise test

Plugs shall be so constructed that they comply with the following temperature rise test:

- (a) Non-rewireable plugs shall be tested as delivered with the minimum cross-sectional area of conductor size for each respective current rating.
- (b) Rewireable plugs shall be fitted with polyvinyl chloride flexible cords with conductors having the minimum cross-sectional area specified in the manufacturer's instructions.

The terminal screws or nuts shall be tightened with a torque equal to two-thirds of that specified in [Table 2.2](#) Test No. 5.

To ensure normal cooling of the terminals, the conductors connected to plugs shall have a length of at least 1 m.

The plug shall be tested in a draught-free environment at the centre of a plane wooden board, which shall be at least 6 + 2 mm thick, 500 mm wide and 500 mm long with the rear completely enclosed in a wooden mounting enclosure (wall box) of 90 mm × 60 mm × 40 mm. Apertures in the wooden board for the plug pins to pass through are specified in [Table 3.1](#) (see [Figure 2.9](#)).

Plugs shall be tested as follows:

- (i) The appropriate clamping units with the dimensions specified in [Figure 2.10](#) are fitted on each live pin of the plug, together with the thermocouple. The screw is then placed approximately in the middle of the bare part of the pin and tightened with a torque of 0.8 Nm. The clamping unit is fitted with PVC-insulated conductors at least 1 m long, having nominal cross-sectional areas as shown in [Table 3.3](#). Where the conductors pass through the wooden mounting enclosure (wall box) there shall be a complete airtight seal between the conductors and the enclosure.
- (ii) An alternating current of 1.1 times the rated current of the plug is then passed through each live pin/clamping unit for 1 h.
- (iii) For plugs with three poles or more, the current during the test shall be passed through the phase contacts, where applicable. In addition, separate tests shall be made passing the current through the neutral contact, if any, and the adjacent phase contact.
- (iv) The temperature rise of the thermocouple shall not exceed 45 K.

2.13.9 Securement of pins

2.13.9.1 Movement of pins

Plugs shall be tested for pin movement by clamping the pin or pins not under test in a rigid holding block positioned 5 ± 0.5 mm from the plug face and applying a force of 18 ± 1 N to the pin under test. The design of the block shall be such that the pin under test shall not come into contact with the block during the test.

Except for non-rewireable plugs, the test shall be carried out without a cord attached to the plug, and with the terminal screws loosened sufficiently to allow a 1 mm² conductor to be connected.

The plug and test equipment shall be preconditioned at a temperature of $40 \pm 1^\circ\text{C}$ for 1 h, without the test force applied. Throughout the test, all parts of the plug and test equipment shall be maintained at this temperature.

For all plugs, the point of application of the force shall be 14 ± 0.5 mm from the face of the plug along the pins, and the direction of the force shall be—

- (a) in both directions along the line perpendicular to the plane of the pin, and passing through the centre of the pin; and
- (b) in that plane in both directions along a line at right angles to that specified in Item (a).

Over a period of 10 s, the force shall be gradually applied to each of the pins in the manner prescribed in Items (a) and (b), maintained at its maximum value for 10 s, and then released. The deflection of the pins shall be measured along the line of force relative to the face of the rigid holding block during the period when the force is applied. The maximum deflection shall not exceed 2.0 mm.

Following the test on all pins of a plug conforming to [Figure 2.1](#), any distortion 5 min after the completion of the test on the last pin shall be such that it will not prevent the plug from being inserted in the appropriate standard gauges shown in [Appendix A](#), [Appendix B](#) and [Appendix F](#) without the application of undue force.

For other types of plugs, any distortion after 5 min shall be such that will not prevent the plug being inserted into an appropriate socket-outlet without the application of undue force.

2.13.9.2 Fixing of pins

A separate sample of a plug shall be heated to a temperature of $50 \pm 2^\circ\text{C}$ for 1 h and maintained at that temperature during the whole of these tests, including the 5 min period after removal of the test load.

The plug shall be held firmly in such a manner that there will be no undue squeezing or distortion of the body, and the means of holding shall not assist in maintaining the pins in their original position.

Each pin, in turn, shall have applied to it a force which, over a period of 10 s, shall be increased steadily to 60 ± 0.6 N and held at this value for 10 min.

Two tests on each pin shall be conducted, one with the direction of force along the length of the pin towards the body of the plug, and the other with the direction of force along the length of the pin away from the body.

The attachment of pins shall be considered inadequate if any pin is displaced relative to the adjacent material of the body by more than 2.4 mm at any time during these tests, or if any pin fails to return to within 0.8 mm of its nominal length specified in [Figure 2.1](#) within 5 min of the removal of the test force.

2.13.10 Determination of IP rating

The IP rating of a plug shall be determined with a socket-outlet nominated by the manufacturer and with any retaining device engaged. The assembly shall be tested to AS 60529.

Where a plug is to be tested to first characteristic numeral 5 of AS 60529 (dust test), testing shall be carried out under the conditions specified in AS 60529 for Category 2.

2.13.11 Determination of ignitability and combustion propagation

Plugs shall comply with the requirements for resistance to fire in accordance with AS/NZS 3100 for equipment not designated as 'attended' or 'unattended'. The glow-wire test temperature 'T' shall be 750°C .

2.13.12 Tests on non-rewireable plug and flexible cord

2.13.12.1 General

Non-rewireable plugs and flexible cords shall pass the tests in [Clauses 2.13.12.2](#) to [2.13.12.6](#), except that only the test of [Clause 2.13.12.5](#) shall be applied to flexible cords with tinsel conductors. Each of the tests is to be conducted on a separate sample.

For the purpose of these tests, the ambient temperature shall be maintained at $20 \pm 2^\circ\text{C}$.

2.13.12.2 Attachment of flexible cord

The flexing test shall be conducted according to the following procedures:

- (a) *Fixing the plug to the test apparatus* The plug shall be fixed by the pins in a rigid holding block to the oscillating member of the apparatus, as shown in [Figure 2.2](#), so that when the member is in the middle of its travel, the axis of the flexible cord, where it enters the plug, is vertical and passes through the axis of oscillation. For the purpose of this test, any cord guard is considered to be part of the plug.

Plugs with flat cords shall be mounted so that the major axis of the section is parallel to the axis of oscillation.

The plug shall be positioned on the test apparatus so that when the member is oscillating, minimum lateral movement of the weight and cord occurs.

NOTE 1 To obtain a mounting position with the minimum lateral movement of the weight and cord during a test, the apparatus should be constructed in such a manner that the different supports on the oscillatory member may be adjusted by a threaded spindle with a possible range of displacement of at least from 20 mm to 150 mm.

NOTE 2 A device, e.g. a slot or a pin, should be used to check that the weight and cord assembly make minimum lateral movement.

- (b) *Loading of flexible cord* The cord shall be loaded with a mass such that the force applied is—
- (i) 20 ± 0.2 N for accessories with cables or cords having a nominal cross-sectional area exceeding 0.75 mm^2 ; or
 - (ii) 10 ± 0.1 N for accessories with flexible cords having a nominal cross-sectional area not exceeding 0.75 mm^2 .

The weight shall be positioned not less than 300 mm from the point at which the flexible cord enters the plug (see [Figure 2.2](#)).

- (c) *Test method* The oscillating member shall be moved through an angle of 90° (45° on either side of the vertical), the number of flexings being 10 000 and the rate of flexing 60 per minute.

NOTE A flexing is a movement in one direction.

Samples with circular section cables or cords are turned through 90° in the oscillating member after 5 000 flexings. Samples with flat cords are bent only in a direction perpendicular to the plane containing the axis of the cores.

- (d) *Conformance during the flexing test* During the test, no strands shall pierce the insulation so that they become accessible.
- (e) *Conformance after the test* The criteria for conformance are the following:
- (i) The sample shall not show damage.
 - (ii) The protective sleeve, if any, shall not have separated from the body.
 - (iii) The insulation of the flexible cord shall not have been damaged.
 - (iv) Not more than 10% of the number of strands of each conductor shall have broken.

2.13.12.3 Attachment of insulated cores

The plug shall be rigidly held by the pins. A direct pull in the direction in which the flexible cord emerges from the plug shall be applied through the insulated cores clamped together at a point approximately 600 mm from the point of entry to the plug, with the sheathing (if any) being removed back to the plug. Over a period of 10 s, the pull shall be increased uniformly to 110 ± 1 N, maintained at the maximum value for a further 10 s, and then released.

The attachment of the insulated cores shall be considered inadequate if any core detaches from the plug, or if all conductor strands detach from a pin at any time during the test.

2.13.12.4 Attachment of sheathing (sheathed cords)

The plug shall be rigidly held by the pins. A direct pull in the direction in which the flexible cord emerges from the plug shall be applied through the sheathing only at a point approximately 600 mm from the point of entry to the plug, with the insulated cores and bedding being severed at a point approximately 25 mm from the plug. An axial slit shall be made in the sheathing for this purpose. Over a period of 10 s, the pull shall be increased uniformly to 130 ± 1.3 N, maintained at that value for a further 10 s, and then released.