AS/NZS 3760:2010

Incorporating Amendments No. 1 and No. 2

STANDARDS NEW ZEALAND
PAEREWA AOTEAROA

Joint Australian New Zealand Standard

In-service safety inspection and testing of electrical equipment

Superseding AS/NZS 3760:2003

AS/NZS 3760:2010

STANDARDS Australia

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NOTES

In-service safety inspection and testing of electrical equipment

Edition 1 AS 3760:1990
Edition 2 AS/NZS 3760:1996
Edition 3 AS/NZS 3760:2000
Edition 4 AS/NZS 3760:2001
Edition 5 AS/NZS 3760:2003
Edition 6 AS/NZS 3760:2010
Reissued incorporating Amendment No. 1 (April 2011)
Reissued incorporating Amendment No. 2 (December 2012)

CONTENTS

REFERENCED DOCUMENTS

Reference is made in this document to the following:

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

AS/NZS 3000:2007	Electrical installations (known as the Australian/New Zealand wiring rules)
AS/NZS 3001:2008	Electrical installations – Re-locatable premises (including caravans and tents) and their site installations
AS/NZS 3002:2008	Electrical installations – Shows and carnivals
AS/NZS 3003:2003	Electrical installations – Patient treatment areas of hospitals and medical and dental practices and dialysing locations
AS/NZS 3010:2005	Electrical installations – Generating sets
AS/NZS 3012:2003	Electrical installations – Construction and demolition sites
AS/NZS 3019:2007	Electrical installations – Periodic verification
AS/NZS 3190:2009	Approval and test specification – Residual current devices (current-operated earth-leakage devices)
AS/NZS 3551:2004	Technical management programs for medical devices
AS/NZS 4249:1994	Electrical safety practices – Film, video and television sites
AS/NZS 4763 (INT):2006	Safety of portable inverters
AS/NZS 5761:2005	In-service safety inspection and testing – Second-hand electrical equipment prior to sale
AS/NZS 5762:2005	In-service safety inspection and testing – Repaired electrical equipment
AS/NZS ISO 9000:2005	Quality management systems – Series of Standards
AS/NZS ISO 31000:2009	Risk management
AS/NZS 60335.1:2002	Household and similar electrical appliances – General requirements
AS/NZS 61008.1:2004	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – General rules
AS/NZS 61009.1:2004	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – General rules

AUSTRALIAN STANDARDS

AS 1674.2:2007	Safety in welding and allied processes – Electrical
AS 2790:1989	Electricity generating sets – Transportable (Up to 25 kW)
AS 60529:2004	Degrees of protection provided by enclosures (IP Code)

NEW ZEALAND STANDARD

NZS 6115:2006	Electrical Installations – Mobile electro-medical connectable installations

INTERNATIONAL STANDARDS

IEC 60320:– (All parts)	Appliance couplers for household and similar general purposes

NEW ZEALAND LEGISLATION

Electricity Safety Regulations 2010

FOREWORD

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL 036 – In-service testing of electrical equipment to supersede AS/NZS 3760:2003 and its Amendment No. 1 (2005) from the date of publication. This edition has undergone a complete revision.

In-service testing is a necessary part of any safety program to help ensure the safety of persons using electrical equipment in the workplace. This Standard specifies in-service safety inspection and testing protocols and criteria that satisfy these obligations, and provides a cost-effective approach to safety without jeopardizing personnel safety or involving excessive equipment downtime.

The philosophy of the document is to provide an inspection and testing regime capable of implementation with only simple instrumentation, and performed by a person not necessarily having formal qualifications or registration, but who has the necessary practical and theoretical skills, acquired through training, qualification, experience or a combination of these, to correctly undertake the tasks prescribed by this Standard.

Amd 2 Dec '12

This Standard is not intended to demonstrate that equipment complies with the safety Standard appropriate to the equipment.

The methodology of the inspection and testing process is defined.

The frequency of repetition of that process is determined by the equipment type and by examination of the environment in which the equipment is used or working. For indicative purposes a number of different environments are provided with associated or suggested inspection/testing frequencies. These are based on the perception of the level of hazard and the degree of abuse to which the equipment is typically exposed. However, there will usually be multiple sub-environments within any location and the inspecting/testing frequency will be arrived at by an assessment of the actual environment in which the equipment is placed or used.

Words in **bold** in the text are defined in 1.4. When a definition concerns an adjective, the adjective and associated noun are also in **bold**.

OUTCOME STATEMENT

AS/NZS 3760 will enable persons responsible for the safety of electrical equipment in the workplace to instigate an inspection and testing programme to achieve that aim. It also enables persons undertaking the inspection and testing to carry out the task in a safe and effective manner.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
In-service safety inspection and testing of electrical equipment

SECTION 1 – SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies procedures for the safety inspection and testing of **low voltage** single phase and polyphase electrical equipment, connected to the electrical supply by a flexible cord or connecting device, and that

(a) Is new equipment placed into service for the first time;

(b) Is already in-service;

(c) Has been serviced or repaired;

(d) Is returning to service from a second-hand sale; or

(e) Is available for **hire**.

This Standard also specifies procedures for the safety inspection and testing of

(f) **Residual current devices (RCDs)** except those within the scope of AS/NZS 3003 and NZS 6115; and

(g) Portable inverters that generate or produce **low voltage**.

Typical examples of equipment covered by this Standard are:

(h) **Portable equipment**, hand-held equipment and **stationary equipment**, designed for connection to the **low voltage** supply by a **supply cord**, an appliance inlet or pins for insertion into a socket-outlet (see Figure G1);

(i) **Cord sets, cord extension sets** and outlet devices (also known as **electrical portable outlet devices (EPODs)**, or power boards);

(j) Flexible cords connected to **fixed equipment** in **hostile environments**;

(k) Portable power supplies (includes power adaptor/plug-pack, both of the safety **isolating transformer** and switch-mode type);

(l) Battery chargers including those for commercial or industrial use;

(m) Portable and transportable heavy duty tools such as high pressure washers and concrete grinders.

1.1.1

This Standard applies only to equipment in-service at a place of work or public place, or offered for **hire**.

1.1.2

This Standard does not apply to electrical equipment (such as suspended light fittings), installed at a height of 2.5 m or greater above the ground, floor or platform, where there is not a reasonable chance of a person touching the equipment and, at the same time, coming into contact with earth or any conducting medium which may be in electrical contact with earth or through which a circuit may be completed to earth.

1.1.3
This Standard does not apply to equipment which would need to be dismantled to perform the inspection and tests specified in this Standard.

NOTE – If, for some reason outside the scope of this Standard, equipment has to be dismantled to verify safety, this action is only to be performed by a technically qualified person.

1.1.4
Requirements for functional checks are not included in this Standard.

1.1.5
This Standard does not apply to **RCDs** within the scope of AS/NZS 3003 or NZS 6115.

1.1.6
This Standard does not apply to **fixed equipment** (except **RCDs**) or **stationary equipment** connected to wiring that forms part of the electrical installation and hence falls within the scope of AS/NZS 3000.

1.1.7
This Standard does not apply to medical electrical equipment nor any equipment connected to medical electrical equipment in a medical electrical system as defined in AS/NZS 3551.

NOTE – Test and inspection requirements for this equipment are contained in AS/NZS 3551.

1.1.8
This Standard does not apply to portable generators, within the scope of AS/NZS 3010 or AS 2790.

1.1.9
This Standard does not apply to demonstration stock in retail or wholesale outlets.

1.2 GENERAL

Equipment needs to be subject to regular inspection and testing to detect obvious damage, wear or other conditions which might render it unsafe. Equipment shall not be dismantled to perform inspection and testing, nor tested to destruction. Appendix A provides background information on the inspection and electrical testing regime set out in this Standard.

1.2.1 New equipment

1.2.1.1
In Australia, when the equipment is new, the supplier is deemed responsible for its initial electrical safety. New equipment need not be tested but shall be examined for obvious damage. Where deemed compliant the owner or **responsible person** shall ensure it is tagged in accordance with 2.4.2.1.

NOTE – This clause is drawn to the attention of owners of computer and office equipment, who may arrange for the tagging action to be undertaken by their in-house **competent person**.

1.2.1.2

In New Zealand, the equipment shall be inspected, tested and tagged on entry to service, unless it is supplied through an electrically safe **RCD**, or **portable residual current device (PRCD)** which itself has a current tag.

NOTE – For further information refer to the Electricity Safety Regulations: Regulation 26.

1.2.2 In-service equipment

Equipment already in-service shall be inspected and tested in accordance with Section 2.

1.2.3 Fixed or stationary equipment

Fixed equipment or **stationary equipment** connected by flexible cable or flexible cord (referred to as equipment wiring in AS/NZS 3000 – see Figure 4.5 from that standard that is reproduced below):

(a) That is not flexed in normal use nor exposed to damage nor is in a **hostile environment**, does not normally constitute a hazard sufficient to warrant routine in service electrical safety testing. Accordingly, the testing of such equipment is not required by this Standard;

(b) Where the flexible cable or flexible cord is flexed on equipment which is moved only for restocking, maintenance or, cleaning, for example, in-service testing is required. For such **fixed equipment** or **stationary equipment** it is sufficient, for the purposes of this Standard, to do a visual inspection and earth test only since **insulation** testing requires disconnection. For carrying out the earth test on such equipment additional knowledge and processes are required.

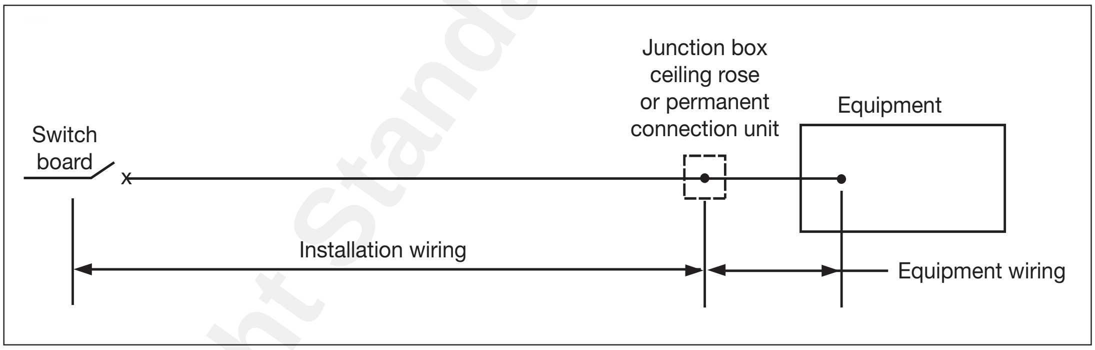


Figure 4.5 from AS/NZS 3000 showing equipment connected to the installation wiring by equipment wiring

1.2.4 Hire equipment

1.2.4.1 Responsibility for hire equipment at the commencement of hire

(a) New equipment from the supplier shall enter service in the **hire** industry in accordance with 1.2.1;

(b) The **hirer** has the responsibility to ensure that hired equipment complies with the requirements of this Standard at the commencement of **hire**;

(c) **Hirers** may combine the function of the tag specified in 2.4.2 and their in-house 'Ready for **hire**' tag, by, for example, colour-coding it to comply with 2.4.2.

1.2.4.2 Responsibility for hire equipment during hire

Responsibility for testing, inspection and tagging passes to the **hiree**. The appropriate time interval to retest shall be derived from Table 4, by assessing the environment in which the equipment is utilized.

1.3 INTERPRETATION

1.3.1

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard and subject to the same level of compliance as if it were in the body of the Standard, whereas an 'informative' appendix is provided for information and guidance, and may indicate good practice. Non-compliance with an informative appendix will not be seen as non-compliance with the Standard.

1.3.2 Shall

Indicates a statement is mandatory to achieve compliance with this Standard.

1.3.3 Should

Indicates a statement is preferred as indicating good practice, but is not mandatory.

1.3.4 May

Indicates the existence of an option.

1.3.5

Clause references are provided without prefix as the clause number only, for example 2.3.2.

1.3.6

Unless otherwise specified, all a.c. **voltage** and current values referenced are expressed in root mean square (rms) values.

1.4 DEFINITIONS

For the purpose of this Standard, the following definitions shall apply:

1.4.1 Accessible earthed parts

(a) **Accessible earthed parts** are a conductive part of electrical equipment, required to be connected to a protective earth, and that:

  (i) Are separated from **live parts** by **basic insulation**

  (ii) Can be touched with the jointed test finger as specified in AS 60529, and that

  (iii) Are not a **live part** but can become live if **basic insulation** fails;

(b) The term **accessible earthed parts** does not apply to the following:

  (i) **Insulation**, or by other conductive parts that are themselves earthed or separated from **live parts** by **double insulation** or **reinforced insulation**

  (ii) Metal nameplates, screwheads, covers or plates, and their means of fixing, which cannot become live in the event of failure of **insulation** of **live parts**, 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 electrical breakdown.

  (iii) Conductive 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 service personnel having an appropriate level of electrotechnical training.

(iv) Conductive 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.

NOTE – Non-metallic material that is conductive to a degree, and may contribute to a hazardous condition arising shall be deemed to be an **accessible earthed part**, subject to the above provisions.

(v) All external metal parts that are not connected to the protective earthing conductor and that are separated from live parts by **double insulation** or **reinforced insulation**, and includes parts used to support the equipment in operation.

NOTE – These parts are also known as accessible unearthed metal parts.

1.4.2 Class I equipment (basic insulated, protectively earthed equipment)

Equipment in which protection against electric shock does not rely on **basic insulation** only, but which includes an additional level of protection, in that conductive accessible parts are connected to the protective earthing conductor in the fixed wiring of the installation in such a way that those 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 **extra-low voltage**.

(2) This provision includes a protective earthing conductor as part of the flexible cord or flexible cable for equipment intended for use with a flexible cord or flexible cable.

(3) Other classes are described in AS/NZS 60335.1.

1.4.3 Class II equipment (double insulated equipment)

Equipment in which protection against electric shock does not rely on **basic insulation** only, but in which an extra layer of **insulation** (called '**supplementary insulation**') is provided to give **double insulation**, there being no provision for protective earthing or reliance upon installation conditions. This equipment is generally manufactured with a non-conductive (insulated) enclosure, and is marked either with the words 'DOUBLE INSULATED' or with the symbol ⧈ to allow easy identification.

NOTE –

(1) **Class II equipment** may also be manufactured with metal enclosures which are double insulated from **live parts**.

(2) **Class II equipment** may be provided with an earth connection for purposes other than safety, this earth connection is referred to as a functional earth (FE). Functionally earthed parts are double insulated from **live parts**.

1.4.4 Competent person

A **competent person** is one who the **responsible person** ensures has the necessary practical and theoretical skills, acquired through training, qualification, experience or a combination of these, to correctly undertake the required tasks.

NOTE –

(1) A **competent person** is not required to be a registered or licensed electrical practitioner. Requirements for registration vary between jurisdictions.

(2) Competency levels may need to be updated following technological advances in both the testing instrumentation available and the equipment being examined.

(3) It is expected that the **competent person** will:

(i) Be able to use test equipment safely and effectively

(ii) Have an understanding of the dangers of electricity, leading to an appreciation of the need for inspection and testing

(iii) Have an understanding of the construction of **Class I** and **Class II equipment**, and of the terms: **basic insulation**, **supplementary insulation**, **reinforced insulation** and **double insulation**, protective earth and earth continuity, **insulation** resistance and earth leakage current

(iv) Have an understanding of the application and requirements of this Standard

(v) Have an understanding of the relevant legislative requirements appropriate for the jurisdiction they are operating in.

(4) Guidelines to the knowledge of electrical principles with which a **competent person** is likely to be familiar are listed in Appendix B.

1.4.5 Cord set

An assembly of a plug intended for connection to a mains socket-outlet, a sheathed flexible cord and an appliance connector.

NOTE – An example of a single phase **cord set** is shown in Appendix C, Figure C1.

1.4.6 Cord extension set

An assembly of a plug intended for connection to a mains socket-outlet, a sheathed flexible cord and a cord extension socket.

NOTE – An example of a single phase **cord extension set** is shown in Appendix C, Figure C2.

1.4.7 Electric portable outlet device (EPOD)

A device, other than a **cord set**, or **cord extension set** having a single means of connection to a **low voltage** supply, and one or more outlet facilities. It may incorporate a reeling or coiling arrangement.

1.4.8 Fixed equipment

Equipment which is fastened to a support, secured in position or otherwise, due to its size and mass, located in a specific location.

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

1.4.9 Hire

A **hire** situation is created when the **hirer** provides electrical equipment, to a person or entity external to the **hirer's** organization, which passes out of the control of the **hirer**. A situation where equipment is supplied and operated by the **hirer** is not considered to constitute a **hire**. The term **hire** also includes **lease**.

1.4.10 Hiree

The person or business, that receives the equipment from the **hirer** or lessee.

1.4.11 Hirer

The person or business that offers the equipment for **hire** or lease.

1.4.12 Hostile environment

One in which the equipment or appliance is normally subject to events or operating conditions likely to result in damage to the equipment or a reduction in its expected life span. This includes, but is not limited to mechanical damage, exposure to moisture, heat, vibration, corrosive chemicals, and dust.

1.4.13 Insulation

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 include **insulation** used exclusively for functional purposes.

(b) **Supplementary insulation**

An independent **insulation**, applied in addition to the **basic insulation**, in order to ensure protection against electric shock in the event of a failure of the **basic insulation**;

(c) **Double insulation**

An **insulation** system 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**.

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

1.4.14 Isolating transformer

A transformer, including any enclosing case, the input winding of which is electrically separated from the output winding by **insulation** at least equivalent to **double insulation** or **reinforced insulation**.

1.4.15 Live parts

Live parts include live supply conductors and all parts which are electrically connected to the line supply conductors. While the neutral wire shall also be considered a **live part**, the protective earth is not a **live part**.

1.4.16 Portable equipment

Equipment which is moved while in operation, or an appliance which can be easily moved from one place to another while connected to the supply.

1.4.17 Power supply

An electrical device that—

Provides an output not exceeding 50 V a.c. or 120 V ripple free d.c; so as to provide supply to separate equipment.

NOTE – **A power supply** is also known as a plug pack, **extra low voltage power supply** unit or an a.c. adaptor.

1.4.18 Residual current device (RCD)

A mechanical switching device designed to make, carry and break currents under normal service conditions, and to cause the opening of the contacts when the residual current attains a given value under specified conditions. The **RCD** may be fixed or portable (**PRCD**).

RCDs are classified in AS/NZS 3190 according to their rated residual current as follows:

(a) Type I : ≤ 10 mA;

(b) Type II : > 10 mA ≤ 30 mA;

NOTE – More information may be found in AS/NZS 61008.1, and AS/NZS 61009.1.

1.4.19 Responsible person

The **responsible person** shall be considered as:

(a) The owner of the premises; or

(b) The owner of the electrical equipment; or

(c) A person who has a legal responsibility for the safety of electrical equipment within the scope of this Standard. Guidelines to assist a **responsible person** to assess the knowledge of a **competent person** are set out in Appendix B.

1.4.20 Stationary equipment

Equipment having a mass exceeding 18 kg.

1.4.21 Supply cord

A flexible cable or flexible cord, for supply purposes, which has one end connected to a plug with pins designed to engage with a socket-outlet, and the other end connected to terminals within the equipment.

1.4.22 Voltage

Differences of electric potential, normally existing between conductors and between conductors and earth as follows:

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

(b) **Low voltage** (LV) – exceeding extra-low **voltage**, but not exceeding 1000 V a.c. or 1500 V d.c.

SECTION 2 – INSPECTION AND TESTS

2 GENERAL

Experience has shown that greater than 90 % of defects are detectable by visual inspection. Therefore, equipment shall be visually inspected, physically checked and tested in accordance with this section.

The frequency of repetition of that process is determined by the equipment type and by examination of the environment in which the equipment is used or working.

For indicative purposes a number of environments are shown in column (a) of Table 4. These are based on the perception of the level of hazard and the degree of abuse to which the equipment is typically exposed.

However, there will usually be multiple sub-environments within any location and the inspecting/testing frequency will be arrived at by an assessment by the **responsible person**, of the actual environment in which the equipment is placed or used.

NOTE – For equipment that is supplied by **cord set**, both the **cord set** and equipment need to be tested and tagged separately.

2.1 FREQUENCY OF INSPECTION AND TESTS

Electrical equipment shall be inspected and tested:

(a) At intervals indicated in Table 4 (subject to a tolerance of two weeks), or as varied by a **responsible person** based on a risk assessment;

NOTE –

(1) Regulatory authorities, other Standards, workplace safety requirements or manufacturers' instructions may specify shorter or longer intervals appropriate to particular industries or specific types of equipment.

(2) Some regulatory jurisdictions limit the inspection and testing of electrical equipment to defined work activity or working environments. For example construction work or equipment used in a hostile operating environment.

(b) On return to service after a repair or servicing, that could have affected the electrical safety of the equipment. AS/NZS 5762 may apply;

(c) Before placement in service, if sourced from a second-hand sale, to ensure the equipment is safe. AS/NZS 5761 shall apply.

To allow the flexibility to devise a customized solution for particular circumstances, organizations with sufficient expertise and resource may substitute other periods than those indicated in Table 4, after conducting a documented risk assessment, undertaken in accordance with the process specified in AS/NZS ISO 31000, and taking into consideration any relevant legislative requirements or guidelines.

This risk assessment option does not apply to equipment offered for **hire**.

NOTE – This exclusion has been made as the **hirer** has no control over the end use of the equipment and therefore a valid risk assessment cannot be conducted by the **hirer**.

2.2 PERSONNEL

The inspection and testing tasks specified in this Standard shall be carried out by a **competent person**.

2.3 INSPECTION AND TESTING

2.3.1 General

Where applicable, in-service testing and inspection shall include:

(a) An external inspection of the equipment and the connecting facilities (for example, **supply cord**);

(b) Protective earth continuity tests for **Class I equipment**, **EPODs**, **cord sets**, and **cord extension sets**;

(c) **Insulation** testing, which may be achieved by measuring **insulation** resistance, or leakage current;

(d) Confirmation of the correct polarity of live connections in **cord extension sets** with rewireable plugs or rewireable cord extension sockets;

(e) Confirmation of the correct polarity of live connections in **cord sets** with rewireable plugs or rewireable connectors.

NOTE –

(1) Clear backed plugs and cord extension sockets facilitate the easy inspection of the effectiveness of the sheath grip and polarity checking.

(2) There are items incorporating an electrically held relay, which require **voltage** to maintain continuity. Such items may require application of rated **voltage** to allow testing.

2.3.2 Inspection

The following equipment checks shall be made by visual and physical inspection of all equipment:

(a) Check for obvious damage, defects, or modifications in the equipment and its accessories, connectors, plugs or cord extension sockets; and for discoloration that may indicate exposure to excessive heat, chemicals or moisture;

(b) Check that flexible cords are effectively anchored to equipment, plugs, connectors and cord extension sockets;

NOTE – This inspection, including flexing and straining at points of entry and clamping points by the application of reasonable combination of push/pull and rotary movements, may detect broken strands or loose connections.

(c) Check for damage to flexible cords to ensure that:

(i) The inner cores of flexible cords are not exposed or twisted

(ii) The external sheaths are not cut, abraded, twisted, or damaged to such an extent that the **insulation** of the inner cores is visible, and

(iii) Unprotected conductors or the use of banding **insulation** tape are not in evidence.

NOTE –

(1) Carefully running the flexible cord through the hand will often detect internal damage such as twisted conductors or broken core filling.

(2) Connecting the plugs/cord extension sockets of **cord extension sets** together helps to confirm that the terminals have not spread.

(d) For **EPODs**, check that the warning indicating the maximum load to be connected to the device is intact and legible;

(e) Check that any operating controls are in good working order i.e. that they are secure, aligned and appropriately identified;

(f) Check that covers, guards, and the like are secured and working in the manner intended by the manufacturer or supplier;

(g) Check that ventilation inlets and exhausts are unobstructed;

(h) The pins of insulated pin plugs should be inspected for damage to the **insulation** of the pins, and, if fitted, the shroud on cord extension sockets should be inspected for damage;

(i) Check that the current rating of the plug is consistent with the current rating of the equipment.

2.3.3 Testing

The purpose of testing is to detect the unobservable faults not found by the visual inspection process, and forms an integral part of the inspection/testing process.

2.3.3.1 Earthing continuity

To confirm that the resistance of the protective earth circuit is sufficiently low to ensure correct operation of the circuit protecting device, the continuity of the protective earthing conductor from the plug earth pin to **accessible earthed parts** of **Class I equipment** shall be checked.

The continuity of the protective earth conductor between the earth pin of the plug and the earth contact and every outlet(s) of **cord sets**, **cord extension sets**, **EPODs** and **PRCDs** shall be checked.

Such equipment shall be tested in accordance with Appendix D and shall have a measured resistance of the protective earth circuit, or the protective earthing conductor which does not exceed 1Ω.

NOTE – This test is best undertaken in conjunction with the inspection performed under 2.3.2(b).

2.3.3.2 Testing of insulation

Insulation shall be subject to a leakage current test or an **insulation** resistance test in accordance with Appendix E.

Amd 2
Dec ’12

NOTE – For equipment that contains single phase motors, or if an insulation test fails due to the presence of internal components such as LEDs, the leakage current test is the preferred option.

If the equipment must be energized to close or operate a switching device in order to test the **insulation**, then the leakage current test in accordance with Appendix E shall be performed.

When a leakage current test is performed in accordance with Appendix E, the leakage current values obtained shall not exceed those specified in Table 1.

When an **insulation** resistance test is performed in accordance with Appendix E, the **insulation** resistance values obtained shall be not less than those specified in Table 2.

TABLE 1 – Leakage current limits

Equipment	Leakage test	Maximum leakage mA
Class I	Measure the current flowing in the protective earthing conductor	5
Class II	Measure the current flowing between accessible metal and earth	1
PRCDs with FE	Measure the current flowing in the functional earthing conductor	5
Cord extension sets, cord sets, EPODs and **PRCDs**	Measure the current flowing in the protective earthing conductor	1

TABLE 2 – Insulation resistance limits

Equipment	Insulation test	Minimum insulation resistance MΩ
Class I	Measure between **live parts** and **accessible earthed parts**	1.0
Class II	Measure between **live parts** and any accessible metal parts	1.0
PRCDs with FE	Measure between **live parts** and the functional earthing conductor	0.05
Cord extension sets, cord sets, EPODs and **PRCDs**	Measure between **live parts** and the protective earthing conductor	1.0
Mineral insulated metal sheath heating elements	Measure between **live parts** and **accessible earthed parts**	0.01

The **insulation** resistance of **PRCDs** with FE connections shall be not less than 0.05 MΩ as shown in Table 2. Alternatively, **PRCDs** which require the supply to be closed, and units with a FE connection may be tested for leakage current with a maximum allowed value of 5 mA as shown in Table 1. (A FE in an **RCD** is a connection with earth to ensure the correct normal operation of the **RCD**.)

2.3.3.3 Testing of portable isolating transformers and power supplies

Testing shall be performed in accordance with Appendix F for **portable isolating transformers** or Appendix G for **power supplies**.

The **insulation** resistance between appropriate parts specified above shall be not less than 1 MΩ.

2.3.3.4 Test for operation of RCDs

RCDs shall be tested in accordance with Appendix H. The maximum tripping time shall not exceed the values in Table 3.

Amd 2 Dec '12

RCDs which are permanently wired to terminals in equipment shall be tested using the RCD test button only, observing the operating time which should be 'without undue delay'. In case of doubt, use an external timing circuit, capable of detecting the test current start and finish, to measure disconnect time which shall be not more than 150 ms for a 30 mA **RCD** and 40 ms for a 10 mA **RCD**. (The test button current is assumed to be 2 times the rated residual current.)

NOTE –

(1) The test for operating time using a.c. for a.c. and d.c. pulse sensitive **RCDs** is acceptable as d.c. calibration is linked to a.c. calibration and verified by type test.

Amd 2 Dec '12

(2) The test methods for **RCDs** in 2.3.3.4 and Appendix H of this Standard may be used to verify **RCD** operation where required in other Standards for initial verification or periodic verification at intervals specified in those other Standards, for example AS/NZS 3000, AS/NZS 3001, AS/NZS 3002, AS/NZS 3012, AS/NZS 3019.

TABLE 3 – Maximum tripping times

RCD type	Test current a.c. mA	Maximum tripping time ms
Type I	10	40
Type II	30	300

2.3.3.5 Polarity of rewireable plugs and rewireable cord extension sockets

The correct polarity of the individual wires in rewireable plugs and rewireable cord extension sockets is shown in (a) and (b) below, and additional details of older and international schemes are provided in Appendix C. The indicative frequency of test is provided in column (b) of Table 4.

(a) Plugs

The order (polarity) of the pins of a three pin flat pin plug, to their connections, shall be Earth (radial pin – green/yellow wire), Neutral (blue wire) and then Active (brown wire), in a clockwise direction, when viewed from the front of the plug looking at the pins.

(b) Cord extension sockets

The order (polarity) of the socket apertures of a three pin flat pin socket, to their connections, shall be Earth (radial pin – green/yellow wire), Active (brown wire) and then Neutral (blue wire), in a clockwise direction, when viewed from the front of the socket looking at the apertures.

2.3.3.6 Testing of portable generators

Details of testing for portable generators other than those within the scope of AS/NZS 3010 or AS 2790 are provided in AS/NZS 3012.

2.3.3.7 Testing of arc welders with exposed terminals

A brief description of the main types of welding power supplies is provided in Appendix J.

(a) Inspect both mains and welding leads for damage or excessive charring;

(b) For transformer types, test as **Class I equipment**, and measure the **insulation** resistance

   (i) Between the active and neutral pins of the supply plug and exposed metal parts

   (ii) Between the active and neutral pins of the supply plug and the output terminals.

   Confirm that the mains **voltage** does not appear at the output terminals.

   NOTE – AS 1674.2 specifies additional requirements including testing intervals.

2.3.3.8 Testing of portable inverters

Testing of portable inverters is specified in Annex F of AS/NZS 4763 (INT).

2.3.3.9 Testing of Class I equipment that is totally encapsulated

Some **Class I equipment** is manufactured by entirely encapsulating it so that although it is supplied by a **supply cord** or by a **cord set** incorporating a protective earth conductor that is required by **Class I equipment**, there is no access to the equipment to confirm the efficacy of the protective earth conductor by test. When it is suspected that the equipment is of this nature, because the earth continuity cannot be verified, inspect the **supply cord** carefully as usual, and test the **insulation** by measuring either the leakage current or the **insulation** resistance as appropriate.

2.4 ACTION RESULTING FROM INSPECTION AND TESTING

2.4.1 Non-compliant equipment

Where in-service inspection or testing identifies equipment which fails to comply with the criteria given in this Standard, the equipment shall be appropriately labelled to indicate that the equipment requires remedial action and warn against further use. Such equipment shall be withdrawn from service. The choice of remedial action, disposal or other corrective action shall be determined by the owner or the person responsible for the safety of the site where the equipment is used.

2.4.2 Compliant equipment

Following testing, compliant equipment shall be fitted with a durable, non-reusable, non-metallic tag or other indicator. Special techniques shall not be required to identify the equipment.

NOTE – This shall not preclude tags from also bearing a code to facilitate electronic data collection.

2.4.2.1

The tag, shall be durable, legible, non-reusable, non-metallic and may be colour coded to identify the period in which the test was performed, and shall include all of the following information as a minimum:

(a) The name of the person or company who performed the test;

(b) The test or inspection date, a retest date and a reference to AS/NZS 3760;

NOTE –

(1) The requirement to include a retest date forms part of the Standard, 12 months from its date of publication.

(2) The requirement to include a reference to AS/NZS 3760 forms part of the Standard, 24 months from its date of publication.

(3) Some regulatory authorities or other Standards, such as AS/NZS 3012 and the AS/NZS ISO 9000 series, may require other inspection and test records to be kept.

(4) AS/NZS 4249 and AS/NZS 3012 provide guidance on one method of colour coding. Alternative methods are acceptable.

(5) Australian regulators, as listed in Appendix K, may require colour coding which complies with their particular State/Territory legislation.

(6) The retest date may be indicated by specifying the validly period of the tag from the indicated test or inspection.

(c) In Australia, equipment that is new and entering into service for the first time but not tested and tagged shall have a tag applied that includes the following information:

(i) Wording, “new to service”

(ii) Date of entry to service

(iii) Date when next test is due

(iv) Statement, “This appliance has not been tested in accordance with AS/NZS 3760”.

2.4.2.2

Where a tag does not include information required under 2.4.2.1 (a) and (b), the records shall be available on site for audit, on the next working day.

NOTE – Such equipment should be marked or labelled to facilitate its ready identification from the use of such records.

2.5 DOCUMENTATION

2.5.1

Where records of test and inspection are kept, the following should be recorded:

(a) A register of all equipment;

(b) A record of formal inspection and tests;

(c) A ‘repair’ register;

(d) A record of all faulty equipment showing details of services or corrective actions.

NOTE –

(1) Electrical and/or occupational health and safety (OH&S) regulators may require documentation to be kept in some or all cases.

(2) Where organizations perform voluntary additional inspections and tests, records of such should be kept.

2.5.2

Where records are kept, they should be retained for 7 years, or such period as required by the relevant regulator. It is acceptable for the purposes of this Standard to keep these records in electronic format if this is the preferred method.

2.5.3

Where a risk assessment has been performed in accordance with 2.1.1, all documentation shall be retained for 7 years or such period as may be required by the relevant regulator.

TABLE 4 – Indicative testing and inspection intervals for electrical equipment
(CAUTION: This page must be read in conjunction with AS/NZS 3760 as a whole, and particularly 2.1)

Type of environment and/or equipment	Interval between inspection and tests				
	Equipment including Class I equipment, Class II equipment, cord sets, cord extension sets and EPODs	Residual current devices (RCDs)			
		Push-button test – by user		Operating time and push-button test	
		Portable	**Fixed**	**Portable**	**Fixed**
(a)	(b)	(c)	(d)	(e)	(f)
1 Factories, workshops, places of manufacture, assembly, maintenance or fabrication	6 months	Daily, or before every use, whichever is the longer	6 months	12 months	12 months
2 Environment where the equipment or **supply** flexible **cord** is subject to flexing in normal use OR is open to abuse OR is in a **hostile environment**	12 months	3 months	6 months	12 months	12 months
3 Environment where the equipment or **supply cord** is NOT subject to flexing in normal use and is NOT open to abuse and is NOT in a **hostile environment**	5 years	3 months	6 months	2 years	2 years

Type of environment and/or equipment	Interval between inspection and tests				
	Equipment including Class I equipment, Class II equipment, cord sets, cord extension sets and EPODs	Residual current devices (RCDs)			
		Push-button test – by user		Operating time and push-button test	
(a)	(b)	**Portable** (c)	**Fixed** (d)	**Portable** (e)	**Fixed** (f)
4 Residential type areas of: hotels, residential institutions, motels, boarding houses, halls, hostels accommodation houses, and the like	2 years	6 months	6 months	2 years	2 years
5 Equipment used for commercial cleaning	6 months	Daily, or before every use, whichever is the longer	N/A	6 months	N/A
6 **Hire** equipment: Inspection	Prior to hire	Including push-button test by **hirer** prior to **hire**		N/A	N/A
Test and tag	3 months	N/A		3 months	12 months
7 Repaired, serviced and second-hand equipment	After repair or service which could affect electrical safety, or on reintroduction to service, refer to AS/NZS 5762.				

APPENDIX A
BACKGROUND

(Informative)

A1 GENERAL

This appendix provides some background to the inspection and electrical testing requirements specified in this Standard and relevant regulatory codes.

For the safety of people using electrical equipment the following requirements should be met:

(a) Equipment is to be designed and manufactured to appropriate safety standards;

(b) Equipment, without being dismantled, is to be subject to routine inspection and testing to detect obvious damage, wear or other conditions which might render it unsafe;

(c) Equipment identified as faulty is to be withdrawn from service and referred for repair or disposal by expert personnel;

(d) Appropriate equipment is to be used for each particular application;

(e) In specific cases, for example, for use in confined spaces, equipment is also to be used in accordance with an appropriate set of rules linking the type of work with the class of equipment and environmental safety facilities.

This Standard refers only to the matters in items (b) and (c).

The following information provides some insight and background to the inspection and electrical testing requirements specified in this Standard and relevant regulatory codes.

A2 PRINCIPLES OF CONSTRUCTION OF ELECTRICAL EQUIPMENT

Accessible earthed parts of equipment operating from supply **voltage** have to be prevented from becoming live in the event of **insulation** failure or the bypassing of **insulation** during the normal use of the equipment (for example, through the ingress of conducting liquids or other conducting materials).

This protection may be provided by either one or both of the following:

(a) Provision of **basic insulation** between the accessible metal parts and the **live parts**, and earthing the accessible metal parts. Equipment for which some or all of the accessible metal parts require protective earthing, is a basic insulated item, which is also referred to as **Class I equipment**.

NOTE – Some electric drills have an external metal chuck, which may be double insulated from **live parts**. The nameplate marking may indicate this.

(b) Provision of **double insulation** or **reinforced insulation** between the accessible metal parts and the **live parts**. Equipment in which none of the accessible metal parts requires protective earthing, due to the provision of **double insulation** or **reinforced insulation**, is double insulated, also referred to as **Class II equipment**. This equipment is generally manufactured with a non-conductive (insulated) enclosure, and is marked either with the words ‘DOUBLE INSULATED’ or with the symbol ⧈ to allow easy identification.

NOTE –

(1) This type of equipment cannot be tested for earth continuity or **insulation** resistance to earth. The **insulation** resistance can be measured between **live parts** and a flexible electrode (such as aluminum foil) wrapped over the **insulation**.

(2) Some hybrid constructions exist whereby **Class I equipment** is totally encapsulated. By denying access to earthed parts, a protective earth continuity test cannot be performed. In these cases only **insulation** resistance or leakage current tests can be performed.

A3 FUNCTIONAL EARTHING (FE)

Class II equipment is sometimes connected to earth for a purpose other than safety, such as electromagnetic interference suppression or harmonic current suppression. Such equipment is considered to be functionally earthed.

Class II equipment that incorporates functionally earthed parts is required to have at least **double insulation** or **reinforced insulation** between **live parts** and the functionally earthed parts. Consequently, the **insulation** resistance or leakage current between **live parts** and functionally earthed parts should comply with the limits specified for **Class II equipment**.

Since the equipment is earthed for purposes other than safety, it is not necessary to measure the earth continuity resistance between earth pin of the plug or the earth contact of the appliance inlet and the functionally earthed parts.

It can be difficult to identify functionally earthed **Class II equipment** and at this time the only advice that can be offered is that the equipment may be marked with the symbol : it will not be marked with the symbol . The marking is likely to be on a terminal within the equipment.

A4 PROTECTIVE EARTHING

The resistance to earth from protectively earthed parts in **Class I equipment** has to be low enough to permit adequate fault current to flow to earth, thereby ensuring that the overcurrent protection device in the final sub-circuit (that is, fixed wiring) opens quickly in the event of **insulation** failure.

The protective earthing conductor also ensures that any leakage current from the **live parts** within **Class I equipment** flows to earth via a low resistance path.

A5 INSULATION RESISTANCE

Insulation resistance testing is intended to confirm the integrity of the **insulation** between **live parts** and accessible metal parts.

Accordingly, equipment has its **insulation** resistance measured prior to commissioning, and at regular intervals during its service life to ensure that no degradation has occurred since manufacture, during transport, or over its service life.

A6 TEST EQUIPMENT

The equipment required to carry out the tests detailed in this Standard should be subject to routine verification at regular intervals to ensure it is working correctly and its accuracy is maintained.

A7 DOCUMENTATION

Records of maintenance, including (but not limited to) tests, should be kept throughout the working life of the equipment. Such records are a useful management tool for reviewing the frequency of inspection and test actions, and ensuring these actions have been carried out. It is recommended that such records be retained for not less than 7 years.

APPENDIX B
GUIDELINES ON THE ELECTRICAL KNOWLEDGE OF A COMPETENT PERSON

(Informative)

B1 GENERAL

Guidelines on the electrical knowledge and other principles with which a **competent person** is likely to be familiar are provided below on an indicative basis only.

NOTE – Additional information may be available from electrical or OH&S regulators in the various jurisdictions.

B1.1 Basic electrical principles

(a) Introduction to electricity, AC and DC;

(b) Electrical units: Amps, Ohms, Volts.

B1.2 Circuit protection

(a) Fuses;

(b) Circuit breakers;

(c) **Residual current devices (RCDs).**

B1.3 Electrical safety

(a) Working with electricity;

(b) Effects of current flow.

B1.4 Inspection and testing to AS/NZS 3760

(a) Inclusions and exclusions;

(b) Classes of equipment;

(c) Types of **insulation**;

(d) Protective earth operation;

(e) **Insulation** resistance;

(f) Leakage current;

(g) Correct and safe use of test equipment.

B1.5 Applicable to jurisdictional regulations

Regulatory requirements of country, state or territory.

APPENDIX C
POLARITY FOR CORD SETS AND CORD EXTENSION SETS

(Normative)

C1

Cord sets and **cord extension sets** with rewireable plugs and/or connectors and/or cord extension sockets shall be checked for correct polarity of the wiring.

C2

The correct wiring for a **cord set** is shown in Figure C1.

NOTE – A three-conductor cord with a suitable power plug for the locality in which the appliance is used on one end and an IEC 60320 C13 connector on the other is commonly called an 'IEC cord set'.

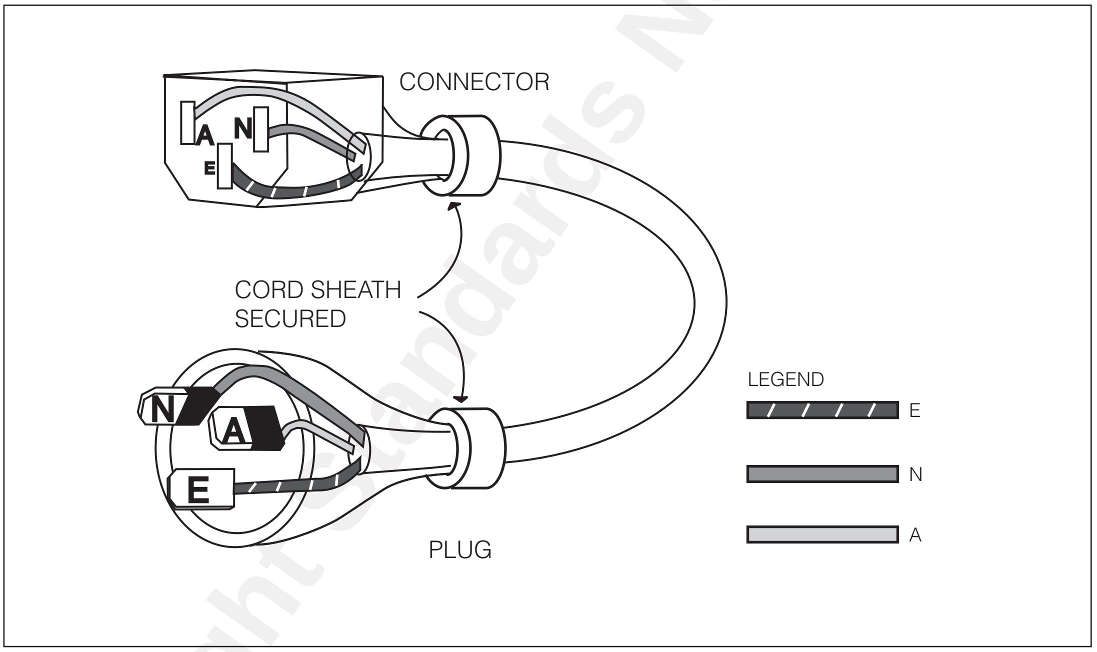


FIGURE C1 – Cord set

C3

The correct wiring for a **cord extension set** is shown in Figure C2.

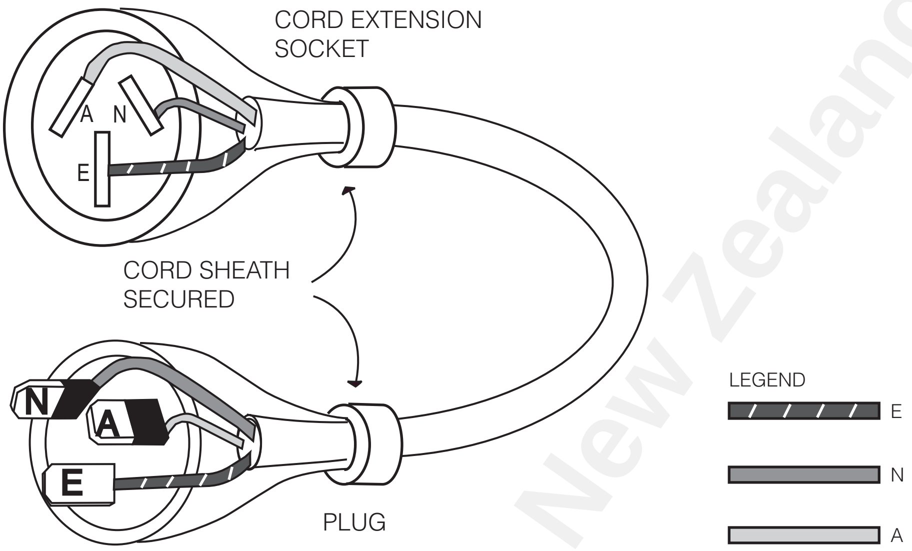


FIGURE C2 – Cord extension set

C4

The recommended conductor colours for the flexible cord in **cord sets**, and **cord extension sets** are given in Table C1 in the “International” column. The superseded column is included for completeness, as older **cord sets**, **cord extension sets**, and imported **cord sets**, constructed to differing schemes are still in use. Until confirmed, caution should be exercised, as the active conductor’s **insulation** may not be brown.

> **WARNING** – Imported plugs on **cord sets** based on schemes, other than the international scheme, are frequently removed and replaced. Such **cord sets** should be treated with caution until the correct polarity is confirmed.

TABLE C1 – Conductor colours for flexible cords

Function	International	Superseded
Active/Line/Phase	Brown	Red
Neutral	Light Blue	Black
Earth	Green and Yellow	Green

C5

Conductor colour schemes for modern flexible cords are shown in Table C2.

TABLE C2 – Colour schemes of conductor insulation in modern sheathed flexible cords

	Single phase		Three phase			Reserved colours	
Equipment type	**Class I equipment**	**Class II equipment**	**Class I appliances** delta connected or star connected without ne utral	**Class II equipment:** delta connected or star connected without neutral	**Class I equipment** star connected with neutral	**Class II equipment** star connected with neutral	–
Cord type	three-core cord	two-core cord	four-core cord	three-core cord	five-core cord	four-core cord	
Cord colour scheme	green-and-yellow, blue, brown core **insulations**	(usually) blue, brown core **insulations**	green-and-yellow, brown, black, grey core **insulations**	brown, black, grey core **insulations**	green-and-yellow, blue, brown, black, grey core **insulations**	blue, brown, black, grey core **insulations**	cores with green-and-yellow coloured **insulation** are reserved for 'earth' and cores with blue **insulation** are reserved for neutral

NOTE – The colour schemes are in conformance with the latest Australian/New Zealand, European, and international Standards for flexible cords.

APPENDIX D
TEST OF EARTHING CONTINUITY

(Normative)

D1 GENERAL

The test of earthing continuity resistance shall be conducted to 2.3.3.1 during in-service testing of all **Class I equipment**. The test shall include flexing and straining at points of entry and clamping points by the application of a reasonable combination of push/pull and rotary movements. This may detect broken strands or loose connections.

D2 INSTRUMENTATION

For earth continuity testing, either of the following shall be used:

(a) An ohmmeter of accuracy of Class 5 or better; or

NOTE – Class 5 denotes an accuracy of 5 % full scale deflection.

(b) An equipment tester or portable appliance tester (PAT) with one or more of the following test capabilities:
- (i) 12 V maximum, test current in the range 100 to 200 mA;
- (ii) 12 V maximum, test current of 10 A;
- (iii) 12 V maximum, test current of 1.5 times the rated current of the appliance or 25 A, whichever is the greater.

D3 TEST CONDITIONS

D3.1

Earthing continuity resistance shall be measured between any **accessible earthed parts**, including rotating metal parts, and the earth pin of the plug. The test duration is limited to the maximum time required for measurement.

NOTE –
(1) Figure D1 shows one method of testing resistance.
(2) Values measured (with the flexible cord included), are usually found to comply with a value of less than 0.5Ω.

D3.2

For **cord sets**, **cord extension sets**, **EPODs** and **PRCDs**, the resistance between the earthing connections of the plug and the earth aperture contact(s) of the outlet(s) shall be measured.

NOTE – See Figure D2 for testing to EPODs.

Amd 1
Apr ’11

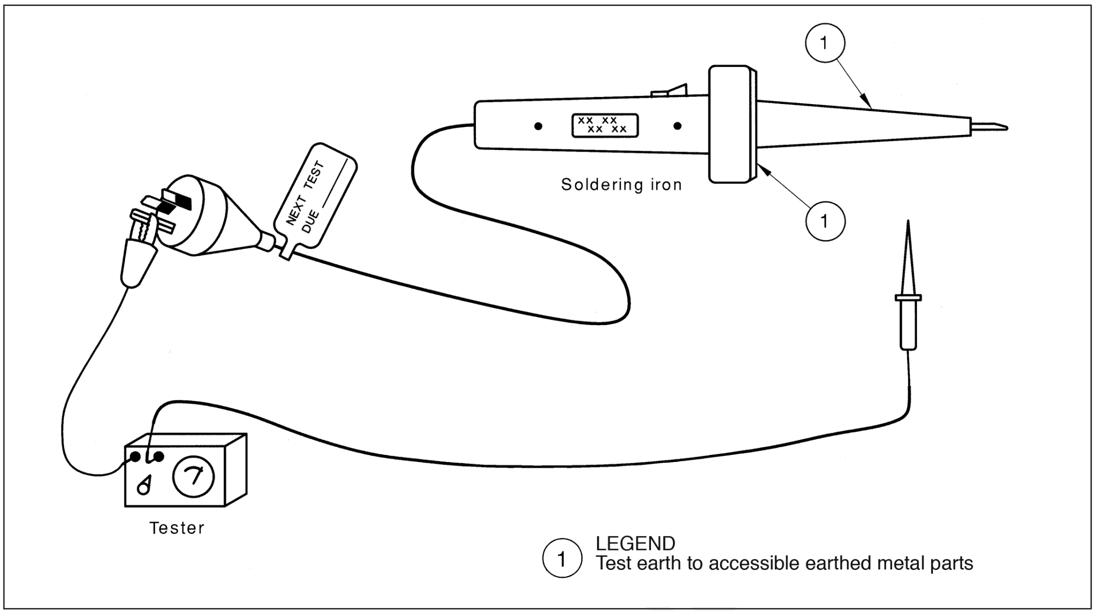


FIGURE D1 – Measurement of the earth continuity resistance between accessible earthed metal parts and the earth pin of the mains plug

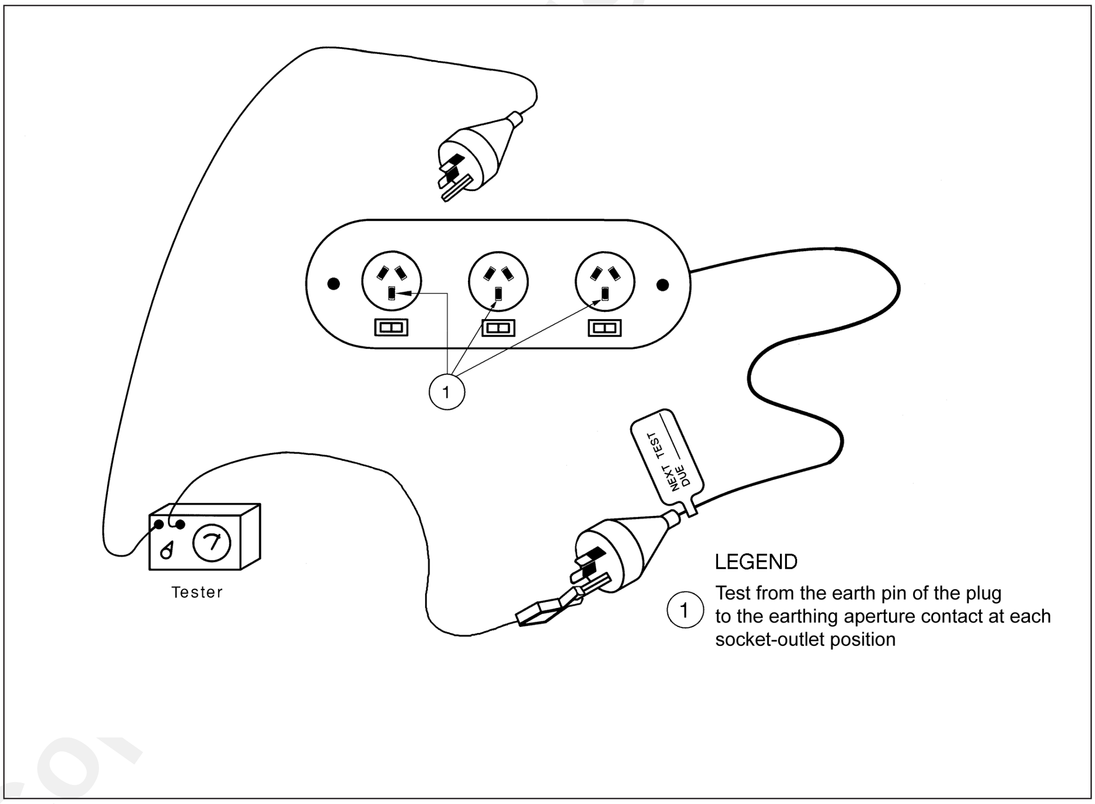


FIGURE D2 – Measurement of the earth continuity resistance between the mains plug earth pin and the earthing aperture contacts of an EPOD

APPENDIX E
INSULATION TESTING

(Normative)

E1 GENERAL

The integrity of the **insulation** between **live parts** and other parts shall be tested by measuring the leakage current value or by measuring the **insulation** resistance value.

NOTE – Compliance values are specified in Table 1 and Table 2.

E2 INSTRUMENTATION AND METHOD

E2.1 Leakage current

The leakage current test shall be carried out with the equipment supplied at its rated **voltage**.

WARNING – When performing leakage current tests with the equipment energized, the protective earth conductor may be live and present a shock hazard.

E2.1.1 In **Class I equipment,** measurement of the leakage current to earth shall be carried out while the equipment is operating by using one of the following methods:

(a) A differential test method, e.g. a portable appliance tester (PAT) incorporating a differential test feature;

(b) A direct reading meter inserted in series with the protective earth wire circuit of the test equipment, usually by means of a custom-made jig;

NOTE – This is not recommended, if there are alternative earth paths.

(c) A clamp meter in conjunction with a special **cord set** where the protective earth conductor can be safely separated for measurement.

NOTE – This is not recommended, if there are alternative earth paths.

At the limit specified in Table 1, the uncertainty of measurement shall not exceed 5 %.

E2.1.2 For testing **Class II equipment**, special equipment, knowledge, and processes are required. The leakage current test may be carried out using a differential test method that measures the difference between current flowing in the phase and neutral conductors. Alternatively, a touch current measuring instrument can be used.

NOTE – Typical test circuits for the differential test method are shown in Figure E1 and Figure E2.

If the equipment is intended to be immersed in readily accessible water during normal use the test is carried out with the equipment immersed, and a rectangular stainless steel electrode, having dimensions approximately 250 mm x 50 mm, is placed in the water with the probe connected to the electrode.

The leakage current measured during this test shall not exceed 3 mA.

E2.2 Insulation resistance

Whether an **insulation** resistance meter or a PAT is used, it shall have the following characteristics:

(a) A measuring circuit isolated from earth;

(b) A nominal measuring **voltage** of 500 V d.c. (To avoid the equipment apparently failing the test, 250 V d.c. may be used for equipment containing surge protection devices, such as MOVs/EMI filtering, that bridge the **insulation** being tested);

NOTE – For guidance on the requirements of **insulation** measuring equipment, refer to 8.3.6.1 in AS/NZS 3000 (that is, maintain terminal **voltage** within + 20 % and – 10 % when measuring a resistance of 1 MΩ on the 1 MΩ range).

(c) An accuracy of Class 5 or better.

NOTE – Class 5 denotes an accuracy of 5 %, full scale deflection.

E3 TEST CONDITIONS

E3.1 Class I equipment – Live parts to accessible earthed parts

Insulation resistance tests shall be performed with the mains switch/selector on the equipment in the 'on' position, with the equipment de-energized and the live supply conductors joined together.

NOTE – Figure E3 shows the testing of **insulation** resistance of **accessible earthed parts**.

E3.2 Class II equipment – Live parts to accessible metal parts

Insulation resistance is measured between the live supply conductors connected together electrically, and accessible metal parts. During the test, any mains switch/selector in the equipment is in the 'ON' position.

NOTE – Figure E4 shows testing of **insulation** resistance of accessible metal parts.

E3.3 Cord sets, cord extension sets and EPODs

For **cord sets** and **cord extension sets** the **insulation** resistance shall be measured between live supply conductors connected together electrically, and the earthing conductor. For **EPODs** insulation resistance shall be measured between the live supply conductors and each socket-outlet earth aperture contact. During the test any mains switch/selector in the equipment is in the 'ON' position. When internal components may affect test values obtained, see E2.2 (b).

Amd 2 Dec '12

NOTE –

(1) Figure E5 shows the insulation resistance testing of an **EPOD**.

(2) For **EPODs** that feature an LED indicator connected between the active conductor and earth, if the EPOD fails the insulation resistance test, the integrity of the insulation should be confirmed by the leakage current test.

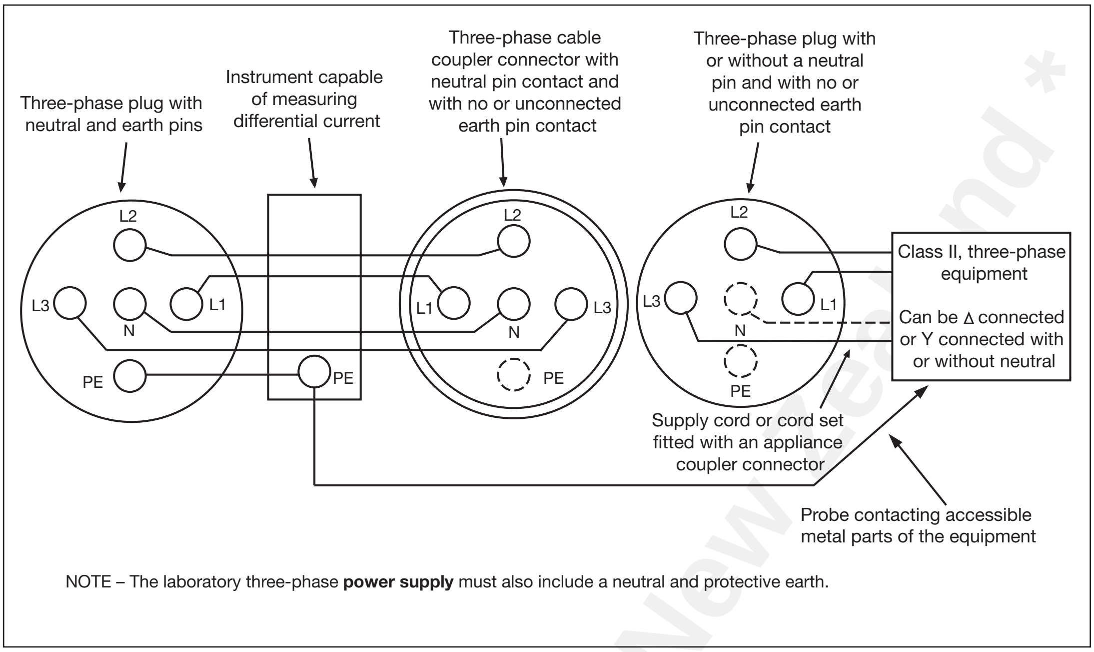


FIGURE E1 – Leakage current test setup using differential test method for Class II three-phase equipment

Amd 1
Apr '11

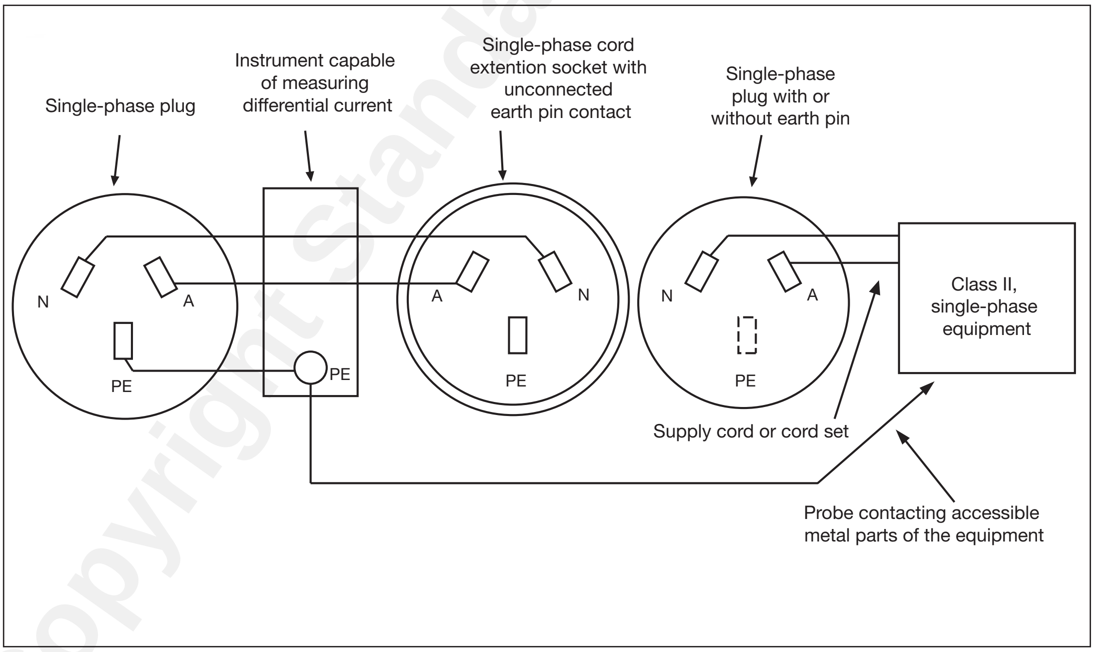


FIGURE E2 – Leakage current test setup using differential test method for Class II single-phase equipment

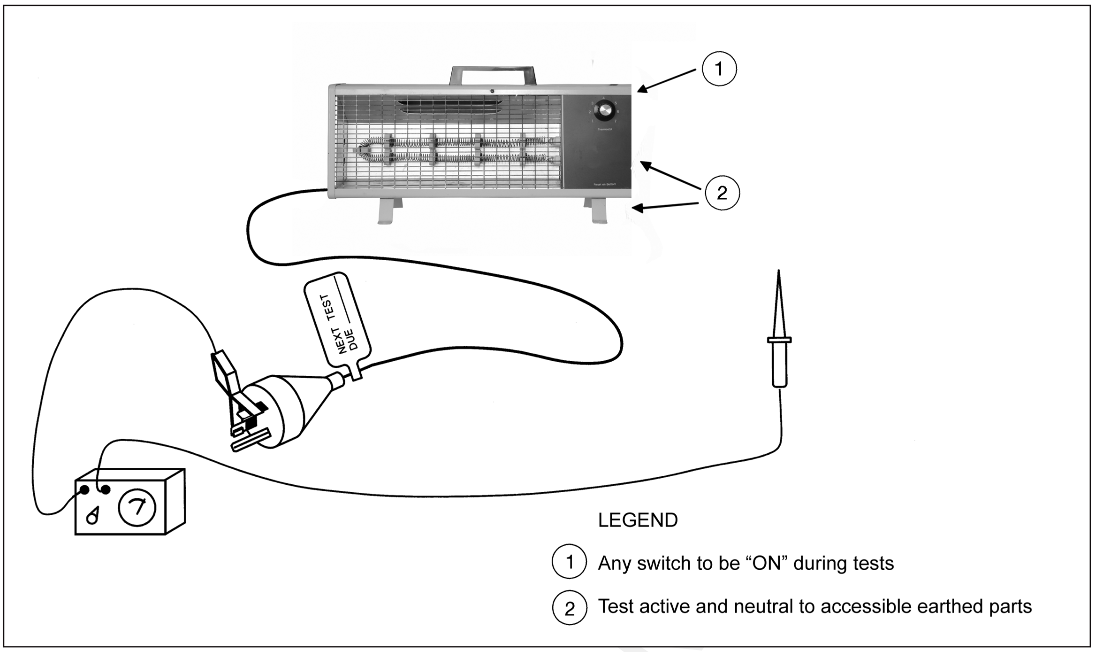


FIGURE E3 – Measurement of the insulation resistance between live supply conductors and accessible earthed parts of typical Class I equipment

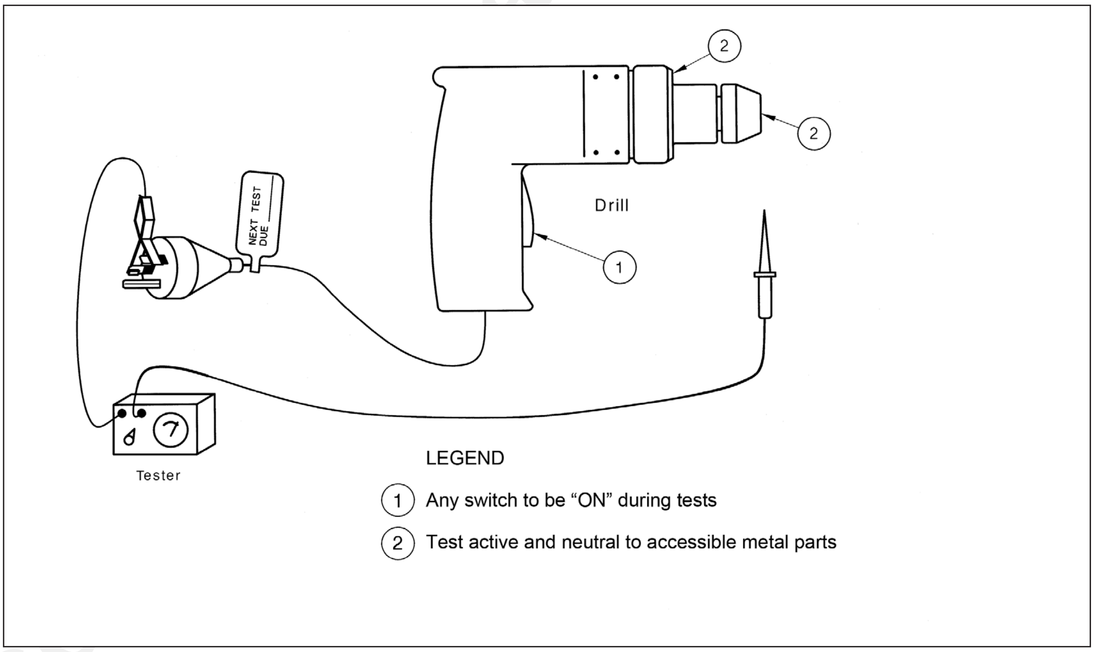


FIGURE E4 – Measurement of the insulation resistance between live supply conductors and accessible metal parts of a typical Class II equipment

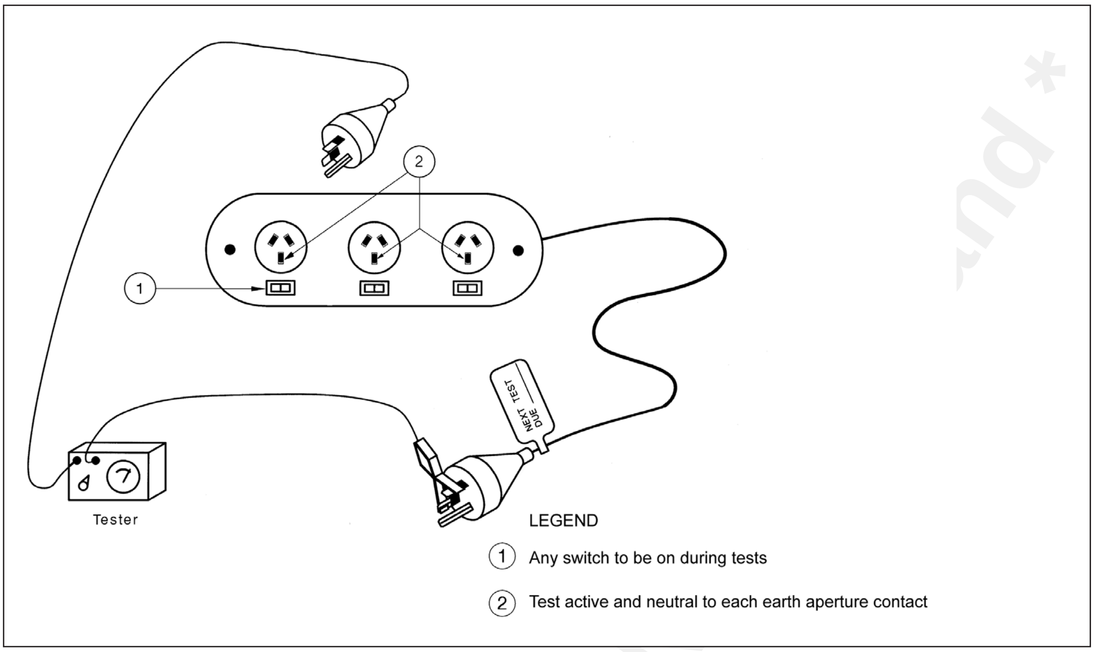


FIGURE E5 – Measurement of the insulation resistance of an EPOD

APPENDIX F
INSULATION RESISTANCE TESTING OF PORTABLE ISOLATING TRANSFORMERS

(Normative)

F1 GENERAL

Insulation resistance shall be measured on portable **isolating transformers** according to 2.3.3.3.

F2 INSTRUMENTATION

Whether an **insulation** resistance meter or a PAT is used, it shall have the following characteristics:

(a) A measuring circuit isolated from earth;

(b) A nominal measuring **voltage** of 500 V d.c. (to avoid the equipment apparently failing the test, 250 V d.c. may be used for equipment containing surge protection devices, such as MOVs/EMI filtering, that bridge the **insulation** being tested);

NOTE – For guidance on the requirements of **insulation** measuring equipment, refer to 8.3.6.1 in AS/NZS 3000 (that is, maintain terminal **voltage** within + 20 % and – 10 % when measuring a resistance of 1 MΩ on the 1 MΩ range).

(c) An accuracy of Class 5 or better.

NOTE – Class 5 denotes an accuracy of 5 %, full scale deflection.

F3 TEST CONDITIONS

Insulation resistance shall be measured between:

(a) Live supply conductors and **accessible earthed parts** of a **Class I isolating transformer**;

NOTE – A method is shown in Figure F1. The earth slot in the output socket-outlet must not be connected to accessible earthed parts or the earth conductor in the **supply cord** or appliance inlet.

(b) The connections from the transformer output (secondary) winding and **accessible earthed parts** of a **Class I isolating transformer**;

Amd 2 Dec '12

NOTE – A method is shown in Figure F3. The earth slot in the output socket-outlet must not be connected to **accessible earthed parts** or the earth conductor in the **supply cord** or appliance inlet.

(c) Live supply conductors and accessible metal parts of **Class II isolating transformers**;

NOTE – A method is shown in Figure F1. The earth slot in the output socket-outlet must not be connected to accessible metal parts or the earth conductor in the **supply cord** or appliance inlet.

(d) Live supply conductors and the connections from the transformer output (secondary) winding;

Amd 2 Dec '12

NOTE – A method is shown in Figure F2. The earth slot in the output socket-outlet must not be connected to accessible earthed metal parts or the earth conductor in the **supply cord** or appliance inlet.

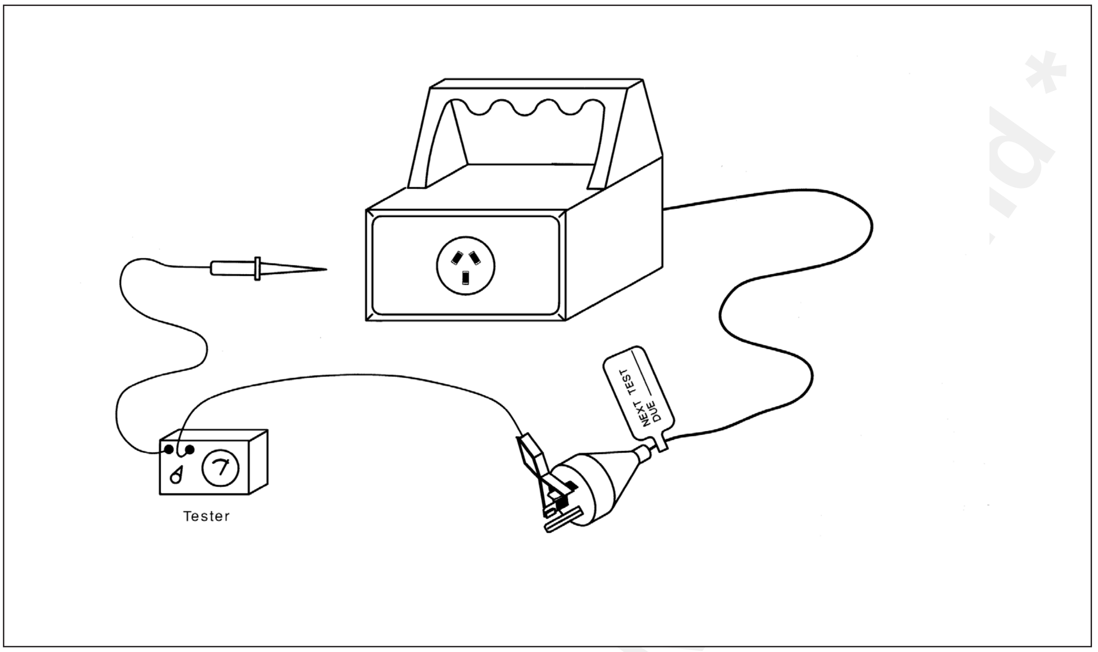
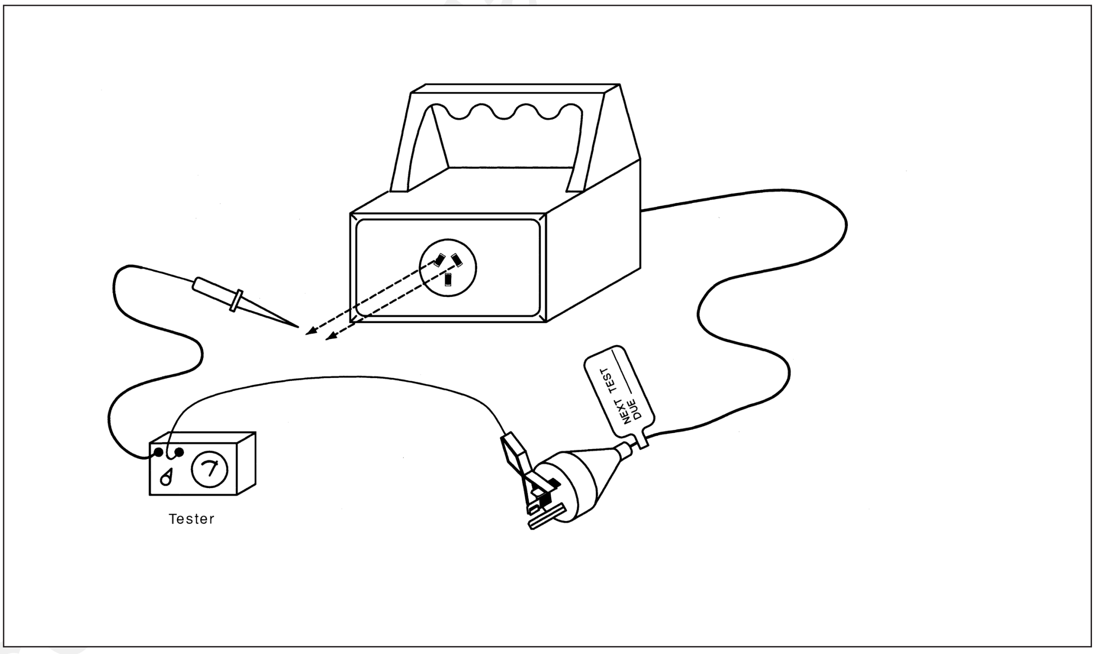
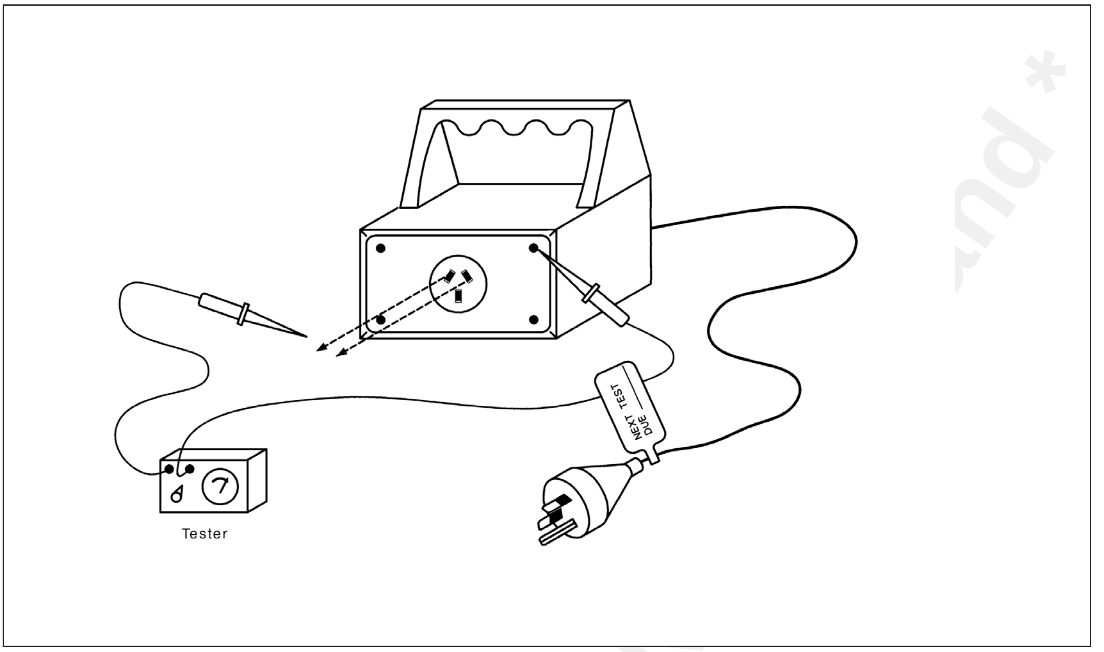


FIGURE F1 – Measurement of the insulation resistance between live supply conductors to a portable isolating transformer and accessible earthed parts for Class I isolating transformers or accessible metal parts for Class II isolating transformers



Amd 1 Apr '11

FIGURE F2 – Measurement of the insulation resistance between live supply conductors and the portable isolating transformer output (secondary) winding



Amd 1
Apr '11

FIGURE F3 – Measurement of the insulation resistance between a portable isolating transformer (secondary) winding and accessible earthed parts for Class I isolating transformers

APPENDIX G
INSULATION RESISTANCE TESTING OF A POWER SUPPLY

(Normative)

G1 GENERAL

Insulation resistance on power supplies shall be measured according to 2.3.3.3.

G2 INSTRUMENTATION

Whether an **insulation** resistance meter or a PAT is used, it shall have the following characteristics:

(a) A measuring circuit isolated from earth;

(b) A nominal measuring **voltage** 500 V d.c. (to avoid the equipment apparently failing the test, 250 V d.c. may be used for equipment containing surge protection devices, such as MOVs/EMI filtering, that bridge the **insulation** being tested);

NOTE – For guidance on the requirements of **insulation** measuring equipment, refer to 8.3.6.1 in AS/NZS 3000 (that is, maintain terminal **voltage** within + 20 % and – 10 % when measuring a resistance of 1 MΩ on the 1 MΩ range).

(c) An accuracy of Class 5 or better.

NOTE – Class 5 denotes an accuracy of 5 %, full scale deflection.

G3 TEST CONDITIONS

Insulation resistance shall be measured between:

(a) Live supply conductors and the connections from the output.

NOTE – A method is shown in Figure G1.

(b) Live supply conductors electrically connected together, and **accessible earthed parts** of a Class I enclosing case;

(c) Live supply conductors and external metal parts of a Class II enclosing case.

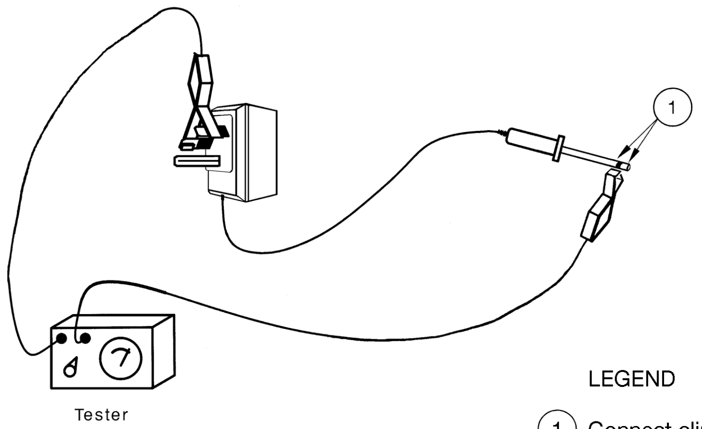


FIGURE G1 – Measurement of the insulation resistance of a power supply

APPENDIX H
TEST FOR THE OPERATING TIME OF RESIDUAL CURRENT DEVICES (RCDS)

(Normative)

H1 GENERAL

H1.1

The operating time of **RCDs** shall be checked according to 2.3.3.4 with maximum values acceptable shown in Table 3.

H1.2

The following tests are not required by this Standard:

(a) Calibration sensitivity at slowly rising current;

(b) Non trip threshold (50 % rated sensitivity);

(c) d.c. pulse tests for type A. The test for operating time using a.c. for type A **RCDs** (a.c. and d.c. pulse half-wave sensitive) is acceptable as d.c. calibration is linked to a.c. calibration and verified by type test. The test for operating time, ensures that both type AC (sine wave a.c.) and type A have retained their type test calibration.

H2 INSTRUMENTATION

The **RCD** tester shall be capable of applying rated tripping current ±5 % and measure time with an accuracy dependent on the nominal tripping time as follows:

TABLE H1 – Tripping time accuracy

Tripping time	Accuracy
40 ms	± 2 ms
300 ms	± 8 ms

H3 TEST CONDITIONS

H3.1

For single-phase **RCDs** a current, equal to the rated tripping current, shall be 'suddenly' applied between active and protective earth and the operating time measured.

NOTE –

(1) Tests are applied by the instrument test button (suddenly applied). In case of doubt, a number of test operations, up to five, may be required.

(2) Some **RCDs** may have a different result (approximately 10 ms) depending on the point on wave of the test current. In case of doubt, the operating time at both 0° and 180° should be tested.

(3) Load leakage and stored energy can affect the result and increase the meter trip time indication. In case of doubt, all load on the circuit should be disconnected.

(4) A 240 V test meter, used on 230 V may give a low test current and correspondingly longer times. Ensure the correct rating and tolerance of the test instrument.

(5) The test from active to earth involves the complete earth fault loop and the resistance of the earth wire, or current flowing in the earth wire may affect results. In case of doubt, a bench test may be required.

(6) **RCDs** which are permanently wired to terminals in equipment may be tested by push button only, and observing the operating time, which should be without undue delay. In case of doubt, use an external timer circuit, to detect the test current start and finish, and actually measure the disconnect time which should be not more than 150 ms for a 30 mA unit and 40 ms for a 10 mA unit. (The test button current is assumed to be 2 times the rated residual current.)

Amd 2 Dec '12

H3.2

For three-phase **RCDs** tests on three or four pole **RCDs** used on a three-phase supply shall be conducted with a three-phase supply connected.

The tests shall be undertaken individually on each phase in turn, with all load connections disconnected, (including the neutral) as any standing leakage current on the load side may add or subtract vectorially from the test current.

H3.2.1

The test may be performed on a single-phase supply, on one phase only, with all load switched OFF, if one of the following conditions is satisfied:

(a) The **RCD** is verified as having no circuit connections, internal or external to an active or neutral conductor; or

(b) The active and neutral circuit connections to the **RCD** are verified to ensure that a current flowing through the toroid is balanced or cancelled by a return current.

NOTE –

(1) Test results on three-phase **RCDs** may be influenced by a residual standing leakage. The standing leakage may add to the residual test current, or subtract from the residual test current, depending on the phase relationship of the leakage current to the test current.

(2) The standing leakage may be due to leakage in the load **insulation** to earth.

(3) The standing leakage may be from incorrect connections allowing a current to bypass the toroid in one direction. This can result from the **RCD** supply circuit current itself through the toroid not being balanced (or cancelled) by a return neutral current through the toroid. For example, the **RCD** active supply is downstream of the toroid, but the neutral return is upstream of the toroid, or vice versa.

APPENDIX J
ARC WELDERS

(Informative)

J1 GENERAL

A welding **power supply** is a device that provides an electric current to perform welding operations. Current requirements can be very low, say 5 A but the average current required is usually of the order of 80 A and some applications may be considerably higher.

Welding machines are usually classified as a constant current (CC) machine or a constant **voltage** (CV) machine. A CC machine varies its output **voltage** to maintain a steady current, while a CV machine will vary its output current to maintain a set **voltage**.

The selection of machine type largely depends on the type of welding expected to be undertaken. Typically shielded metal arc welding will use a CC machine, while gas metal arc and flux-cored arc welding will use a CV machine. With a CC machine the welder can be assured that a fixed level of current is reaching the material to be welded regardless of minor variations in the arc distance.

J2 MACHINE CONSTRUCTION

Most welding machines belong to one of the following types:

(a) Transformer – where the mains **voltage** or output of a generator is transformed into a high current, low **voltage** output. This type usually allows the welder to vary the output current by either moving a magnetic shunt in and out of the transformer core, or by selecting from a set of taps on the transformer. These are typically the least expensive;

(b) Generator or alternator – where a **voltage** source is derived from a mechanical energy source. For example, an internal combustion engine is used to drive the generator or alternator. A salient feature of this configuration is that if specified, a DC **voltage** can be generated directly, without the need for additional rectifiers;

(c) Inverter – with the availability of high power semi-conductors it became possible to build a device able to accept a DC input from say a battery and use it to feed an inverter based on switching principles to produce a high **power supply** capable of coping with high welding loads. More commonly, a mains or generated supply is switched at high frequency into a transformer. The advantage of this type is that the electrical characteristics of the welding power can be changed by software in real time. Typically, the controller software will exhibit features such as current pulsing, variable ratios and current densities.

J3 OPERATIONAL RISKS

The primary hazards of electric welding are electric shock, burns from hot material, ultraviolet radiant energy, toxic fumes, fire and explosion. Inert gas welders may have associated ozone oxides of nitrogen, fluoride and silicon which are highly toxic and in both the short and long term cause inflammation and congestion of the respiratory track.

The welding area should be well ventilated and illuminated, adequately screened to minimize risk to non participants, and well away from inflammable materials, gases, liquids or their containers.

APPENDIX K
REGULATORY APPLICATION OF THIS STANDARD

(Informative)

K1 GENERAL

Relevant regulatory authorities in the Australian States and Territories and in New Zealand may require compliance with this Standard under their various regulatory instruments.

The purpose of this appendix is to provide contact details of the relevant authorities who enforce regulations relating to the in-service inspection and testing of electrical equipment in each of the Australian States and Territories and in New Zealand.

This information is accurate at the time of publication of this Standard. Users are advised to consult the relevant nominated regulatory authority for information current at the time of use.

K2 REGULATORY AUTHORITIES

NEW SOUTH WALES

Office of Fair Trading

Street address:	1 Fitzwilliam Street, Parramatta, NSW
Postal address:	PO Box 972, Parramatta 2124, NSW
Phone:	(02) 9895 0111
Facsimile:	(02) 9895 0222
Website:	www.fairtrading.nsw.gov.au

WorkCover NSW

Street address:	92-100 Donnison Street, Gosford, NSW
Postal address:	Locked Bag 2906, Lisarow NSW 2252
	WorkCover assistance service, phone: (02) 4321 5000.
Facsimile:	(02) 4325 4145
Website:	www.workcover.nsw.gov.au

VICTORIA

Energy Safe Victoria

Street address:	Level 3, 4 Riverside Quay, Southbank, VIC 3006
Postal address:	PO Box 262, Collins Street West, VIC 8007
Phone:	(03) 9203 9700
Facsimile:	(03) 9686 2197
Email:	info@esv.vic.gov.au
Website:	www.esv.vic.gov.au

Victorian WorkCover Authority

Street address:	Level 24, 222 Exhibition Street, Melbourne 3000
Postal address:	GPO Box 4306, Melbourne 3001
	WorkCover Advisory Service, phone: (03) 9641 1555
Facsimile:	(03) 9641 1222
Website:	www.workcover.vic.gov.au

QUEENSLAND

Electrical Regulatory Authorities Council, C/O: Electrical Safety Office, Department of Justice and Attorney-General

Street address:	50 Ann Street, Brisbane, QLD 4000
Postal address:	GPO Box 69, Brisbane, QLD 4001
Phone:	(07) 3405 6463
Facsimile:	(07) 3237 0229
Website:	www.erac.gov.au

Electrical Safety Office, Department of Industrial Relations

Street address:	Level 6, Neville Bonner Building, 75 William Street, Brisbane QLD 4000
Postal address:	GPO Box 69, Brisbane QLD 4001
Phone:	(07) 3237 0220
Facsimile:	(07) 3237 0229
Website:	www.eso.qld.gov.au

AUSTRALIAN CAPITAL TERRITORY

ACT Planning and Land Authority

Street address:	Central Office, Ground Floor, North, Dame Pattie Menzies House, 16 Challis Street Dickson, ACT 2602
Postal address:	GPO Box 1908, Canberra, ACT 2601
Phone:	(02) 6207 1926
Facsimile:	(02) 6207 1925
Website:	www.actpla.act.gov.au

ACT Workcover

Street address:	Level 4 Eclipse House, 197 London Circuit, Canberra City, ACT 2601
Postal address:	PO Box 224, Civic Square, ACT 2608
Phone:	(02) 6205 0200
Facsimile:	(02) 6205 0336
Website:	www.workcover.act.gov.au

Commonwealth OH&S regulator, Comcare

Street address:	Level 1, 14 Moore Street, Canberra, ACT 2600
Postal address:	GPO Box 9905, Canberra ACT 2601
Phone:	(02) 1300 366 979
Facsimile:	(02) 6257 5634
Website:	www.comcare.gov.au

TASMANIA

Workplace Standards Tasmania

Street address:	30 Gordons Hill Road, Rosny Park, TAS 7018
Postal address:	PO Box 56, Rosny Park, TAS 7018
Phone:	(03) 6233 7657
Facsimile:	(03) 6233 8338
Website:	www.wsa.tas.gov.au

NORTHERN TERRITORY

Electrical Safety Office

Street address:	Minerals House, 66 The Esplanade, Darwin, NT 0800
Postal address:	GPO Box 4821, Darwin, NT 0801
Phone:	(08) 8999 5010
Facsimile:	(08) 8999 6260
Website:	www.deet.nt.gov.au/wha/pages/electrical

SOUTH AUSTRALIA

Office of the Technical Regulator (SA)

Street address:	Level 8, 11 Waymouth Street, Adelaide, SA 5000
Postal address:	GPO Box 1533, Adelaide, SA 5000
Phone:	(08) 8226 5500
Facsimile:	(08) 8226 5523
Website:	www.technicalregulator.sa.gov.au

Amd 1
Apr '11

Safework (SA)

Street address:	Level 3, 1 Richmond Road, Keswick, SA 5035
Postal Address:	GPO Box 465, Adelaide, SA 5001
Phone:	(08) 8303 0400
Facsimile:	(08) 8303 0277
Website:	www.safework.sa.gov.au

WESTERN AUSTRALIA

Electrical Work is also subject to the terms of the Occupational Safety and Health Act 1984 and the Occupational Safety and Health Regulations 1996, which are administered by WorkSafe Western Australia.

Energy Safety Directorate

Street address:	West Leederville Office (Head Office), 20 Southport Street, West Leederville, WA 6007
Postal address:	Locked Bag 14, Cloisters Square, WA 6850
Phone:	(08) 9422 5200
Facsimile:	(08) 9422 5244
Website:	www.energysafety.wa.gov.au

Work Safe Western Australia

Street address:	5th Floor, 1260 Hay Street, West Perth, WA 6005
Postal address:	PO Box 294, West Perth, WA 6872
Phone:	(08) 9327 8777
Facsimile:	(08) 9321 8973
Website:	www.safetyline.wa.gov.au

NEW ZEALAND

Energy Safety

Amd 1 Apr '11

Street address:	33 Bowen Street, Wellington 6011	
Postal address:	PO Box 1473, Wellington 6140	
Phone:	0508 377 463	+ 64 3 962 6248 for international calls
Facsimile:	0508 723 336	+ 64 4 460 1365 international
Website:	www.energysafety.govt.nz	

Department of Labour

Street address:	4th Floor, Unisys House, 56 The Terrace, Wellington 6011
Postal address:	PO Box 3705, Wellington 6140
Phone:	+64 4 915 4400
Contact Centre:	0800 20 90 20
Facsimile:	+64 4 915 4015
Website:	www.dol.govt.nz

Standards Australia

Standards Australia is an independent company, limited by guarantee, which prepares and publishes most of the voluntary technical and commercial standards used in Australia. These standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth government, Standards Australia is recognized as Australia's peak national standards body.

Standards New Zealand

The first national Standards organization was created in New Zealand in 1932. The Standards Council of New Zealand is the national authority responsible for the production of Standards. Standards New Zealand is the trading arm of the Standards Council established under the Standards Act 1988.

Australian/New Zealand Standards

Under a Memorandum of Understanding between Standards Australia and Standards New Zealand, Australian/New Zealand Standards are prepared by committees of experts from industry, governments, consumers and other sectors. The requirements or recommendations contained in published Standards are a consensus of the views of representative interests and also take account of comments received from other sources. They reflect the latest scientific and industry experience. Australian/New Zealand Standards are kept under continuous review after publication and are updated regularly to take account of changing technology.

International involvement

Standards Australia and Standards New Zealand are responsible for ensuring that the Australian and New Zealand viewpoints are considered in the formulation of international Standards and that the latest international experience is incorporated in national and Joint Standards. This role is vital in assisting local industry to compete in international markets. Both organizations are the national members of ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission).

Visit our websites

www.standards.org.au www.standards.co.nz

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