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STANDARDS Australia

AS/NZS 3760:2022

Incorporating Amendment No. 1

AUSTRALIAN/NEW ZEALAND STANDARD

In-service safety inspection and testing of electrical equipment and RCDs

Superseding AS/NZS 3760:2010 on 24 June 2023

AS/NZS 3760:2022

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Better Regulation Division- SafeWork NSW

Better Regulation Division – NSW Fair Trading

Building Services Contractors of NZ

Consumer Electronics Suppliers Association

Electrical Regulatory Authorities Council

Electrical Workers Registration Board

ECANZ - Master Electricians NZ

Hire and Rental Industry Association of Australia

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Australian/New Zealand Standard™

In-service safety inspection and testing of electrical equipment and RCDs

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REFERENCED DOCUMENTS

Reference is made in this document to the following:

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

AS/NZS 3000:2018 AMD 1:2020 AMD 2:2021	Electrical installations (known as the Australian/New Zealand wiring rules)
AS/NZS 3001	Electrical installations – Transportable structures and vehicles including their site supplies
AS/NZS 3002	Electrical installations – Shows and carnivals
AS/NZS 3003	Electrical installations – Patient areas
AS/NZS 3010	Electrical installations – Generating sets
AS/NZS 3012	Electrical installations – Construction and demolition sites
AS/NZS 3019	Electrical installations – Periodic verification
AS/NZS 3190	Approval and test specification – Residual current devices (current-operated earth-leakage devices)
AS/NZS 3551	Management programs for medical devices
AS/NZS 4249	Electrical safety practices – Film, video and television sites
AS/NZS 4763	Safety of portable inverters
AS/NZS 5761	In-service safety inspection and testing – Second-hand electrical equipment prior to sale
AS/NZS 5762	In-service safety inspection and testing – Repaired electrical equipment
AS/NZS ISO 9000	Quality management systems – Fundamentals and vocabulary
AS/NZS ISO 31000	Risk management – Principles and guidelines
AS/NZS 60335.1	Household and similar electrical appliances – General requirements
AS/NZS 61008.1	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – General rules
AS/NZS 61009.1	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – General rules

AUSTRALIAN STANDARDS

AS 1674.2	Safety in welding and allied processes – Electrical
AS 60529:	Degrees of protection provided by enclosures (IP Code)

NEW ZEALAND STANDARD

NZS 6115	Electrical Installations – Mobile electro-medical connectable installations

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INTERNATIONAL STANDARDS

IEC 60320-3	Appliance couplers for household and similar general purposes - Part 3: Standard sheets and gauges
IEC 61800-5-1 Ed 2.1	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy

NEW ZEALAND LEGISLATION

Electricity (Safety) Regulations 2010

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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 3760:2010 and its Amendment No. 1 (2011) and Amendment No. 2 (2012) 12 months from the date of publication. This edition has undergone a complete revision.

A1 This Standard incorporates Amendment No. 1 (December 2022). The changes required by the amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected. Where an application date other than immediate is applicable to an amendment the date of application (DOA) is indicated by the marginal bar against the part affected.

In-service testing is a necessary part of any safety programme 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.

Note: In-service testing and inspection deals with the safety of electrical equipment and not just the electrical safety.

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.

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

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 that 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.

AS/NZS 3760:2021 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.

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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard

In-service safety inspection and testing of electrical equipment and RCDs

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 an electrical supply by a flexible cord or connecting device, and that:

- Is new equipment placed into service for the first time;
- Is already in-service;
- Has been serviced or repaired;
- Is returning to service from a second-hand sale; or
- Is available for **hire**.

This standard also specifies procedures for the safety inspection and testing of:

- In Australia, residual current devices (**RCDs**) installed in the electrical installation;
- Portable inverters that generate or produce low **voltage**.

Typical examples of equipment covered by this standard are:

- **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;
- **Cord sets**, **cord extension sets** and portable outlet devices;
- **Portable residual current devices** (**PRCD**), outgoing assemblies for construction sites (ACS); portable socket-outlet assemblies (PSOA), outlet boxes;
- Flexible cords connected to **fixed equipment** in **hostile environments**;
- Portable power supplies (includes power adaptor/plug-pack, both of the **safety isolating transformer** and switch-mode type);
- Battery chargers, including those for commercial or industrial use;
- 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, public place, accommodation place, or equipment offered for **hire**.

1.1.2

This standard does not apply to

a) Electrical equipment 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 that may be in electrical contact with earth or through which a circuit may be completed to earth;

b) Equipment that would need to be dismantled to perform the inspection and tests specified in this standard;

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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.

c) Requirements for functional checks;

d) **RCDs** used in the supply to medical equipment within the scope of AS/NZS 3003 or NZS 6115;

e) **Fixed equipment** (except, in Australia, **RCDs**) or **stationary equipment** connected to wiring that forms part of the electrical installation and hence falls within the scope of AS/NZS 3000;

f) 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.

g) Portable generators, within the scope of AS/NZS 3010;

h) In New Zealand, demonstration stock in retail or wholesale outlets;

i) In Australia, demonstration stock in retail or wholesale outlets, however the **responsible person** should regularly conduct a visual inspection.

1.2 GENERAL

Equipment needs to be subject to regular inspection and testing to detect damage, wear or other conditions that 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 should be examined for obvious damage. Where deemed compliant, the owner or **responsible person** should ensure it is tagged in accordance with 2.5.2.1(c).

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**) that itself has a current tag.

NOTE – For further information, refer to the Electricity (Safety) Regulations 2010: 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 4.7 from that standard which 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;

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b) Where the flexible cable or flexible cord is flexed on equipment that is moved only, for example, for restocking, maintenance or cleaning, 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.

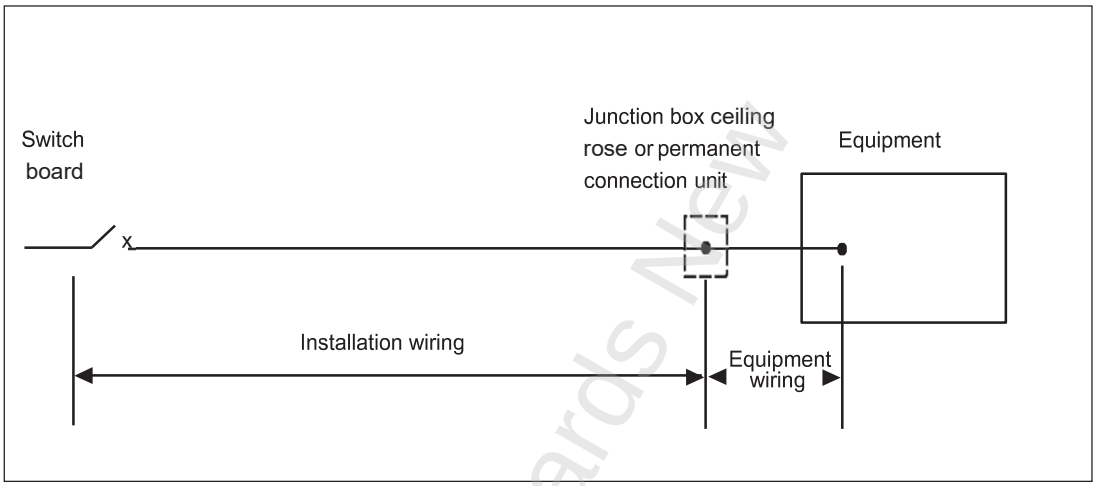


Figure 4.7 from AS/NZS 3000 showing equipment connected to the installation wiring by equipment wiring

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 2.5.2.1 and their in-house 'Ready for **hire**' tag.

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 2.4, 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 this standard.

Shall

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

Should

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

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May

Indicates the existence of an option.

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

Unless otherwise specified, all AC **voltage** and current specified 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 conductive parts of electrical equipment, required to be connected to a protective earth, and that:

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

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

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

(i) Other conductive parts that are themselves earthed or separated from **live parts** by **double insulation** or **reinforced insulation**.

(ii) Metal nameplates, screw-heads, covers or plates, and their means of fixing, that 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, having a cover that 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, with a configuration and mass that 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 Assessment

Testing with an appropriate test instrument, examination, inspection and the recording of the results.

NOTE – This definition does not apply to risk assessment

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

Equipment in which protection against electric shock does not rely on **basic insulation** only, but that 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**, **reinforced insulation** or parts operating at safety extra-low **voltage**.

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(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.

1.4.4 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 'Class II', 'DOUBLE INSULATED' or with the symbol ⧈ to allow easy identification.

NOTE –

(1) **Class II equipment** may also be manufactured with a metal enclosure that is 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**.

1.4.5 Competent person

A 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 should be maintained, this includes updating skills and knowledge as necessary following technological advances in both the testing instrumentation available and the equipment being inspected and tested as well as changes to this standard.

(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 equipment** 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.

(vi) Have an understanding of the risks associated with the use of the electrical equipment being inspected and tested and the risks created by the use of electricity, including the use of guards, barriers and other parts protecting the user from injury.

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

1.4.6 Cord set

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

NOTE – An example of a single phase **cord set** is shown in Appendix C, Figure C.1.

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1.4.7 Cord extension set

An assembly of a plug intended for connection to a 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 C.2.

1.4.8 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.

1.4.9 Fixed equipment

Equipment that 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.

1.4.10 Hire

A **hire** situation is created when the **hirer** provides electrical equipment, to a person or entity external to the **hirer's** organization, that 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.

1.4.11 Hiree

The person or a person conducting a business or undertaking (PCBU) that receives the equipment from the **hirer** or lessee.

NOTE - PCBU is defined in relevant legislation.

1.4.12 Hirer

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

1.4.13 Hostile environment

One that 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.

1.4.14 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** that provides a degree of protection against electric shock equivalent to **double insulation**.

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

1.4.15 Isolating transformer

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

1.4.16 Live parts

Live parts include live supply conductors and all parts that 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**.

1.4.17 Portable equipment

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

1.4.18 Power supply

An electrical device that—

Provides an output not exceeding 50 V AC or 120 V ripple free DC so as to provide supply to separate equipment.

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

1.4.19 Residual current device (RCD)

A device intended to isolate electrical supply to protected circuits, socket outlets or electrical equipment in the event of a current flow to earth that exceeds a predetermined value. The **RCD** may be a **fixed RCD** or a **portable RCD** (**PRCD**).

NOTE –Information on classifications can be found in AS/NZS 3190, AS/NZS 61008.1 and AS/NZS 61009.1.

1.4.20 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.

NOTE - Guidelines to assist a **responsible person** to assess the knowledge of **a competent person** are set out in Appendix B

1.4.21 Stationary equipment

Equipment having a mass exceeding 18 kg.

1.4.22 Supply cord

A flexible cable or flexible cord, for supply purposes, that 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.

1.4.23 Third party

Entity that carries out the tests and inspections for payment or reward and is not an employee of the **responsible person**.

NOTE - The **Third Party** is expected to have the electrical knowledge of a **competent person** as set out in Appendix B

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1.4.24 Voltage

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

a) **Extra-low voltage** – not exceeding 50 V AC or 120 V ripple free DC;

b) **Low voltage** – exceeding **extra-low voltage**, but not exceeding 1 000 V AC. or 1 500 V DC.

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SECTION 2 – INSPECTION AND TESTS

2.1 GENERAL

Experience has shown that more 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 2.4. These are based on the perception of the level of hazard and the degree of abuse that 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 a risk assessment by the **responsible person**, of the actual environment in which the equipment is placed or used.

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

2.2 FREQUENCY OF INSPECTION AND TESTS

Electrical equipment shall be inspected and tested:

a) At intervals indicated in Table 2.4 (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.

d) 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 2.4, 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 **hire**r has no control over the end use of the equipment and therefore a valid risk assessment cannot be conducted by the **hirer**.

2.3 PERSONNEL

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

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2.4 INSPECTION AND TESTING

2.4.1 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, that 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 that require **voltage** to maintain continuity. Such items may require application of rated **voltage** to allow testing.

2.4.2 Inspection

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

a) Check for obvious damage, defects, or modifications to 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 help 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 **insulation** tape are not in evidence. **Insulation** tape shall not be used to provide repair of the damaged cord, sheath and **insulation** of conductors.

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;

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h) The pins of plugs should be inspected for damage, including damage or tampering with the pins and damage to the **insulation** of the pins;

i) The shroud on cord extension sockets should be inspected for damage;

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

2.4.3 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.

2.4.3.1 Earthing continuity

The continuity of the protective earthing conductor from the plug earth pin or the appliance inlet 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 that does not exceed 1 Ω.

NOTE – This test is best undertaken in conjunction with the inspection performed under 2.4.2(b). If there is any indication of corrosion, additional earth continuity tests should be performed. 1.4.13 defines a **hostile environment**.

2.4.3.2 Testing of insulation

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

NOTE – For equipment that contains single phase motors, or if an **insulation** test fails due to the presence of internal components such as light emitting diodes (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 2.1.

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 2.2.

TABLE 2.1 – 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

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Note:

For equipment containing a variable speed power drive system, alternative requirements to leakage current requirements that may be acceptable are included in IEC 61800-5-1 Edition 2.1. Advanced technical support may be required for **assessment**.

TABLE 2.2 – 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
Class 1 equipment incorporating 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 2.2. Alternatively, **PRCDs** that require the electrical 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 2.1.

NOTE – A FE in a **PRCD** is a connection with earth to ensure the correct normal operation of the **PRCD**.

2.4.3.3 Testing of portable isolating transformers and power supplies

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

The **insulation** resistance between appropriate parts specified in Table 2.2 shall be not less than 1 MΩ.

2.4.3.4 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 2.3.

RCDs that are permanently wired to terminals in equipment can be tested using the **RCD** test button only, observing the operating time that 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 that shall be not more than 300 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 AC for AC and DC pulse sensitive **RCDs** is acceptable, as DC calibration is linked to AC calibration and verified by type test.

(2) The test methods for **RCDs** in 2.4.3.4 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.

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(3) Type 1 **RCD**, that tripping is ensured —

(i) As for Type A; and

(ii) With rated residual alternating current not exceeding 10 mA with an interrupting time not exceeding 40 ms at rated residual current. **RCDs** with rated residual currents not exceeding 10 mA, but with an interrupting time exceeding 40 ms, but not exceeding 300 ms at rated residual current are treated as Type A devices and marked 'General type, not for patient areas' in accordance with AS/NZS 61008.1 and AS/NZS 61009.1.

(iii) A **PRCD** marked with a rated residual current of 10 mA is considered to be a Type I **RCD** in accordance with AS/NZS 3190. A **PRCD** marked with a rated residual current of 30 mA is considered to be a Type II **RCD** in accordance with AS/NZS 3190.

(4) It should be noted that a push-button test only confirms the operation of the **RCD** and does not provide validation of the actual trip-time.

TABLE 2.3 – Maximum tripping times

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

2.4.3.5 Polarity of rewireable non-reversible connectors, rewireable plugs and rewireable cord extension sockets

The correct polarity of the individual wires in rewireable non-reversible connectors, rewireable plugs and rewireable cord extension sockets is shown in (a) (b) and (c) 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 2.4.

a) Connectors

The order (polarity) of the contact positions in rewireable non-reversible connectors, when looking at the engagement face of the connectors their disposition shall be as follows:

- Earthing contact (if any): upper central position (green/yellow wire);
- Active (line) contact: lower right-hand position (brown wire);
- Neutral contact: lower left-hand position (blue wire).

NOTE – See Figure C.1

b) 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);
- Active (brown wire);

in a clockwise direction, when viewed from the front of the plug looking at the pins.

NOTE – See Figure C.2

c) Cord extension sockets

The order (polarity) of the socket apertures of a three pin flat pin socket, to their connections, shall be

A1

- Earth (radial pin aperture – green/yellow wire);
- Active (brown wire);
- Neutral (blue wire);

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in a clockwise direction, when viewed from the front of the socket looking at the apertures.

NOTE – See Figure C.2

2.4.3.6 Testing of portable generators

Details of testing for portable generators are provided in AS/NZS 3012.

2.4.3.7 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 the
   - mains leads for damage; and
   - welding leads for damage such as 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.

   Or alternatively the leakage current to earth shall be measured using the differential test method.

c) Confirm that the mains **voltage** does not appear at the output terminals;

d) Visually check that the **Voltage** Reduction Device (VRD), if fitted, is operational.

NOTE – Details of testing of arc welders with exposed terminals are given as follows:

Australia: AS 1674.2.

New Zealand: IEC 60974-4.

2.4.3.8 Testing of portable inverters

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

2.4.3.9 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 effectiveness of the continuity of the protective earth conductor from the plug earth pin or the appliance inlet 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.

2.5 ACTION RESULTING FROM INSPECTION AND TESTING

2.5.1 Non-compliant equipment

Where in-service inspection or testing identifies equipment that fails to comply with the criteria given in this standard, the equipment shall be appropriately distinguishably 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.

2.5.2 Compliant equipment

Following in-service inspection and 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.

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2.5.2.1

The tag shall be durable, legible, non-reusable and 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 and entity who performed the test;

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

NOTE –

(1) 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.

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

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

(4) 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”.

2.5.2.2

Where it is impractical due to the size of the equipment for it to have a tag that includes the information required under 2.5.2.1(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.

2.6 DOCUMENTATION

2.6.1

In Australia records of inspection and testing should be kept for all equipment that is inspected and/or tested. The responsible person may require additional details to be included such as:

a) Earth continuity resistance;

b) **Insulation** resistance;

c) Leakage current;

d) Visual inspection.

In New Zealand records of testing and inspection shall be kept along with a register of all equipment that is inspected and/or tested.

For hired equipment, whilst in care of the **hiree**, if the equipment is required to be retagged for a new period, the test and inspection records shall be recorded on site by the **hiree**, alternately the equipment should be returned to the **hirer** for retagging.

NOTE –

(1) Electrical and/or occupational health and safety (OH&S) regulators may not require documentation to be kept.

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

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2.6.1.1

In New Zealand where testing is undertaken by a **third party** testing provider, full records including test values of all tests performed should be kept with the following information included, where relevant, as a minimum:

a) Earth continuity resistance;

b) **Insulation** resistance;

c) Leakage current;

d) Visual inspection.

NOTE –

(1) Other records may be required for specific equipment; e.g. a record of polarity may be required on equipment with rewireable plugs, sockets or fittings.

(2) Electronic records are acceptable.

2.6.2

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.

2.6.3

Where a risk assessment has been performed in accordance with 2.2, all documentation shall be retained for 7 years or such period as may be required by the relevant regulator.

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TABLE 2.4 – Indicative testing and inspection intervals for electrical equipment.
(CAUTION: This table must be read in conjunction with AS/NZS 3760 as a whole, and particularly 2.2)

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 Operating time test applicable for Australia only for RCDs installed in the electrical installation	
(a)	(b)	Portable (c)	Fixed (d)	Portable (e)	Fixed (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

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Table 2.4 (continued)

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 Operating time test applicable for Australia only for RCDs installed in the electrical installation**	
(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 Test and tag	Prior to **hire**	Including push-button test by **hirer** prior to **hire**		N/A	N/A
	3 months	N/A		3 months	12 months
7 Repaired and serviced equipment	After repair or service that could affect electrical safety, or on reintroduction to service, AS/NZS 5762 applies (Refer to clause 2.2(b)).				

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Table 2.4 (continued)

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 Operating time test applicable for Australia only for RCDs installed in the electrical installation	
(a)	(b)	Portable (c)	Fixed (d)	Portable (e)	Fixed (f)
8. Second hand equipment	For second hand equipment AS/NZS 5761 applies (Refer to clause 2.2 (c))				

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APPENDIX A
BACKGROUND

(Informative)

A.1 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 that 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) Standards require that the equipment be marked with information to ensure its correct use such as:

- rated **voltage** or rated **voltage** range in volts;
- symbol for nature of supply, unless the rated frequency is marked;
- rated power input in watts or rated current in amperes;
- name, trade mark or identification mark of the manufacturer or responsible vendor;
- model or type reference; IP number according to degree of protection against ingress of water, other than IPX0;

NOTE –

(1) The rated frequency is 50 Hz.

(2) In New Zealand the rated **voltage** is 230 V for single-phase appliances and 400 V for three-phase.

The marked **voltage**, frequency, current and power ratings should be compatible with the supply characteristics where the equipment is used.

Other safety requirements may be included with the instructions for use supplied with the equipment. For example, it may be recommended to wear eye protection when using the equipment and if so a symbol may be marked on the equipment as a reminder. For eye protection the following symbol may be used.



If it is used its meaning will be explained in the instructions. Other such symbols are detailed in ISO 7010

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

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f) 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.

A.2 PRINCIPLES OF CONSTRUCTION OF ELECTRICAL EQUIPMENT

Accessible earthed parts of equipment operating from supply **low 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, is also referred to as **Class I equipment**.

NOTE – Some electric drills have an external metal chuck that may be double insulated from **live parts**.

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 ‘Class II’ or ‘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 aluminium 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.

A.3 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.

For **class II equipment** that includes a functional earth, this equipment will be marked on the rating plate with



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A.4 PROTECTIVE EARTHING

The resistance to earth from protectively earthed parts in **Class I equipment** has to be low enough to ensure that failure of **basic insulation** does not allow exposed metal parts to become live.

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.

A.5 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 no degradation has occurred since manufacture, during transport, or over its service life.

A.6 TEST EQUIPMENT

The verification should be carried out against a calibrated source.

It is recommended that the verification should be carried out within the timeframe specified in the manufacturer's instructions.

If the equipment has been misused or damaged, it should be re-verified immediately.

A.7 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.

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APPENDIX B
GUIDELINES ON THE ELECTRICAL KNOWLEDGE OF A COMPETENT PERSON

(Informative)

B.1 GENERAL

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

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

B.1.1 Basic electrical principles

a) Introduction to electricity, AC and DC;

b) Electrical units: Amps, Ohms, Volts.

B.1.2 Circuit protection

a) Fuses;

b) Circuit breakers;

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

B.1.3 Electrical safety

a) Working with electricity;

b) Effects of current flow.

B.1.4 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;

h) Correct operation of guards, barriers and other parts protecting the user from injury due to the use of electricity.

B.1.5 Applicable to jurisdictional regulations

Regulatory requirements of country, state or territory.

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APPENDIX C
POLARITY FOR CORD SETS AND CORD EXTENSION SETS

(Normative)

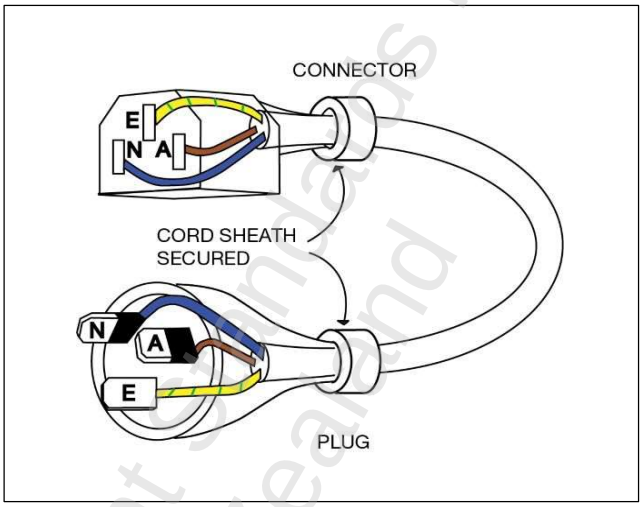
C.1

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.

C.2

The correct wiring for a **cord set** is shown in Figure C.1.

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 60320-3 C13 connector on the other is commonly called an 'IEC **cord set**'.



LEGEND

N = neutral		**= Neutral conductor insulation**
A = Active (Line)		**= Active (Line) conductor insulation**
E = Protective earth		**= Protective earth conductor insulation**

FIGURE C.1 – Cord set

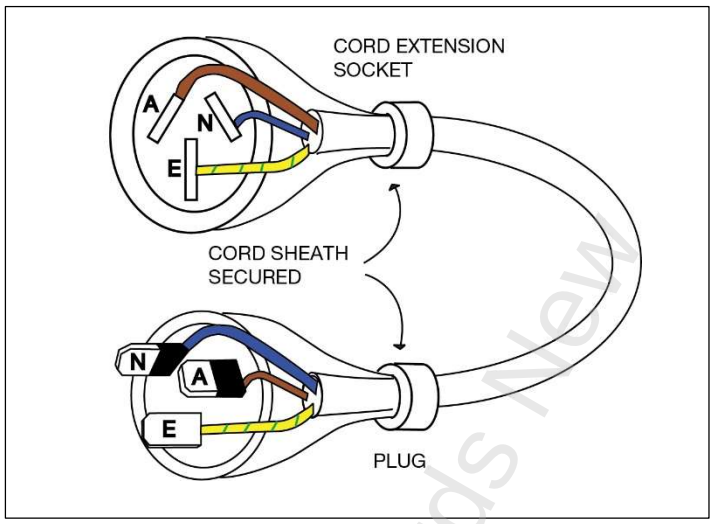
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C.3

The correct wiring for a **cord extension set** is shown in Figure C.2.



LEGEND

See Figure C.1

FIGURE C.2 – Cord extension set

C.4

The recommended conductor colours for the flexible cord in **cord sets**, and **cord extension sets** are given in Table C.1.1 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 C.1.1 – Conductor colours for flexible cords

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

C.5

Conductor colour schemes for modern flexible cords are shown in Table C.1.2.

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TABLE C.1.2 – 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 equipment** delta connected or star connected without neutral	**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**	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 'protective 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.							

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APPENDIX D
TEST OF EARTHING CONTINUITY

(Normative)

D.1 GENERAL

The test of earthing continuity resistance shall be conducted to 2.4.3.1 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 help detect broken strands or loose connections.

D.2 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.

NOTE – Equipment that is used in a **hostile environment** and may be in continuous physical contact with the person operating it, a protective earth test at a current of 10 Amps can be performed; e.g. floor polishers and associated leads.

D.3 TEST CONDITIONS

D.3.1

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 D.1 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 0.5 Ω.

D.3.2

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 D.2 for testing to **EPODs**.

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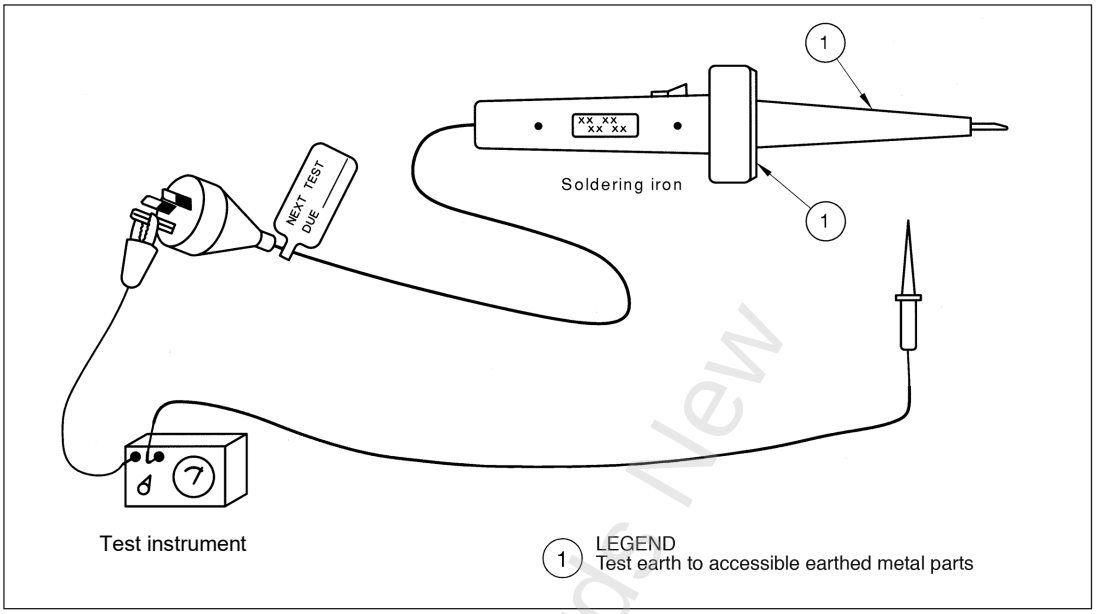


FIGURE D.1 – Measurement of the earth continuity resistance between accessible earthed metal parts and the earth pin of the mains plug

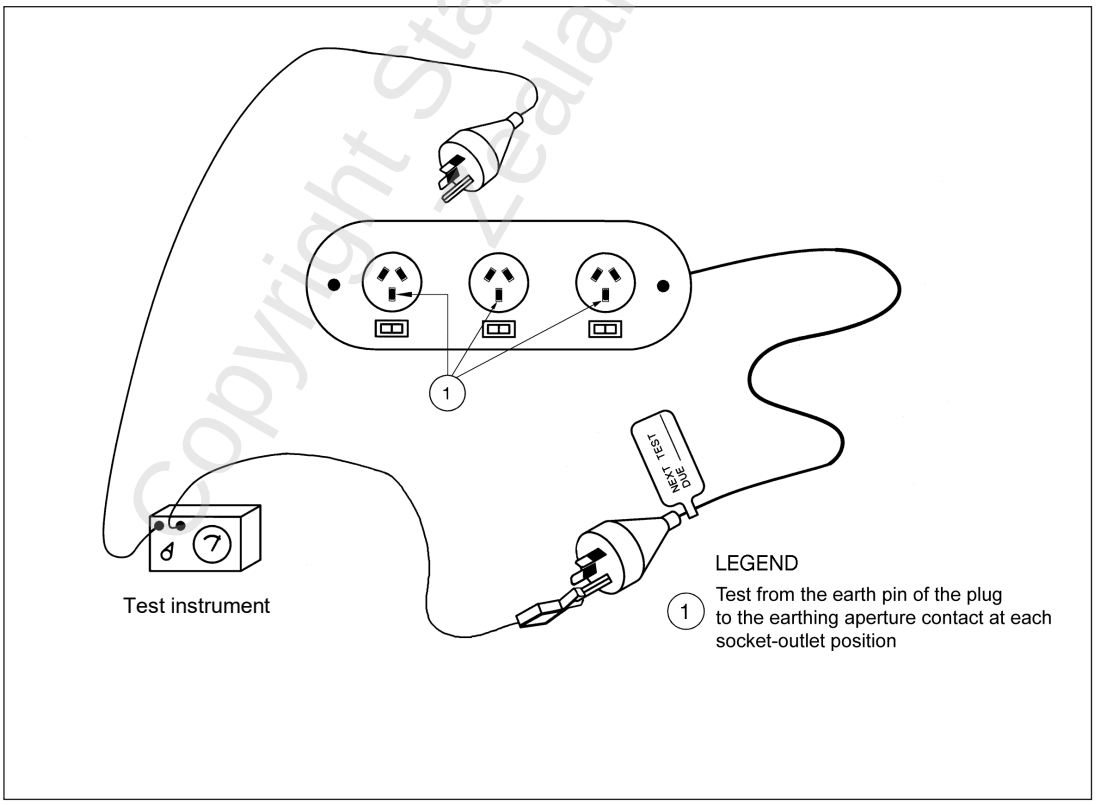


FIGURE D.2 – Measurement of the earth continuity resistance between the mains plug earth pin and the earthing aperture contacts of an EPOD

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APPENDIX E
INSULATION TESTING

(Normative)

E.1 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 2.1 and Table 2.2.

E.2 INSTRUMENTATION AND METHOD

E.2.1 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.

E.2.1.1 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, using 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 2.1, the uncertainty of measurement shall not exceed 5 %.

E.2.1.2 For testing **Class II equipment**, 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 E.1 and Figure E.2.

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 × 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.

E.2.2 Insulation resistance

Whether an **insulation** resistance meter (IRM) or a portable appliance tester (PAT) is used, it shall have the following characteristics:

a) A measuring circuit isolated from earth;

b) A nominal measuring **voltage** of 500 V DC (to avoid the equipment apparently failing the test, 250 V DC may be used for equipment containing, surge protection devices such as Metal Oxide Varistors (MOVs), or Electromagnetic Interference (EMI) filters, that bridge the **insulation** being tested);

NOTE – For guidance on the requirements of **insulation** measuring equipment, refer to 8.3.6.2 in AS/NZS 3000 (that is, maintain terminal **voltage** within + 20 % and – 10 % when measuring a resistance of 1 MΩ on the 500 V range).

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c) An accuracy of Class 5 or better.

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

E.3 TEST CONDITIONS

E.3.1 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 E.3 shows the testing of **insulation** resistance of **accessible earthed parts**.

E.3.2 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 E.4 shows testing of **insulation** resistance of accessible metal parts.

E.3.3 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 E.2.2 (b).

NOTE –

(1) Figure E.5 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.

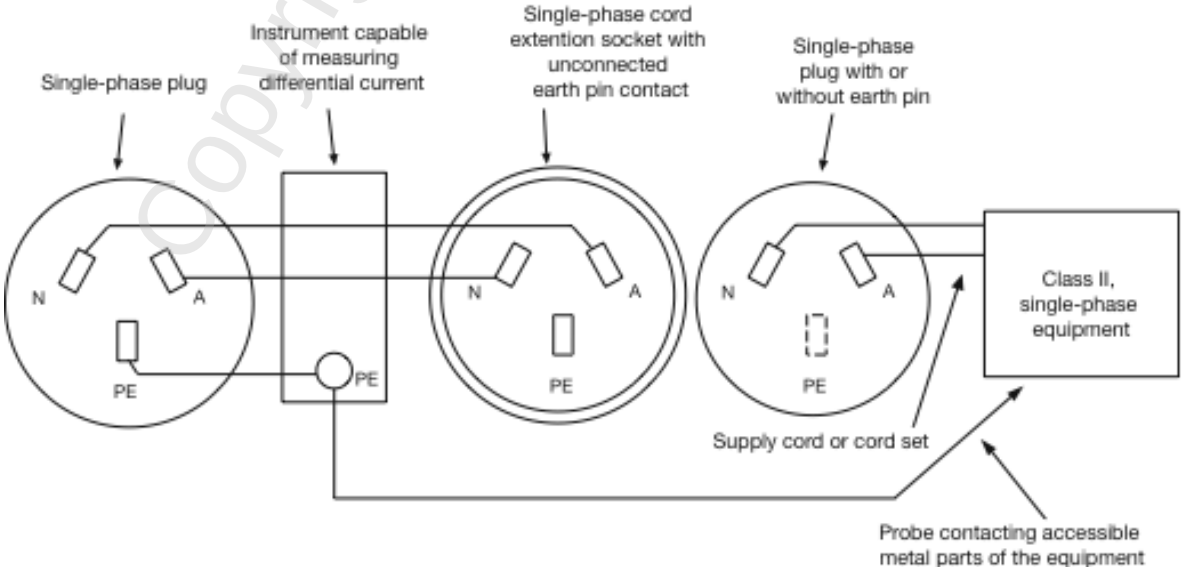


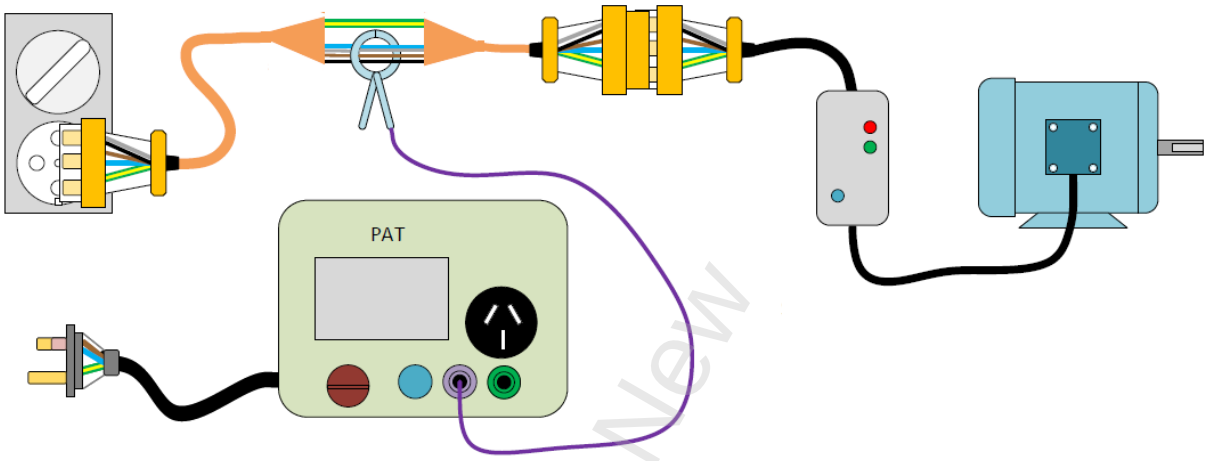
FIGURE E.1 – Leakage current test setup using differential test method for Class II single-phase equipment

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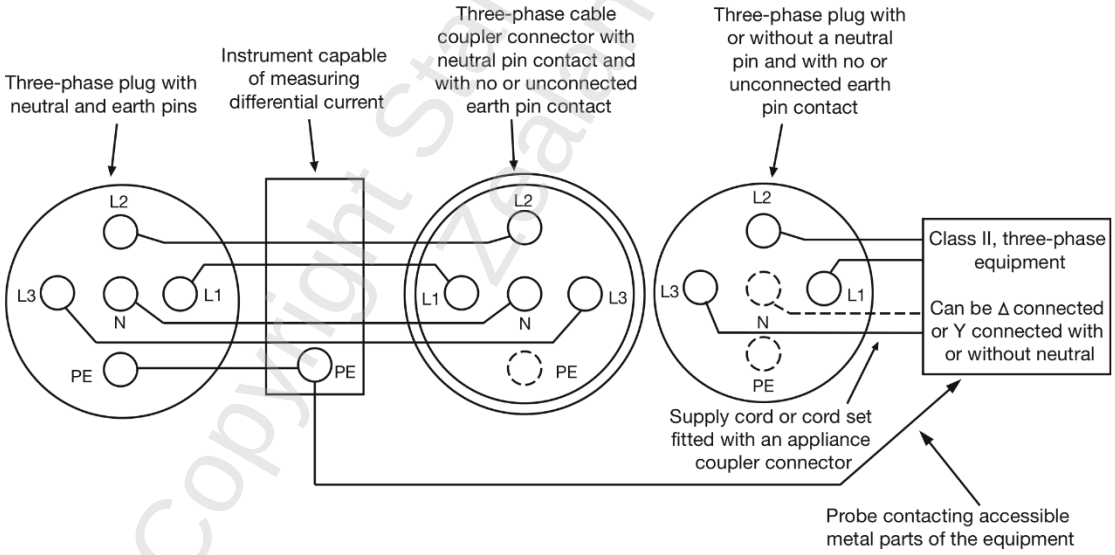
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a) Example of testing using a PAT and a clamp meter in conjunction with a special cord set where the protective earth conductor can be safely separated for measurement.

Switches, if any, to be in the on position



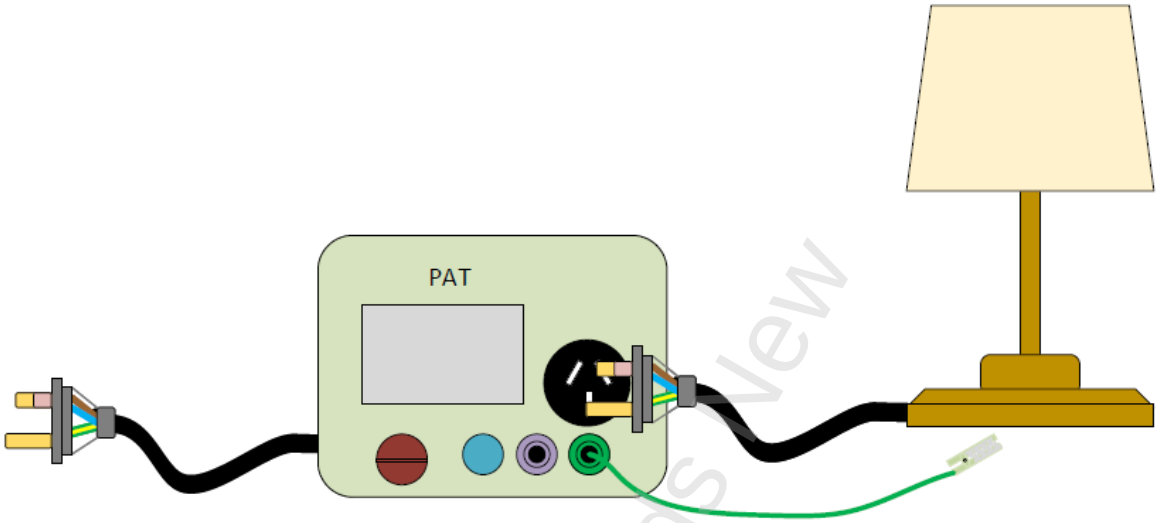
b) Example of testing using an instrument capable of measuring differential current in conjunction with a special cord set where the protective earth conductor can be safely separated for measurement.

Switches, if any, to be in the on position

FIGURE E.2 – Leakage current test setup using differential test method for Class II three-phase equipment

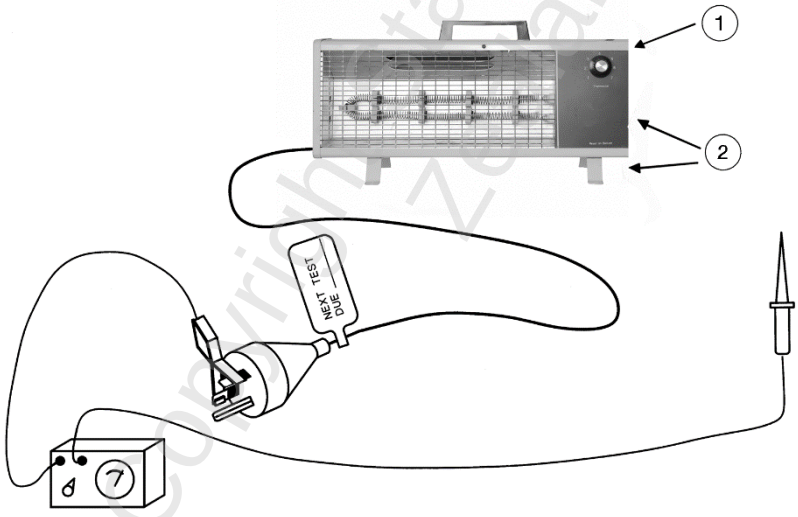
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a) Example of testing using a PAT.

Any switch to be in the on position during the test.



IRM

b) Example of testing using an IRM.

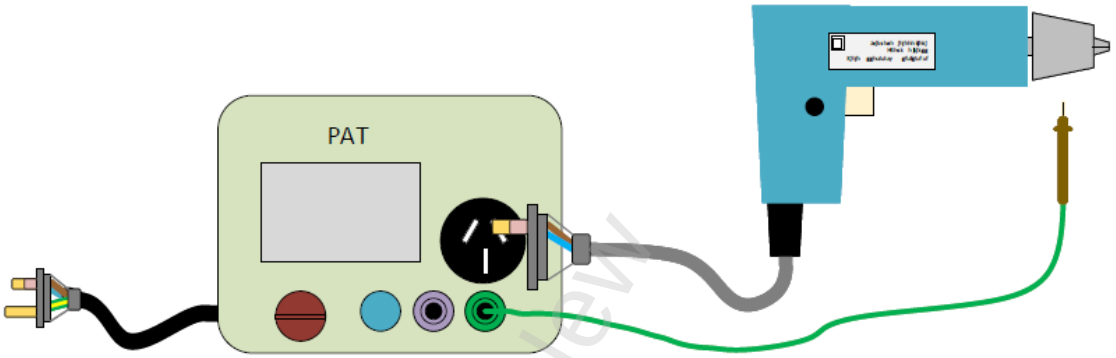
1) Any switch to be in the on position during the test.

2) Test active and neutral to **accessible earthed parts**

FIGURE E.3 – Measurement of the insulation resistance between live supply conductors and accessible earthed parts of typical Class I equipment

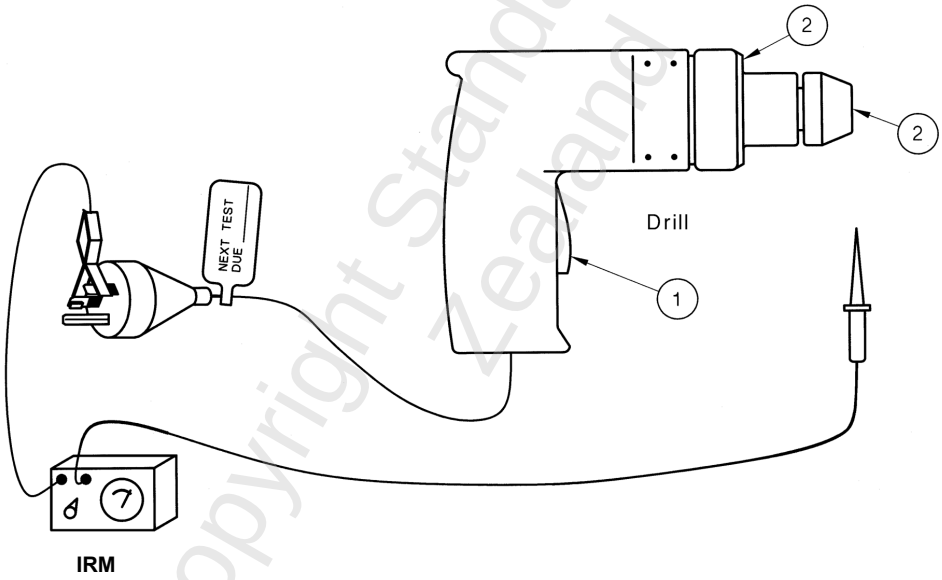
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a) Example of testing using a PAT.

Any switch to be in the on position during the test.



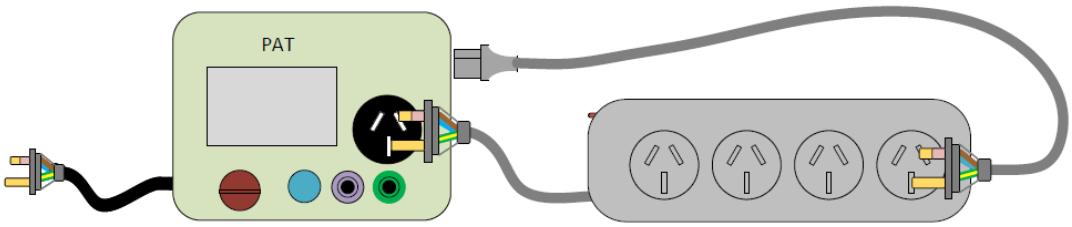
b) Example of testing using an IRM.

Any Switch to be in the on position during the test.

FIGURE E.4 – Measurement of the insulation resistance between live supply conductors and accessible metal parts of a typical Class II equipment

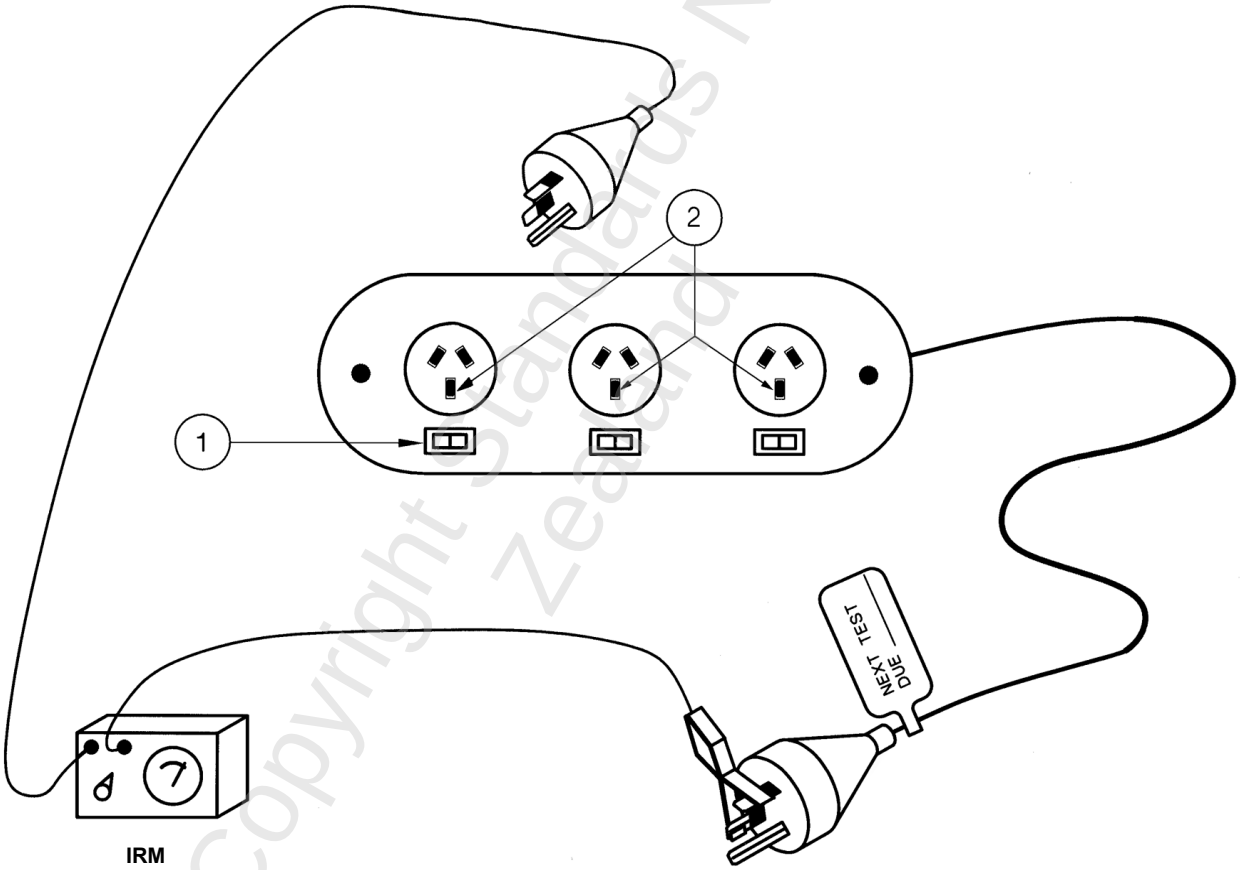
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a) Example of testing using a PAT.

Switches, if any, to be in the on position.



b) Example of testing using an IRM.

1) Switches, if any, to be in the on position.

2) Test active and neutral to each earth aperture contact

FIGURE E.5 – Measurement of the insulation resistance of an EPOD

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APPENDIX F
INSULATION RESISTANCE TESTING OF PORTABLE ISOLATING TRANSFORMERS

(Normative)

F.1 GENERAL

Insulation resistance shall be measured on **portable isolating transformer**s according to 2.4.3.3.

F.2 INSTRUMENTATION

Whether an **insulation** resistance meter (IRM) or a portable appliance tester (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 DC may be used for equipment containing, surge protection devices such as MOVs, or EMI filters, that bridge the **insulation** being tested);

NOTE – For guidance on the requirements of **insulation** measuring equipment, refer to 8.3.6.2 in AS/NZS 3000 (that is, maintain terminal **voltage** within + 20 % and – 10 % when measuring a resistance of 1 MΩ on the 500 V range).

c) An accuracy of Class 5 or better.

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

F.3 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 F.1. 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**;

NOTE – A method is shown in Figure F.3. 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**;

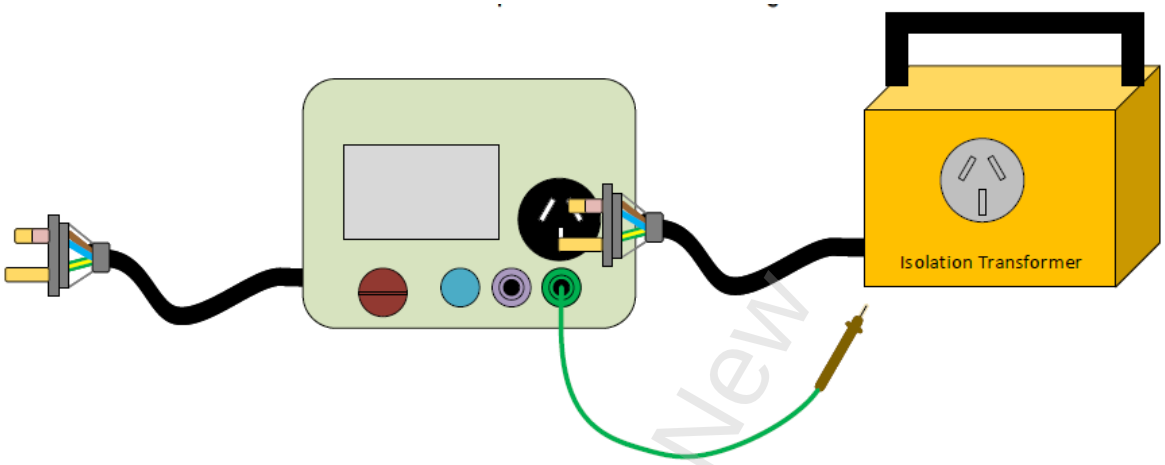
NOTE – A method is shown in Figure F.1. The earth slot in the output socket-outlet must not be connected to accessible metal parts or the earth conductor in the **supply cord** or appliance inlet.

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

NOTE – A method is shown in Figure F.2. 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.

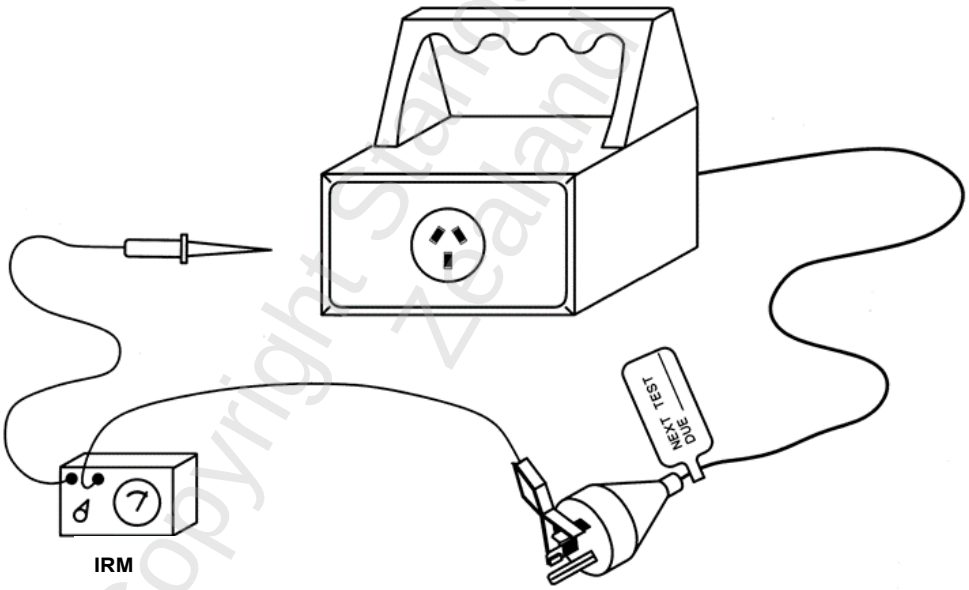
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a) Example of testing using a PAT.

Switches, if any, to be in the on position during the test.



b) Example of testing using an IRM.

Switches, if any, to be in the on position during the test.

FIGURE F.1 – 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

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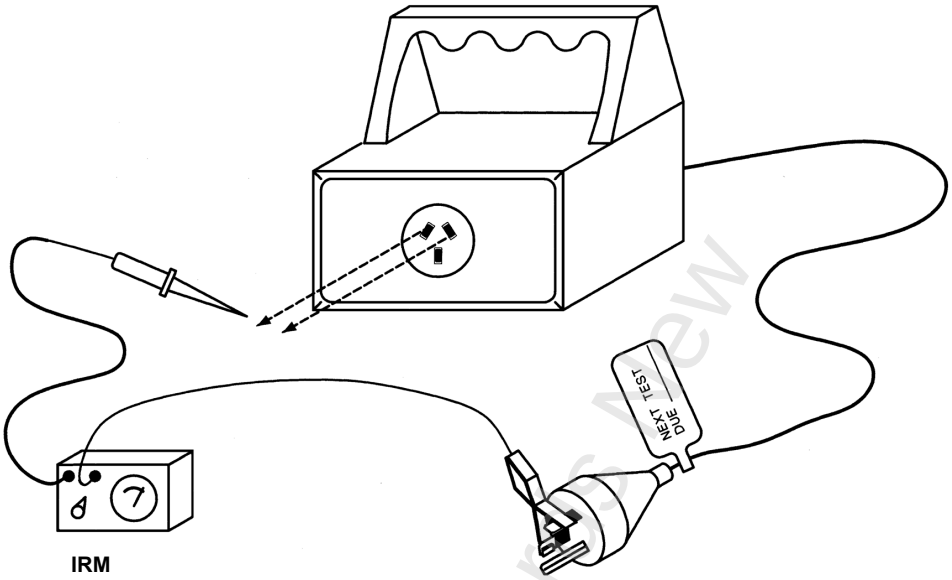


FIGURE F.2 – Measurement of the insulation resistance between live supply conductors and the portable isolating transformer output (secondary) winding

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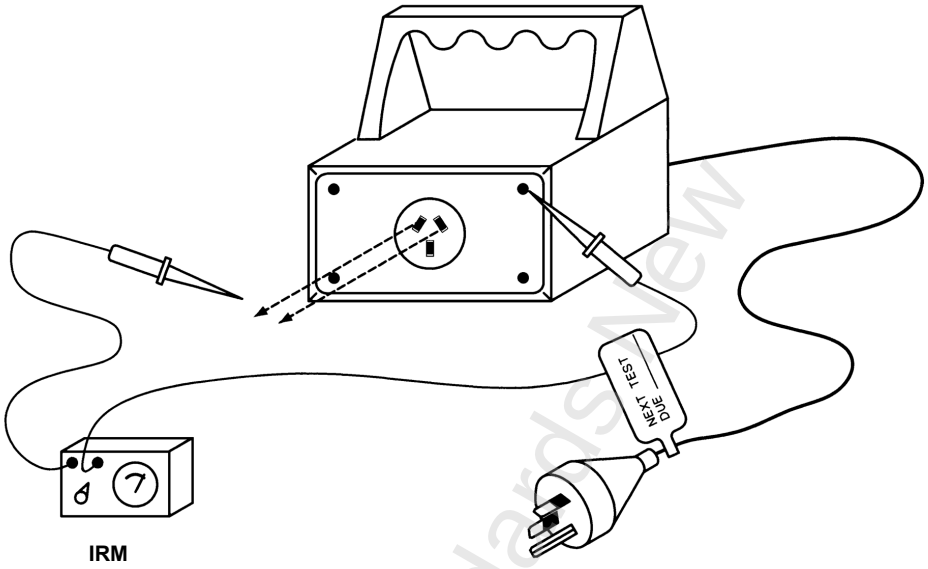


FIGURE F.3 – Measurement of the insulation resistance between a portable isolating transformer (secondary) winding and accessible earthed parts for Class I isolating transformers

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APPENDIX G
INSULATION RESISTANCE TESTING OF A POWER SUPPLY

(Normative)

G.1 GENERAL

Insulation resistance on power supplies shall be measured according to 2.4.3.3.

G.2 INSTRUMENTATION

Whether an **insulation** resistance meter (IRM) or a portable appliance tester (PAT) is used, it shall have the following characteristics:

a) A measuring circuit isolated from earth;

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

NOTE – For guidance on the requirements of **insulation** measuring equipment, refer to 8.3.6.2 in AS/NZS 3000 (that is, maintain terminal **voltage** within + 20 % and – 10 % when measuring a resistance of 1 MΩ on the 500 V 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.

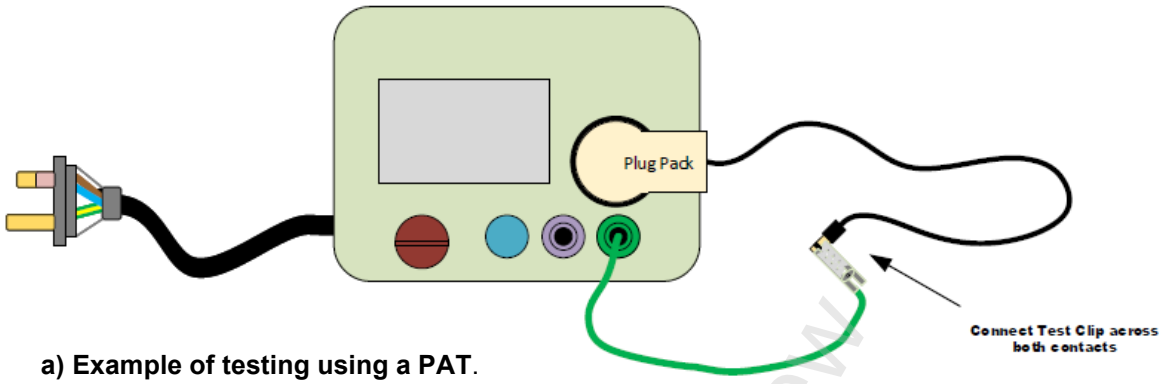
NOTE – A method is shown in Figure G.1.

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.

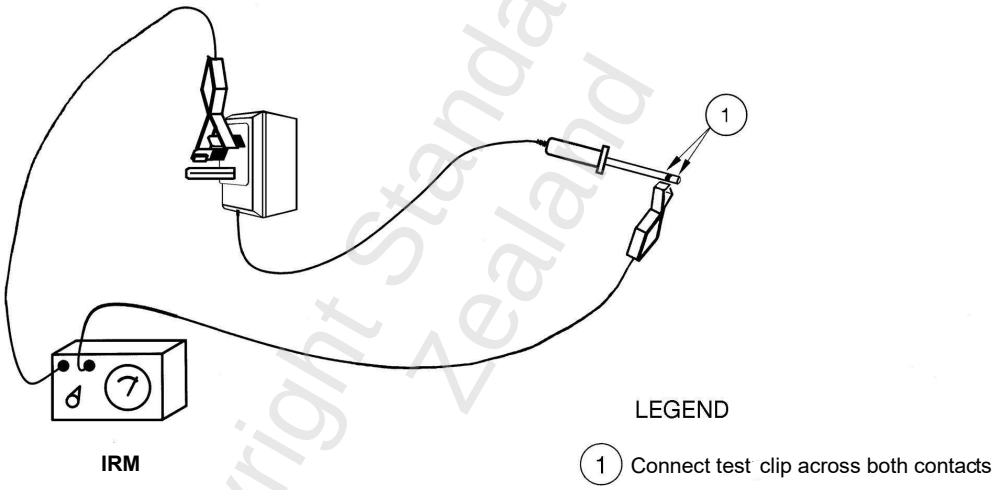
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a) Example of testing using a PAT.

Switches, if any, to be in the on position during the test.



b) Example of testing using an IRM.

Switches, if any, to be in the on position during the test.

FIGURE G.1 – Measurement of the insulation resistance of a power supply

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

(Normative)

H.1 GENERAL

H.1.1

The operating time of **RCDs** shall be checked according to 2.4.3.4 with maximum values acceptable shown in Table 2.3.

H.1.2

The following tests are not required by this standard:

a) Calibration sensitivity at slowly rising current;

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

c) Correct operation in case of a sudden appearance of a sinusoidal AC residual current;

d) Correct operation in case of sudden appearance of residual current of 5 $I_{\Delta n}$ and between 5 $I_{\Delta n}$ and 500 A;

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

H.2 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 H.1 – Tripping time accuracy

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

H.3 TEST CONDITIONS

H.3.1

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 0º and 180º 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.

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(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** that are permanently wired to terminals in equipment may be tested by push button only, and observing the operating time, that 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 that should be not more than 300 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).

H.3.2

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/pole in turn.

A leakage current, equal to the rated tripping current, shall be 'suddenly' applied between phase/pole active and protective earth and the operating time measured.

NOTE –

(1) Test results on three-phase **RCDs** may be influenced by a residual standing leakage current as any standing leakage current on the load side may add or subtract vectorially from the test current; i.e. the standing leakage current 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) If in doubt, disconnect all load connections (including the neutral) and re-test accordingly.

(3) Refer to NOTES from H.3.1 for further information.

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APPENDIX J
ARC WELDERS

(Informative)

J.1 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.

J.2 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.

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APPENDIX K
REGULATORY APPLICATION OF THIS STANDARD

(Informative)

K.1 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.

K.2 REGULATORY AUTHORITIES

NEW SOUTH WALES	
	NSW Fair Trading Street address: 4 Parramatta Square 12 Darcy Street Parramatta NSW 2150 Postal address: PO Box 972 Parramatta 2124, NSW Phone: 13 32 20 or + 61 2 9895 0111 Website: www.fairtrading.nsw.gov.au
	SafeWork NSW Street address: 92-100 Donnison Street, Gosford, NSW Postal address: Locked Bag 2906, Lisarow NSW 2252 SafeWork assistance service, phone: 13 10 50 Email contact@safework.nsw.gov.au Website: www.safework.nsw.gov.au
VICTORIA	
	Energy Safe Victoria Street address: Level 5, 4 Riverside Quay, Southbank, VIC 3006 Postal address: PO Box 262, Collins Street West, VIC 8007 Phone: (03) 9203 9700 Email: info@energysafe.vic.gov.au Website: www.esv.vic.gov.au

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	Victorian Workcover Authority Street address: 1 Malop Street, Geelong VIC 3220 Postal address: PO Box 279, Geelong 3220 WorkCover Advisory Service, phone: 1800 136 089 Facsimile: (03) 9641 1222 Website: www.worksafe.vic.gov.au
QUEENSLAND	
	Electrical Safety Office, Office of Industrial Relations Street address: 1 William Street, Brisbane QLD 4000 Postal address: GPO Box 69, Brisbane QLD 4001 Phone: (07) 3738 5100 Website: www.eso.qld.gov.au
AUSTRALIAN CAPITAL TERRITORY	
	Access Canberra Postal address: GPO Box 158, Canberra ACT 2601 Phone: General: 13 22 81 Electrical Inspectors (02) 6207 7775 Email: Electrical.Inspections@act.gov.au Website: www.accesscanberra.act.gov.au
	Worksafe ACT Postal address: GPO Box 158, Canberra ACT 2601 Phone: • General: 13 22 81 • Notifiable Incidents: 02 6207 3000 Email: worksafe@worksafe.act.gov.au Website: www.worksafe.act.gov.au
	Comcare: The national work health and safety, and workers compensation authority Postal address: GPO Box 9905, Canberra ACT 2601 Phone: 1300 366 979 Facsimile: 1300 196 971 Email: General.Enquiries@comcare.gov.au Website: www.comcare.gov.au

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TASMANIA	
	WorkSafe Tasmania Street address: 30 Gordons Hill Road, Rosny Park, TAS 7018 Postal address: PO Box 56, Rosny Park, TAS 7018 Website: www.worksafe.tas.gov.au
	Consumer, Building & Occupational Services (Electricity Standards & Safety) Street address: 30 Gordons Hill Road, Rosny Park, TAS 7018 Postal address: PO Box 56, Rosny Park, TAS 7018 Website: www.cbos.tas.gov.au
NORTHERN TERRITORY	
	NT WorkSafe Electrical Safety Street address: Ground floor, Darwin Corporate Park, Building 3, 631 Stuart Highway, Berrimah NT 0828 Postal address: GPO Box 1722, Darwin NT 0801 Phone: 1800 019 115 Email address: ntworksafe@nt.gov.au Website: https://worksafe.nt.gov.au/
SOUTH AUSTRALIA	
	Office of the Technical Regulator (SA) Street address: Level 8, 11 Waymouth Street, Adelaide, SA 5000 Postal address: GPO Box 320, Adelaide, SA 5001 Phone: (08) 8226 5500 Facsimile: (08) 8226 5529 Website: www.sa.gov.au/otr
	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

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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, that are administered by WorkSafe Western Australia
	Building and Energy – Department of Mines, Industry Regulation and Safety Street address: Level 1 Mason Bird Building, 303 Sevenoaks Street, Cannington WA 6107 Postal address: Locked Bag 100, East Perth, WA 6892 Phone: 1300 489 099 Facsimile: (08) 6251 1501 Website: www.commerce.wa.gov.au/building-and-energy
	WorkSafe WA – Department of Mines, Industry Regulation and Safety Street address: Level 1 Mason Bird Building, 303 Sevenoaks Street, Cannington WA 6107 Postal address: Locked Bag 100, East Perth WA 6892 Phone: 1300 307 877 Website: www.commerce.wa.gov.au/worksafe

NEW ZEALAND	
	WorkSafe New Zealand (Energy Safety) Street address: Level 6, 86 Customhouse Quay, Wellington 6011 Postal address: PO Box 165, Wellington 6140 Phone: +64 4 897 7699 Contact Centre: 0800 030 040 Facsimile: +64 4 914 6866 (general faxes only) Website: www.worksafe.govt.nz

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Standards New Zealand

The first national standards organisation was created in New Zealand in 1932. The New Zealand Standards Executive is established under the Standards and Accreditation Act 2015 and is the national body responsible for the production of standards.

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.

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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 organisations are the national members of ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission).

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