Demonstrate knowledge of safeguards for use with portable electrical appliances

US 15848 v3

Training and Assessment Resource

NCES Level 2

Contents

Introduction to Training Assessment Resource

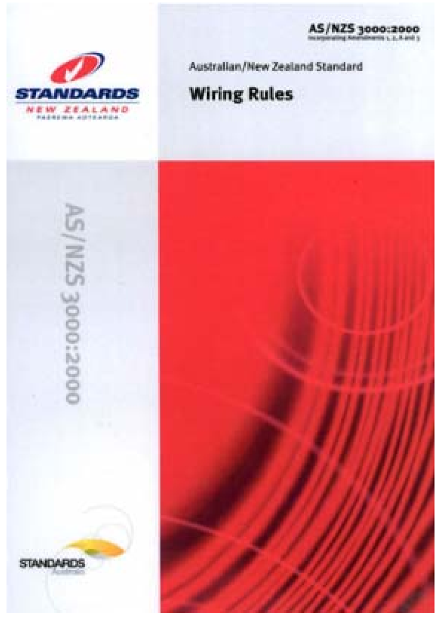
This Training Assessment Resource (TAR) contains the information that you require to complete the written assignment in the assessment pack for this unit standard.

Purpose

People who obtain credit for this unit standard are able to:

- Demonstrate knowledge of regulations for safeguards for portable electrical appliances
- Demonstrate knowledge of residual current devices
- Demonstrate knowledge of isolating transformers
- Demonstrate knowledge of double insulation for purpose of protection
- Inspect portable electrical appliances for defects

1. Legislation, Standards, Specifications and Codes of Practice



The electricity supply industry in New Zealand is controlled through Government legislation and this determines what can be done within the industry. The relevant documents that describe these requirements are:

Electricity Act 1992

The legislation that provides for the regulation of the supply of electricity and the electricity industry in New Zealand including the regulation and control of people who work in the industry.

Electricity Regulations 1997 and subsequent Amendments

The regulations that govern the standards of installation, plant and equipment used within the electricity industry.

New Zealand Electrical Codes of Practice (NZECP)

These provide additional information to clarify the interpretation of the regulations and set standard work practices.

Joint Australian/New Zealand Standards (AS/NZ)

There is a move towards the utilisation of standards rather than regulation and to make them common to both Australia and New Zealand. At the moment this change is in transition and there is a choice as to whether an installation complies with either the standard or the regulation. The difference between standards and regulations are; standards give you the expected outcome while the regulations, with the NZECP are more concise in respect to what is required. Standards are replacing the Electrical Codes of Practice (ECP).

Two common standards are:

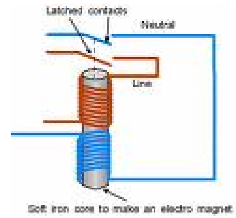
1. AS/NZS 3000:2000 Wiring Rules: The standard that is commonly used by electricians for the installation of electrical wiring.
2. AS/NZS 3760:2003 In-service Safety Inspection and Testing of Electrical Equipment: The standard that is commonly used by electrical service technicians and covers the requirements for portable electrical appliances, plant and equipment.

2. Electrical Safety Devices

A variety of electrical safety devices are available to protect against electric shock.

For your own safety whenever you're using an electrical appliance outside or in damp conditions you should use an isolating transformer or residual current device (RCD). An isolating transformer protects you from shocks by providing an electricity supply that is isolated from earth. For maximum protection the transformer should be placed as near as possible to the wall socket. This means that both the power tool you're using, and the extension lead, are protected by the isolating transformer.

2.1 Residual Current Devices



When buying electrical fittings and appliances, always ask for products that have an enhanced level of safety, such as a built-in RCD or recessed sockets.

An RCD constantly monitors the current flowing along a circuit. If it senses any loss of current, where electricity is diverting to the earth rather than through the circuit, it will immediately shut off.

If your body is providing the path for the electricity to divert to the earth, you could be seriously injured, burned, severely shocked or electrocuted.

An RCD will prevent the shock being fatal by shutting the system down instantly.

RCD's should be installed in damp areas of your home where there are electric fittings, such as bathrooms, laundries, kitchens, garages, pools and external electric outlets.

Activity

How does an RCD work?

Types of RCD

Different types of RCD’s include fixed RCD’s, which can be installed in standard socket outlets and wired in a way that protects other outlets downstream, circuit RCD’s, which are wired into your switchboard, and portable RCD’s. Some RCD’s of the most common acronyms used are:

Acronym	Definition
RCD	Residual Current Device (New Zealand/Australia/Europe)
ELCB	Earth Leakage Circuit Breaker (New Zealand/Australia and Asia)
RCBO	Residual Current Circuit Breaker with integral over-current protection (Europe)
RCCB	Residual Current Circuit Breaker (Europe)
GFCI	Ground Fault Circuit Interrupters (USA/Canada)

Although RCD's come in many shapes and sizes, there are only a few real differences.

Tripping current

The biggest difference between RCD's is the amount of leakage current required to trip the RCD. The main tripping levels used are:

Acronym	Definition
10mA	For medical or sensitive use
30mA	For personal use
100mA	For personal use
>100mA	For industrial or commercial use

Tripping time

The two basic styles of tripping time are instantaneous, and delay tripping. Instantaneous tripping time means that when the RCD senses an imbalance, it trips as soon as possible. Delayed tripping time is when the RCD senses an imbalance, it starts a timer and if the imbalance still exists when the time is up the RCD will trip. The time that the RCD waits is dependent on the level of the imbalance. The higher the imbalance the faster the trip.

Performance in loss of power

The RCD will react in one of two ways to a loss of power.

The RCD will stay latched. This is a type 'B' RCD and tends to be used more for fixed RCD's.

The other option is that the RCD will not stay latched. This is a type 'A' RCD.

Activity

If an RCD had a tripping level of 10mA, what situations would it typically be used for?

How does it work?

Under normal conditions

Current flowing through the phase conductor is equal to the current returning through the neutral conductor. This means that there is no leakage out of the system. The current flowing into the device is equal to the current used by the load. The magnetic field generated by the phase wire is equal in amplitude and opposite in polarity to the neutral wire so the magnetic fields generated cancel each other out. There is no 'imbalance'.

Under fault conditions

Current flowing through the phase conductor is not equal to the current returning through the neutral conductor. Current is being lost through an alternative return circuit to earth - possibly you! The current in one of the active conductors is equal to the current used by the load and the alternate return circuit, which is not equal to that returning through the other active conductor. As there is an imbalance of current, the magnetic fields of phase and neutral do not cancel each other out; therefore a magnetic field exists. This causes the sensor coil within the RCD to generate a small current. This current in the sensor coil is in turn detected by the sensor circuit. If the sensed current is above a predetermined level then the sensor circuit sends a signal to the solenoid, which causes the contacts to open, or 'trip'.

Note: An RCD only protects against a phase to earth, or a neutral to earth fault. It does not protect against a phase to neutral fault.

Testing requirements

Although there are many standards in existence for the testing of RCD's, most of them test for the same properties, albeit slightly differently.

Speed of response

How quickly does the RCD trip. The time is from when the fault current is introduced to when the current is broken.

Sensitivity

The level of leakage current the RCD requires before it trips.

Ambient effects

How the RCD's performance changes due to the conditions it is used in. Temperature, moisture, lightning impulses, inductive switching noise, load current, voltage fluctuation, or even orientation can affect it.

Endurance

To determine how safely it will endure for its expected lifetime.

High Fault currents

What happens to the RCD when it is subjected to high fault current? Values of up to 3000A are often used.

Activity

Complete the sentence below:

An RCD only protects against a phase to earth, or a neutral to earth fault. It does not protect against a

___

___

2.2 Isolating Transformers

An isolating transformer is an effective safeguard for use with all single-phase portable electrical appliances. The usual reticulated power supply in New Zealand employs the earth return system. This means that a worker who touches a live wire becomes part of a closed circuit (generator to generator) and is at risk.

The isolating transformer removes that risk. The worker will receive a shock on the outlet side of an isolating transformer only when in contact, simultaneously, with both outlet terminals. Always position the transformer as near as possible to the switchboard or point of supply. This ensures that both the tool and lead share the protection provided by the isolating transformer. Use only one tool per transformer unless the exposed metal surfaces of the appliances are all effectively bonded together.

How an Isolating Transformer works

An isolation transformer is a transformer, often with symmetrical windings, which is used to decouple two circuits. An isolation transformer allows an AC signal or power to be taken from one device and fed into another without electrically connecting the two circuits. Isolation transformers block transmission of DC signals from one circuit to the other, but allow AC signals to pass. They also block interference caused by earth loops. Isolation transformers with electrostatic shields are used for power supplies for sensitive equipment such as computers or laboratory instruments.

In electronics testing, troubleshooting and servicing, an isolation transformer is a 1:1 power transformer which is used as a safety precaution. Since the neutral wire of an outlet is directly connected to earth, earthed objects near the device under test (desk, lamp, concrete floor, oscilloscope ground lead, etc.) may be at a hazardous potential difference with respect to that device. By using an isolation transformer, the bonding is eliminated, and the shock hazard is entirely contained within the device.

Isolation transformers are commonly designed with careful attention to capacitive coupling between the two windings. This is necessary because excessive capacitance could also couple AC current from the primary to the secondary. An earthed shield is commonly interposed between the primary and the secondary. Any remaining capacitive coupling between the secondary and earth simply causes the secondary to become balanced about the earth potential.

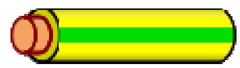
When a proper line-voltage isolation transformer is not available, a substitute may be made by determining the total load of the device under test and finding two identical line transformers each capable of handling the load. A power cord is attached to the primary of one transformer, an outlet to the primary of the other transformer. The secondaries are then connected to each other.

3. Double Insulation

In the electrical appliance manufacturing industry, the following IEC protection classes are used to differentiate between the protective-earth connection requirements of devices.

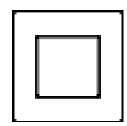
3.1 Appliance classes

Class I



These appliances must have their chassis connected to electrical earth by an earth conductor (coloured yellow/green in most countries, green in the U.S., Canada and Japan). A fault in the appliance which causes a live conductor to contact the casing will cause a current to flow in the earth conductor. This current should trip either an over current device (fuse or circuit breaker) or a residual current circuit breaker which will cut off the supply of electricity to the appliance.

Class II



A Class II or double insulated electrical appliance is one which has been designed in such a way that it does not require a safety connection to electrical earth.

The basic requirement is that no single failure can result in dangerous voltage becoming exposed so that it might cause an electric shock and that this is achieved without relying on an earthed metal casing. This is usually achieved at least in part by having two layers of insulating material surrounding live parts or by using reinforced insulation.

In Europe, a double insulated appliance must be labelled "Class II", "double insulated" or bear the double insulation symbol (a square inside another square).

3.2 Earthed Equipment

Class I electrical equipment is provided with one layer of insulation over the live conductors, and exposed metalwork is bonded to earth so that it cannot become live in the event of an insulation failure. The external metal casing of any item of electrical equipment must be earthed as a legal requirement. With correctly earthed supply installations and equipment, the risk of electric shock is virtually nil.

In practice, the most common instances of faulty earthing are:

> Earth connections broken accidentally or corroded through age.
> Earth connections incorrectly made.
> Earth connections not made at all.
> Earth connections removed for some specific purpose and not reinstated.

The external casings or screens of all electrical equipment must be secured so that it is impossible to touch electrically live parts. If the equipment is disconnected from earth, a notice must be attached which makes this quite evident to any unsuspecting person. Only persons with appropriate knowledge and experience, i.e. competent persons, may work on unearthed equipment.

3.3 Double Insulated Equipment

The application of a Residual Current Device (previously known as Earth Leakage Circuit Breaker) to a conventionally earthed system should be considered where it is vital to provide an additional back-up protection against failure of the primary earthing system.

As a general rule, an RCD will prevent a person from being subjected to a lethal shock from a fault current to earth by limiting the magnitude of the shock to 30 mA and the duration of the shock to 30 ms. An RCD will give no protection from a live to neutral contact.

RCD units are packaged either as fixed installations fitted to the incoming supply or are available in the form of a power breaker 13 Amp fused plug or adaptor. Every RCD unit is fitted with a test button which should be operated regularly to prove breaker operation.

Class II electrical equipment has all exposed metalwork separated from the conductors by two layers of insulation, so that the metalwork cannot become live. There is no earth connection and the operator's safety depends upon the integrity of the two layers of insulation.

4. Schedule of Inspection and Testing

4.1 Visual Inspection

Since over 80% of electrical faults are discovered by visual inspection, this is the most important element of Inspection and Testing. The following schedule is recommended.

Component	Common Fault
Plug	Cracked casing
	Bent pins
	Incorrectly rated fuse
	Incorrectly connected wires
	Loose connections
	Loose cable clamp
Mains Lead	Cuts, fraying, brittle
	Kinked, coiled
	Taped joints
	Overloaded (overheated)
	Male connector (if fitted)
	Not secured by grommet/clamp on appliance
Appliance	Damage/faulty operation of off/on switch
	Damage to casing
	Loose parts
	Missing screws
	Evidence of overheating
	Evidence of moisture
	Missing double insulation mark () on insulating casing (where appropriate)
	Accessible fuse holders: damage or removal of carrier permits live part to be touched
	Exposed output connections have marked voltage rating > 50V

4.2 Periodic testing of appliances & extension leads

The requirements for the testing of electrical equipment given in the Electrical Safety Regulations 1997 depend on the purpose for which the equipment is used.

4.3 Recommended Frequencies for Inspection and Testing

The recommended intervals between electrical tests and formal visual inspections which are tabled below are optima and may require to be reviewed in the light of experience. These frequencies are based on the Institution of Electrical Engineers (IEE), 'Code of Practice for In-Service Inspection and Testing of Electrical Equipment' and the Health and Safety Executive's HSG 107 'Maintaining Portable and Transportable Electrical Equipment'.

5. Appendix One

Equipment	Visual Inspection Frequency[1]	Testing Frequency [1]
Hand held power tools (drills, etc.) and workshop equipment (See also Appendix Two).	6 Months	6 Months
Power Cleaning equipment (Vacuum cleaners, polishers, etc.)	6 Months	6 Months
Most [2] equipment in laboratories, including IT equipment.	12 Months	12 Months
Most [2] equipment in accommodation, residences and catering	12 Months	12 Months
Most [2] equipment in offices, libraries and similar accommodation, excluding IT equipment.	24 Months	24 Months
IT equipment in offices, libraries and similar low risk accommodation.	Note [3]	Note [3]
Double insulated equipment (excluding items covered above).	24 Months	None

Notes:

1. Records should be kept of all formal visual inspections and tests of electrical equipment and a model checklist record for formal visual inspections is available to assist with this. Further details on visual inspections can be found in Appendix One. Where the formal visual inspection frequency and the electrical testing frequency coincide, the formal visual inspection will be incorporated into, and therefore part of the electrical test. Where they don't coincide, visual inspections will need to be carried out at local level.
2. On occasion, specific items of equipment may require an individual risk assessment, which takes into account intrinsic characteristics, mode of use, environment, etc, to arrive at an appropriate inspection / test interval, which may differ from that noted in the table.
3. On the basis of a detailed risk assessment by a specialised organization, similar low risk environments can be removed from the PAT testing regime, though user checks (visual) at a local level will continue to have an important role in ensuring the safety of this equipment. User checks are concerned only with the visually accessible parts of the equipment, cable, plug and any extension cable. Further details on user checks can be found in Appendix One.

6. Appendix Two

The tables below highlight the visual checks required on hand-held portable equipment before use:

Cable

	User Check	Formal Visual Inspection
Signs of mechanical damage, overheating or corrosion	✓	✓
Hardening of outer insulation	✓	✓
Kinking of cable	✓	✓
Coiling of long lengths of cable	✓	✓
A situation where future mechanical damage or corrosion is likely	✓	✓

Plug

	User Check	Formal Visual Inspection
Signs of mechanical damage or corrosion	✓	✓
Signs of overheating, e.g. discolouration or distortion	✓	✓
Cable clamp holding cable securely, where appropriate	✓	✓
Wires connected to correct terminals and of the correct length		✓
Un-insulated ends of wires completely covered by the screws		✓
Securing screws suitably tight		✓
Fuse of correct rating fitted		✓

Equipment

	User Check	Formal Visual Inspection
Metal casing damaged	✓	✓
Grommet, or other protection at place where cable passes through the casing, damaged or missing	✓	✓
Plastic casing of double insulated equipment damaged	✓	✓
Damaged or defective switches	✓	✓

7. Appendix Three

AS/NZS 3760:2003

TABLE 4
Testing and inspection intervals for electrical equipment
(CAUTION: This page must be read in conjunction with the Standard as a whole, and particularly Clause 2.1)

Type of environment and/or equipment	Interval between inspection and tests						
	Class of equipment		Residual Current Devices (RCDs)				Cord sets and power boards
	Class I (protectively earthed)	Class II (double insulated)	Push-button test - by user		Operating time and push-button test		
			Portable	Fixed	Portable	Fixed	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1 Factories, workshops, places of work or repair, manufacturing, assembly, maintenance or fabrication	6 months	12 months	Daily, or before every use, whichever is the longer	6 months	12 months	12 months	6 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	12 months	3 months	6 months	12 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	5 years	19 3 months	6 months	2 years	2 years	AS/NZS 3760:2003 5 years
4 Residential type areas of: hotels, residential institutions, motels, boarding houses, halls, hostels accommodation houses, and the like	2 years	2 years	6 months	6 months	2 years	2 years	2 years
5 Equipment used for commercial cleaning	6 months	12 months	3 months	N/A	12 months	N/A	12 months
6 Hire Equipment: Inspection	Prior to hire		Including push-button test by hirer prior to hire		N/A	N/A	Prior to hire
Test and tag	3 months		N/A		3 months	12 months	3 months
7 Repaired, serviced and second-hand equipment	After repair or service which could affect electrical safety, or on reintroduction to service.						

NOTE 1 The actual sub-environment in which the equipment is located determines the row for the environment to be used in Table 4. e.g. A computer in a non-hostile environment in an office within a factory would attract a test/inspection action in accordance with Row 3.

NOTE 2 Regulatory authorities, other Standards, workplace safety requirements or manufacturers' instructions may specify intervals appropriate to particular industries or specific types of equipment.

NOTE 3 RCDs in transportable equipment shall be regarded as portable RCDs.

NOTE 4 The following Standards refer only to the inspection and testing method of Clause 2.3 of this Standard, but not to the intervals of testing in Table 4 above. Refer to the appropriate Standards for specific test intervals:

AS 1674.2	Safety in welding and allied processes - Electrical
AS/NZS 3001	Electrical installations – Re-locatable premises (including caravans and tents) and their site installations
AS/NZS 3002	Electrical installations – Shows and carnivals
AS/NZS 3003	Electrical installations –Patient treatment areas of hospitals and medical and dental practices and dialysing locations
AS/NZS 3004	Electrical installations –Marinas and pleasure craft at low voltage
AS/NZS 3012	Electrical installations –Construction and demolition sites
AS/NZS 4249	Electrical safety practices – Film, video and television sites

8. Conclusions

To meet the statutory requirements of the Electricity Act and Regulations and Standards both employers and employees have a responsibility to ensure that they are competent in:

> Demonstrating knowledge of regulations for safeguards for portable electrical appliances;

> Demonstrating knowledge of residual current devices (RCD),

> Demonstrating knowledge of isolating transformers,

> Demonstrating knowledge of double insulation for purpose of protection; and

> Inspecting portable electrical appliances for defects

Next Steps

Well done! You have completed the training assessment resource for Unit Standard 15848 – Demonstrate knowledge of safeguards for use with portable electrical appliances.

When you are ready to complete your assessment tasks, please contact your assessor for instructions.

Model Answers to Activity Questions

Activity (page 6)

How does an RCD work?

An RCD constantly monitors the current flowing along a circuit (in and out should be balanced if healthy). If it senses any loss of current, where electricity is diverting to the earth rather than through the circuit, it will immediately shut off due to an imbalance between the in and out current.

Activity (page 8)

If an RCD had a tripping level of 10mA, what situations would it typically be used for?

For sensitive use such as medical applications.

Activity (page 9)

Complete the sentence below:

An RCD only protects against a phase to earth, or a neutral to earth fault. It does not protect against a phase to neutral fault.