

**1. Module details**

**Module name**

**Appliance Circuit Protection & Safety Testing**

**Suggested structured learning time**

A learner possessing the prerequisite skills and knowledge should achieve the module purpose in 18 to 20 hours.

**Module code**

NUE140

**Field of Education code**

031313

**2. Module purpose**

This module provides the knowledge and skills to work with earthing systems, circuit protection and isolation devices used to protect both persons and electrical appliances against damage, under both normal and fault conditions.

Learners will gain an understanding and develop skills in testing earthing systems, circuit protection devices and safety testing associated with appliances.

It covers the operating principles and applications of the MEN system, circuit breakers, fuses and residual current devices, protection against overvoltage and undervoltage, protection by isolation and safety testing.

**3. Learning pathway**

**Intended use in the structured learning program**

This module intended to supplement extensive workplace exposure to domestic appliance servicing work. In particular it applies to testing electrical domestic appliance installations to ensure they comply with requirements and are safe to use. Therefore before undertaking this module an apprentice should have a clear understanding and experience of:

- problem solving series, parallel and series / parallel circuits; the fundamental concepts of alternating current and sinusoidal waveforms; electro-magnetism and its relationship to motors and generators
- safe work with electrical wiring and equipment; common cable types, the basic skills to terminate those cables and the selection and application of fixing devices in installing cables, cable enclosures and accessories

**Recommended prerequisites**

For the most effective learning this module should be undertaken only after modules in Electrical Concepts & Applications and Electrical Wiring and Equipment 1 have been completed.

**4. Relationship to competency standards**

This module provides part of the underpinning knowledge and skills in the ‘Evidence Guide’ of specific units of competency in the National Electrotechnology Training Package and provides similar support, where mapped, to equivalent units in the National Metals and Engineering Competency Standards. For details refer to the module to unit maps, available from EEQSBA.

**5. Content**

**Summary of content**

1. Electrical installation safety
  - Effects and risk of electric shock, current, mechanical movement
  - Protection against indirect contact
2. Earthing and earthing systems – Overview
  - Reasons for earthing
  - AS/NZS 3000 requirements for an effective earthing system
  - MEN earthing systems
  - Principles of operation
  - Layout of typical earthing of electrical installations
3. Circuit protection
  - Causes and effects of excessive circuit current and voltage
  - High level short circuit current (fault current)
  - Overload protection requirements
  - Circuit protection terminologies
  - Circuit protection devices, their operating parameters and ratings
  - Voltage dependent circuit protection devices (surge protection)
4. Supplementary earthing protection – Overview
  - Isolation
  - Operating principles of RCDs
  - Circuit arrangement for RCDs, single and three phase

- 5. Earthing, electrical and mechanical testing methods
  - Visual inspection of electrical equipment to identify faults
  - The test parameters for the electrical testing of equipment
  - Use of appropriate testing device to test electrical equipment
  - Identification of faults on domestic appliances
  - Tagging of electrical equipment and recording of test results

**6. Assessment strategy**

**Assessment methods**

Assessment should be progressive reflecting a holistic approach to ensure the module is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of item types, such as multiple choice, short answer and problem solving.

**Conditions of assessment**

Normally learning and assessment will take place in a formal learning environment.

**7. Learning outcome details**

**Learning outcome 1**

Demonstrate a knowledge and understanding of the need to ensure electrical installations are safe and methods for protection against contact with exposed conductive parts that may become live under fault conditions.

**Assessment criteria**

- 1.1 Explain the effects on the human body of various levels of a.c. and d.c. current and duration of current flow of various current paths.
- 1.2 Outline the risk of ignition of flammable materials due to the thermal effects of current or electric arcs in normal service of an electrical installation.
- 1.3 Outline the risk of injury from mechanical movement of electrically actuated equipment.
- 1.4 Explain how an indirect contact with live parts of an electrical installation may occur.
- 1.5 Identify the methods to protect against indirect contact with live parts of an electrical installation.

<b>Learning outcome 2</b>	Determine and apply in practice the requirements of AS/NZS 3000 in relation to earthing systems.
<b>Assessment criteria</b>	<ul style="list-style-type: none"><li>2.1 List the reasons for earthing.</li><li>2.2 Describe the MEN earthing system and its operation.</li><li>2.3 Identify the systems associated with alternative sources of supply.</li></ul>
<b>Learning outcome 3</b>	Determine and apply in practice the requirements of AS/NZS 3000 and other relevant Australian Standards in relation to circuit protection.
<b>Assessment criteria</b>	<ul style="list-style-type: none"><li>3.1 List the causes of excess current and voltage within a circuit and explain the possible damaging effects that excess current and voltage may incur.</li><li>3.2 Define the terms: short circuit, overload, protection device, prospective fault current, and inverse time characteristic.</li><li>3.3 Briefly describe construction and operating characteristics of rewirable fuses, HRC fuses, motor start fuses, circuit breakers and RCDs.</li><li>3.4 Use time / current curves to explain the tripping characteristics of various types of circuit fuses breakers and RCDs that comply with the requirements of the Wiring Rules.</li></ul>
<b>Learning outcome 4</b>	Describe how isolation and earth leakage methods provide supplementary earthing protection.
<b>Assessment criteria</b>	<ul style="list-style-type: none"><li>4.1 Explain how supplementary earthing protection is provided by segregation and double insulation.</li><li>4.2 Describe the operating principles of residual current devices and how they are classified.</li></ul>
<b>Learning outcome 5</b>	Demonstrate in knowledge and understanding the methods to identify electrical faults and to tag faulty equipment awaiting repair.
<b>Assessment criteria</b>	<ul style="list-style-type: none"><li>5.1 Explain the methods for testing faults in electrical equipment.</li><li>5.2 Identify earthing, electrical and mechanical faults in electrical equipment.</li></ul>

## 8. Delivery of the module

### Delivery strategy

5.3 Demonstrate the correct technique for tagging faulty electrical equipment and noting the fault condition on a service docket.

Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective method to achieve this is by integration of theory and practice where students learn by experimentation, research and reports. It is recommended that learning and assessment be facilitated in a holistic manner that may require a learning outcome sequence other than that indicated in the module.

### Resource requirements

Resources should be sufficient for students to carry out exercises on an individual basis.

This includes samples of different types of circuit protection devices. Some samples may be sectioned to show internal workings.

Useful references include:

Pethebridge, K., and Neeson, I., 2001, *Electrical Wiring Practice*, 6<sup>th</sup> Ed, Vol.1& 2., McGraw Hill, Sydney

Jenneson, J.R. 1996, *Electrical Principles for Electrical Trades*, 4th Ed., McGraw Hill, Sydney

Standards Australia, Standards New Zealand:

AS/NZS 3000 (Latest edition) *Electrical Installations (Wiring rules)*

AS/NZS 3760 (Latest edition) *In-service Safety Inspection and Testing of Electrical Equipment*

AS/NZS 4836 *Safe Working Practice on Low-voltage Electrical Installations*

WorkCover NSW, *WorkCover Code of Practice - Low Voltage Electrical Work Local electricity distributor and authority regulations*

**Occupational health  
and safety requirements**

Where this module is used in an approved Traineeship or Apprenticeship program learners should be advised to obtain, where available, respective EE-Oz Training Standards<sup>1</sup> **User Guides** (*these outline in detail what training and work performance the Learner is required to undertake for the program*).

A safe and healthy environment will be provided for learners and teachers. Safety procedures for the particular learning facilities shall be followed as part of the learning / teaching activity and assessment.

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<sup>1</sup> EE-Oz Training Standards – ElectroComms and EnergyUtilities Industry Skills Council Ltd formally EEQSBA