# REGISTERED
# NATIONAL STANDARD

## UNIT OF COMPETENCY

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| **Title:** | **Demonstrate electrical installation technology**[1] | | | | |
| **TQF Level:** | 4 | **Credits:** | 10 | **Version:** | 1 |
| **National standard code:** | **NS118-04** | | | | |
| **Associated qualification (and code):** | National Certificate in Sustainable Energy (Solar) Level 4 | | | | |
| **Approval date:** | 10th June 2026 | **Review date:** | 10th June 2031 | | |
| **Purpose:** | This unit standard involves imparting knowledge on electrical installation and determining load requirements, in particular:<br>• Apply basic craft skills<br>• Apply skills in installing light fixtures, socket outlets and accessories, switching and cabling, PVC conduit and trunking<br>• Understand types of circuit protection devices<br>• Assess maximum demand and select appropriate size cable<br>• Understand distribution systems and<br>• Safely isolate and test circuits | | | | |

[1] Note, due to safety issues inherent in working with electricity, all training and assessment activities must be in accordance with local industry and regulatory requirements.

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| **Learning Outcome 1 (LO1)** | Understand ***Occupational Health*** and ***Safety*** in workplace |
| **Performance standards** | 1.1 Apply general rules for safety in workshop;<br>1.2 Identify hazards in electrical works and discuss appropriate use of PPEs and mitigation measures;<br>1.3 Demonstrate correct method for lifting weights, erection of tower scaffolding, raising and securing a ladder;<br>1.4 Identify ELV and LV voltage levels (a.c. and d.c) and safety measures;<br>1.5 State procedure for removing a person from contact with live conductor;<br>1.6 State procedure for electric shock. |
| **Learning Outcome 2 (LO2)** | Apply electrical craft skills |
| **Performance Standards** | 2.1 Perform stripping of cable, connection of small conductors to terminals and wiring accessories;<br>2.2 Demonstrate fitting of plugs to flexible cords, fitting flexible cord couplers and appliance sockets;<br>2.3 Demonstrate fixing flexible cords to appliances;<br>2.4 Outline crimping termination to small size conductors up to 6 $mm^2$;<br>2.5 Explain fixing methods to include fixing of masonary, provision of wooden back board to support light points, joint boxes and other outlets. |
| **Learning Outcome 3 (LO3)** | Demonstrate electrical circuit wiring |
| **Performance Standards** | 3.1 Outline the TPS wiring, wiring range of common lighting circuits and circuits serving general purpose operations;<br>3.2 Carry out circuit wiring for one light controlled by one switch, one light controlled by two-way switch, one light controlled independently by three switches;<br>3.3 Perform wiring lighting points using a range of connection systems to include: the use of joint box, loop in at switch, loop in at light;<br>3.4 Illustrate radial circuit serving a number of socket outlets, radial circuits controlling a fixed appliance. |
| **Learning Outcome 4 (LO4)** | Demonstrate ***polyvinyl chloride*** (PVC) conduiting and trunking |
| **Performance standards** | 4.1 Show practical exercises in the basic skills required for the installation of PVC conduit systems to include cutting, joining, connection to accessories, use of manufactured bends, site made bends and sets; |

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| | 4.2 Show practical exercises in the basic skills required for the installation of PVC trunking systems to include cutting, joining, connection to accessories, use of manufactured bends, site made bends and sets;<br>4.3 Perform wiring of PVC conduits for simple lighting circuits and circuits serving GPOs, sufficient to investigate the different wiring techniques used for conduit systems;<br>4.4 Conduct practical exercises using ducting and cable tray wiring. |
| **Learning Outcome 5 (LO5)** | Understand circuit protection devices |
| **Performance standards** | 5.1 Describe fault current, fuses and circuit breakers;<br>5.2 Explain principle of operation of LV protection devices, fusing factor, fault breaking capacity, choice of suitable CPD;<br>*(Range of LV protection devices include but not restricted to rewirable fuses, MCBs, RCDs, MCCBs, ACBs, need for proper discrimination between devices.)*<br>5.3. Perform calculations to estimate fault levels in LV systems;<br>5.4 Explain earthing and earth leakage protection;<br>5.5 Perform calculation of earth loop impedance, earth current and fault voltage;<br>5.6 Verify earth leakage protection to ensure shock protection is provided and to ensure conductors are protected against thermal damage due to earth fault currents;<br>5.7. Select suitable size earth bonding and protective earth conductors;<br>5.8. Identify methods of providing earth electrodes;<br>5.9. Explain principle of operation and applications for RCDs in single phase and three phase circuits;<br>5.10. Show discrimination between RCDs connected in cascade;<br>5.11. Explain time delay RCDs. |
| **Learning Outcome 6 (LO6)** | Determine cable size using maximum demand |
| **Performance standards** | 6.1 Explain maximum demand and diversity factors;<br>6.2 Demonstrate examples of assessment of the maximum demand on domestic and non-domestic installations considering diversity factors;<br>6.3. Perform estimation and calculation of load on single phase final circuits feeding lighting, socket outlets and fixed equipment; |

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| | 6.4. Specify the design of circuits feeding equipment in hazardous areas found in domestic and similar installations;<br>6.5 Outline cable size selection procedures;<br>*(Range of procedures include but not restricted to:*<br>*1. Select suitable size cable for single and three phase circuits,*<br>*2. Verify short circuit protection provided for cables.)*<br>6.6 Explain current carrying capacity (CCC) of a conductor and the applicable derating factors;<br>6.7 Explain voltage drop in a conductor and show voltage drop calculations. Size conductor using voltage drop method. |
| **Learning Outcome 7 (LO7)** | Understand distribution systems within domestic and non-domestic installation |
| **Performance standards** | 7.1 Show distribution within buildings;<br>7.2 Locate switch gear at intake position of larger installations;<br>7.3 Explain methods of sub-mains distribution used within buildings and in mini grid (off-grid systems);<br>7.4 Show sub-mains switch gear, cable distribution systems, types of cable and wiring system used for sub-mains distribution, selection of suitable system for applications;<br>7.5 Specify standard requirements and techniques for the installation of aerial and underground cables;<br>7.6. Identify distribution equipment feeder pillars and link boxes;<br>7.7. Outline cable joining methods;<br>7.8 Identify cable system for site and street light installations. |
| **Learning Outcome 8 (LO8)** | Carry out inspection and testing of installations |
| **Performance standards** | 8.1 Introduce the inspecting and testing methods;<br>8.2 Explain the procedures of performing installation testing;<br>8.3 Apply correct isolation procedures and tagging method;<br>8.4 Apply method and purpose of making the tests required to verify the satisfactory condition of an electrical installation;<br>*(Range to include but not restricted to earth continuity, ring circuit continuity, insulation resistance, polarity, earth loop impedance, function of RCDs, earth electrode resistance, prospective short circuit current.)*<br>8.5 Document the test result. |
| **Pre-requisites** | N/A |
| **Co-requisites** | N/A |

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| **Underpinning skill and knowledge** | The following knowledge and skills underpin this unit standard:<br>**Knowledge:**<br>1. Knowledge of electrical safety<br>2. Knowledge of basic load calculations<br>3. Knowledge of wiring accessories<br>**Skills**<br>4. Safe working principles and equipment handling skills<br>5. Basic craft skills<br>6. Basic measurement skills<br>7. Basic electrical wiring and testing skills. |
| **Assessment requirements** | **Methods of assessment:**<br>A range of assessment methods should be used to assess students' knowledge and application of skills. These shall include but not restricted to the following:<br>a) Direct observation of students performing certain tasks stated under context of assessment;<br>b) Oral questions to test relevant skills and knowledge during observation (e.g., Interviews)<br>c) Written assessment such as:<br>i) Tutorial exercises on important topics in preparation for the final examination<br>ii) Final examination<br>d) Practical assessment:<br>Assessment of electrical wiring skills, PVC conduit wiring, aerial and underground wiring, trunking and ducting, cable tray wiring and testing of circuits.<br>***The student needs to be competent in the final exam and the practical assessment to be classified as "competent" overall for the unit.*** |
| **Moderation arrangements** | 1. Training providers must have their own moderation system approved by TNQAB before accreditation is granted:<br>a) Relevant internal moderation processes are documented; |

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| | b) Assessment is planned for each unit, and moderation processes are integrated into such plan.<br>2. External moderation is conducted by the National Qualifications unit of TNQAB for all unit components of national qualifications:<br>a) Samples of assessed activities are submitted for moderation;<br>b) Moderation (external) forms are available on request from the National Qualifications unit of TNQAB. |
| **Resource requirements** | 1. Access to electrical wiring accessories such as switches, power points, GPOs, electrical cables, protection devices, measuring & testing equipment:<br>• digital multimeters<br>• insulation resistance meter<br>• clamp meter<br>2. Worker's tools<br>• Insulated screw-drivers<br>• Insulated pliers<br>• Soldering iron<br>• Cordless drill and bits<br>• Grinder<br>• Measuring tape<br>• Conduit bender<br>• Conduit cutter<br>• Hammer<br>• Termination tools<br>3. Testing equipment<br>• Digital multimeter<br>• Clamp meter<br>• Insulation resistance meter<br>4. Personal Protection Equipment<br>• Safety shoes<br>• Safety glasses<br>• LV Gloves<br>Recommended text:<br>i) Keith Pethebridge and Ian Neeson, Electrical Wiring Practice Vol 1 & 2 |

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| | ii) Australia and New Zealand standards: AS/NZS 3000 |
| **Requirements to complete this unit** | To demonstrate competence, the person studying this unit is:<br>1. Required to demonstrate all LOs to the expected standards of performance;<br>2. Required to attain an Achieved Grade (Competent) to fulfil the requirements of the Unit Standard. The person is required to be competent in the final exam and practical assessment to attain a pass grade in this unit.<br>3. Eligible to three (3) attempts in the final exam/practical assessment to achieve the required competency within 14 days of the first attempt.<br>Failure to achieve the required competency level after three (3) attempts of the exam or specific part of the assessment will require the person studying this Unit to re-enrol for the same Unit. |
| **Important notes and definitions** | **Notes:**<br>1. All activities associated with this unit standard must comply with the requirements of national codes of practice, regulations and legislation for workplace health, safety, and environmental protection and any subsequent amendments.<br>2. Assessors must comply with Tonga national assessment and moderation requirements.<br>3. The delivery of all units of competencies must be in sequential order and ensure that the pre-requisites requirements are met.<br>**Definitions:**<br>1. ***a.c*** stands for Alternating Current in electricity. The type of electrical current that periodically reverses direction, which is used to deliver power to homes and businesses.<br>2. ***ACB*** stands for Air Circuit Breaker. It is an automatic electrical switching and protective device used to safeguard heavy-duty, low-voltage electrical systems (typically up to 1000 Volts) from dangerous faults like overloads, short circuits, and ground faults.<br>3. ***Appliance sockets*** *(commonly called a wall outlet or receptacle)* is the fixed electrical connector on a wall or floor. |

4. ***Cable size selection*** refers to choosing the correct wire thickness (cross-sectional area) required to safely and efficiently power and electrical load.
5. ***Circuit Protection Devices*** *(CPD)* are safety mechanisms designed to automatically interrupt the flow of electricity when a dangerous fault is detected.
6. ***d.c*** *stands for Direct Current* in electricity. This electrical current flows steadily in one direction, commonly found in batteries, solar cells and electronic devices.
7. ***Earth leakage protection*** is a critical safety system that prevents electric shocks and electrical fires by detecting when electrical current strays from its intended path into the ground (or a person) and immediately shutting off the power.
8. ***Earthing (or grounding)*** is a critical safety system that connects the exposed metal parts of electrical appliances and installations directly to the ground.
9. ***ELV*** refers to Exta-Low Voltage. It is a circuit or system operating at such a low voltage that it carries a low risk of dangerous electrical shock.
10. ***Fitting flexible cord couplers*** refers to safely and securely connecting movable electrical equipment to a power source using temporary plug-add-socket devices.
11. ***GPOs*** stands for General Purpose Outlet (sometimes General Power Outlet). It is the industry term for a standard electrical wall socket used to plug in appliances and electronic devices.
12. ***Hazards*** refer to any condition or situation where contact with electrical energy can cause harm, injury, or property damage.
13. ***LV*** stands for Low Voltage. It typically refers to an electrical supply operating at 1000 volts (1kV) or less for Alternating Current (AC), and up to 1500 volts for Direct Current (DC).
14. ***Manufactured bends*** *(also called factory elbows or sweep bends)* are pre-shaped sections of conduit used to route wires around corners and obstacles.

15. ***MCBs*** stands for Miniature Circuit Breaker. It is an electromechanical safety device used in electrical panel to automatically shut off power when a circuit experiences an overload or a short circuit.
16. ***MCCBs*** stands for Molded Case Circuit Breaker. It is an electrical safety device used to protect electrical circuits from damage caused by overloads, short circuits, or ground faults.
17. ***Mini grid*** is a localized, independent electricity system that generates, distributes, and manages power for a small, defined group of customers (such as a remote village, island, or campus).
18. ***Occupational Health and Safety*** **(OHS)** in electricity refers to the policies, procedures, and practices designed to protect workers from electrical hazards.
19. ***Off-grid*** a home or facility is completely disconnected from the central, public power network (the grid).
20. ***Polarity*** refers to the direction of electrical current flow in a circuit.
21. ***Protective earth conductor*** is a dedicated safety wire that connects the exposed metal parts of an electrical device to the earth. It does not carry electricity during normal operation.
22. ***PVC conducting*** means using PVC (polyvinyl chloride) as a protective material to route and insulate electrical wiring.
23. ***PVC trunking*** is a protective, square or rectangular plastic channel used to organize, conceal, and protect electrical wiring.
24. ***RCD*** stands for Residual Current Device. It is a life-saving electrical safety switch designed to prevent you from receiving a fatal electric shock if you touch a live wire (e.g. through a frayed cord) and to minimize the risk of electrical fires.
25. ***Site made bends*** refers to the visual alignment technique electricians use when operating a manual conduit bender to create specific bends such as offsets.

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| | 26. ***Size earth bonding*** is an essential electrical safety measure that connects exposed metal parts (like pipes or structural steel) to your home's main grounding system.<br>27. ***Thermal damage*** refers to the physical degradation or melting of electrical components, wiring, or insulation caused by excessive heat generation.<br>28. ***TPS wiring*** stands for Thermoplastic-Sheathed cable wiring. It typically refers to a flat electrical wire containing two insulated conductors (a live and a neutral, often called 'twin') and a bare or green-yellow earth wire, all bundled under a tough plastic jacket. |
| **Public comments on unit** | Please contact TNQAB National Qualifications Unit (email EnquireNQ@tnqab.to or Telephone 28136) if you like to discuss or suggest changes to the details of this unit. |