



Australian Government

Department of Education, Employment and Workplace Relations

UETTD RIS58A Locate faults in power system underground power cables

Release: 1

UETTDRIS58A Locate faults in power system underground power cables

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor

1) Scope:

1.1) Descriptor

This Competency Standard Unit covers the diagnosis and location of faults in underground power cables. It includes obtaining the required “access to test” or equivalent permit, setting up of the fault location test equipment and following the procedure to carry out the cable fault location test plan. It also encompasses the interpreting test results, documenting the actual fault location and likely cause and, listing the recommendations for correcting the cable fault to meet client requirements.

Application of the Unit

Application of the Unit 2)

This Competency Standard Unit is intended to augment formally acquired competencies. It is suitable for employment-based programs under an approved contract of training.

Licensing/Regulatory Information

License to practice 3)

The skills and knowledge described in this unit may require a licence/registration to practice in the work place subject to regulations for undertaking of electrical work. Practice in workplace and during training is also subject to regulations directly related to Occupational Health and Safety, electricity/telecommunications/gas/water industry

License to practice**3)**

safety and compliance, industrial relations, environmental protection, anti discrimination and training.
Commonwealth, State/Territory or Local Government legislation and regulations may exist that limits the age of operating certain equipment.

Pre-Requisites**Prerequisite Unit(s)****4)****Competencies****4.1)**

Granting of competency in this unit shall be made only after competency in the following unit(s) has/have been confirmed.

Where pre-requisite pathways have been identified. All competencies in the Common Unit Group must be have been completed plus all the competencies in one (1) of the identified Pathway Unit Group(s):

Common Unit Group

Unit Code	Unit Title
UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace
UEENEEE102A	Fabricate, assemble and dismantle utilities industry components
UEENEEE104A	Solve problems in d.c. Circuits
UEENEEE105A	Fix and secure electrotechnology equipment
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications
UEENEEG101A	Solve problems in electromagnetic devices and related circuits
UEENEEG102A	Solve problems in low voltage a.c. Circuits

Prerequisite Unit(s) 4)

UETTDRCJ21A	Lay ESI electrical cables
UETTDRCJ26A	Install and maintain de-energised low voltage underground polymeric cables.
UETTDRCJ27A	Install and maintain de-energised high voltage underground polymeric cables.
UETTDREL11A	Apply sustainable energy and environmental procedures
UETTDREL12A	Operate plant and equipment near live electrical conductors and apparatus
UETTDREL16A	Working safely near live electrical apparatus
UETTDRI541A	Install network infrastructure electrical equipment
UETTDRI542A	Maintain network infrastructure electrical equipment
UETTDRI555A	Install and maintain low voltage underground services

Literacy and numeracy skills 4.2)

Participants are best equipped to achieve this unit if they have reading, writing and numeracy skills indicated by the following scales. Description of each scale is given in Volume 2, Part 3 “Literacy and Numeracy”

Reading 3 Writing 3 Numeracy 3

Employability Skills Information**Employability Skills 5)**

The required outcomes described in this unit of competency contain applicable facets of Employability Skills. The Employability Skills Summary of the

Employability Skills**5)**

qualification in which this unit of competency is packaged will assist in identifying Employability Skill requirements.

Elements and Performance Criteria Pre-Content

6) Elements describe the essential outcomes of a competency standard unit

Performance Criteria describe the required performance needed to demonstrate achievement of the element.
Assessment of performance is to be consistent with the Evidence Guide.

Elements and Performance Criteria**ELEMENT****PERFORMANCE CRITERIA**

1 Prepare to locate faults in underground power cables

- 1.1 Works schedule(s), including cable specifications and standards, cable route data, history, and characteristics, drawings, plans, requirements, established procedures, and material lists, are received, analysed and confirmed, if necessary, by site inspection.
- 1.2 Relevant requirements and established procedures for the work are communicated to all personnel and identified for all work sites.
- 1.3 OHS policies and procedures related to requirements and established procedures for the location of faults in underground power cables are obtained and confirmed for the purposes of the work to be performed and communicated.
- 1.4 Work is prioritised and sequenced following consultation with others for completion within acceptable timeframes and in accordance with established procedures.
- 1.5 Hazards are identified, OHS risks assessed and control measures are prioritised, implemented and monitored including emergency exits kept clear according to established procedures.

ELEMENT	PERFORMANCE CRITERIA
1.6	Relevant work permits are obtained to access and perform work according to requirements and/or established procedures.
1.7	Resources including personnel, equipment, tools and personal protective equipment required for the job are obtained and confirmed in working order.
1.8	Test equipment is assembled and checked for calibration status as per established procedures.
1.9	Cable fault location test procedures/plan is prepared taking account the range of tests required and according to requirements/established procedures.
1.10	Relevant personnel at worksite are confirmed current in First Aid, and other related work procedures according to requirements.
1.11	Liaison and communication issues with other/authorised personnel, authorities, clients and land owners are resolved to carry out work where necessary.
1.12	Site is prepared according to the work schedule and to minimise risk and damage to property, commerce, and individuals in accordance with established procedures.
1.13	Personnel participating in the work, including plant operators and contractors, are fully briefed and respective responsibilities confirmed where applicable in accordance with established procedures.
1.14	Road signs, barriers and warning devices are positioned in accordance with requirements.
2 Carry out the location of faults in underground power cables	2.1 OHS and sustainable energy principles and practices to reduce the incidents of accidents and minimise waste are monitored and followed in accordance with requirements and/or established procedures.
	2.2 Lifting, climbing, working in confined spaces

ELEMENT**PERFORMANCE CRITERIA**

		and aloft, and use of power tools/equipment, techniques and practices are safely followed and, currency according to requirements confirmed.
	2.3	Essential knowledge and associated skills are applied for the safe location of faults in underground power cables, to ensure completion in an agreed timeframe and, to quality standards with a minimum of waste according to requirements.
	2.4	Cable is tested to determine the location of the relevant faults according to the work schedule, cable fault location test procedures/plan and requirements/established procedures.
	2.5	Hazard warnings and safety signs are recognised and hazards and assessed OHS risks are reported to the immediate authorised persons for directions according to established procedures.
	2.6	Unplanned events in the location of faults in underground power cables are undertaken within the scope of established procedures.
	2.7	Known solutions to a variety of problems are applied using acquired essential knowledge and associated skills.
	2.8	Ongoing checks of quality of the work are undertaken in accordance with instructions and established procedures.
3	Complete the location of faults in underground power cables	3.1 Work undertaken is checked against works schedule for conformance with requirements and anomalies reported in accordance with established procedures Test results are interpreted to determine the cable fault location, the type of fault and/or possible cause. 3.2 Accidents and/or injuries are reported in accordance with requirements/established procedures, where applicable. 3.3 Work site is rehabilitated, cleaned up and made safe in accordance with established procedures.

ELEMENT**PERFORMANCE CRITERIA**

- 3.4 Tools, equipment and any surplus resources and materials are, where appropriate, cleaned, checked and returned to storage in accordance with established procedures.
- 3.5 Relevant work permit(s) are signed off and, cable/site are returned to service in accordance with requirements.
- 3.6 Works completion records, reports, as installed /modified drawing and/or documentation and information are finalised and processed and appropriate personnel notified.

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

8) Essential Knowledge and Associated Skills (EKAS): This describes the essential skills and knowledge and their level, required for this unit.

Evidence shall show that knowledge has been acquired of locating faults in underground power cables.

All knowledge and skills detailed in this unit should be contextualised to current industry practices and technologies.

KS01-TIS58A Power system underground power cables fault finding

Evidence shall show an understanding of the locating of faults in power system underground power cables to an extent indicated by the following aspects:

T1 Installation of underground cable encompassing:

- Requirements for the use of enterprise construction manuals, system diagrams/plans and drawings
- Safety precautions specific to the installation of underground cable - excavation and trench safety regulations, gas detection procedures, working in confined spaces, personal protective equipment, hazards for the use of LPG equipment for jointing of underground cable, gas bottle testing procedures, permit to work systems and isolation procedures.
- Trench excavation and reinstatement procedures
- Installation of underground cable procedures - types of tools and equipment, methods of installing conduits, methods of installing cables and sealing cable ends (direct buried, ducts cleated and racked)
- Procedures for the safe use of LPG equipment for cable jointing

T2 Location of cable faults in underground power cables encompassing:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements
- Types of faults
- Methods of locating faults - Murray loop test, Fisher connection of Murray loop, modified Fisher connection, Varley loop test, time domain reflectometer (TDR), differential TDR radar, digital arc reflection, differential digital arc reflection, current impulse test, differential current impulse, decay, differential decay, pool of potential in earth (POPIE), radio detection, capacitance inductance test; pending faults (thermography and cable/joint temperature measurement); cable location devices/equipment and methods (signal generator/receiver, phasing methods using 'megger', current injection, cable stabbing techniques); cable identification
- Low voltage energised working practices: - regulations, working methods, insulating glove, bare hand, work procedures, specialist equipment.
- Safety precautions specific to working near conductors - safe working practices and procedures, working in confined spaces, permit to work systems and isolation procedures.

REQUIRED SKILLS AND KNOWLEDGE

T3 Jointing and termination of LV polymeric cable encompassing:

- Standards, codes, legislation, supply authority regulations and or enterprise requirements pertaining to the jointing of LV polymeric cables
- Types of cables - single core, multi core and XLPE insulation
- Methods of cable handling - direct laid cables, duct laid cables, solid laid cables, cables supported in cleats or hangers, corrosion protection, minimum bending radius of cables.
- Methods of cable sealing - shorting of cables cores, core of un-terminated cables, methods of protection from corrosion, polymeric sheathed cables sealing with mastic lined, heat shrink caps buried sealed ends.
- Types of jointing tools - general hand tools, compression tools
- Techniques in the use of LPG - safety precautions, personal protective equipment, general maintenance and repair.
- Safety precautions when cable jointing - working in confined spaces, permit to work systems and isolation procedures, emergency rescue/response including First Aid.

T4 LV polymeric cable jointing principles encompassing:

- Techniques in jointing LV XLPE cables - straight through joint, jointing different types of cable and service and street light cable joints
- Techniques in terminating LV XLPE - pole top terminations, substation terminations, distribution pillar /column/cubicle terminations and service and street light cable terminations
- Techniques in repairing LV XLPE cable - different types of damage, repairs to sheath, repairs to cores
- Methods of testing cable after jointing

T5 Standards, codes, legislation, supply authority regulations and or enterprise requirements pertaining to the jointing of HV underground polymeric cables

T6 HV underground polymeric cables requirements for the use of enterprise construction manuals, system diagrams/plans and drawings, encompassing:

- Characteristics of different types of cables and components
- Purpose of stress control
- Applications of various tools and equipment for HV jointing

T7 Procedure for isolating HV underground polymeric cables encompassing:

- Method for proving safe to work
- Earthing procedures

T8 Techniques in jointing HV underground polymeric cable, encompassing:

- Short circuit cores and seal cable
- Straight through
- Trifurcating

REQUIRED SKILLS AND KNOWLEDGE

T9 Techniques in HV underground polymeric cable terminations encompassing:

- Pole top termination
- Substation/switchgear termination
- ABC termination
- Telcon termination

T10 Procedures for repairing HV underground polymeric cables encompassing:

- Location of faults
- Types of damage
- Techniques to repairs to sheath
- Techniques to repairs to core

T11 Jointing LV paper lead/lead type cables encompassing:

- Requirements for the use of enterprise manuals, system diagrams/plans and drawings
- Types of tools and equipment
- Types of LV cables
- Structure of LV PLY cables
- Techniques for lead wiping
- Technique for preparing and jointing LV lead sheathed paper insulated cables
- Installation methods of LV straight joint
- Inspection and repair procedures to outer sheath of lead sheathed LV cable
- Techniques in terminating LV lead sheathed paper insulated cables
- Methods of testing cable after jointing

T12 HV paper lead cable jointing principles encompassing:

- Requirements for the use of enterprise manuals, system diagrams/plans and drawings
- Types of tools, equipment
- Types of HV cables
- Structure of HV cables
- Technique for the installation of transition joint between XLPE and lead sheathed, paper insulated cables
- Technique for the jointing, terminating and repairing of HV paper lead insulated cables
- Methods of testing cable after jointing

T13 Underground cables construction and types encompassing:

- Safety precautions specific to handling underground cables
- Requirements for the use of enterprise manuals, system diagrams/plans and drawings
- Types and applications of UC

REQUIRED SKILLS AND KNOWLEDGE

- Construction types and structures of underground cables
- Characteristics of different types of underground cables
- Ratings

T14 Aluminium and lead cable sheathed — jointing procedures encompassing:

- Safety precautions specific to handling and jointing underground aluminium and lead cable including provision of OHS information such as material safety data sheets (MSDS)
- Requirements for the use of enterprise manuals, system diagrams/plans and drawings
- Construction and structure(s) of aluminium and lead cable underground cables
- Characteristics of aluminium and lead cable
- Ratings
- Techniques in the jointing of aluminium and lead sheathed cable
- Methods of testing cable after jointing.

Evidence Guide

EVIDENCE GUIDE

9) This provides essential advice for assessment of the unit of competency and must be read in conjunction with the Performance Criteria and the range statement of the unit of competency and the Training Package Assessment Guidelines.

The Evidence Guide forms an integral part of this Competency Standard Unit and shall be used in conjunction with all component parts of this unit and, performed in accordance with the Assessment Guidelines of this Training Package.

Overview of Assessment 9.1)

Longitudinal competency development approaches to assessment, such as Profiling, require data to be reliably gathered in a form that can be consistently interpreted over time. This approach is best utilised in Apprenticeship programs and reduces assessment intervention. It is the Industry's preferred model for apprenticeships. However, where summative (or final) assessment is used it is to include the application of the competency in the normal work environment or, at a minimum, the application of the competency in a realistically simulated work environment. It is recognised that, in some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accord

with Industry and, Regulatory policy in this regard.

Methods chosen for a particular assessment will be influenced by various factors. These include the extent of the assessment, the most effective locations for the assessment activities to take place, access to physical resources, additional safety measures that may be required and the critical nature of the competencies being assessed.

The critical safety nature of working with electricity, electrical equipment, gas or any other hazardous substance/material carries risk in deeming a person competent. Hence, sources of evidence need to be 'rich' in nature so as to minimise error in judgment.

Activities associated with normal every day work have a bearing on the decision as to how much and how detailed the data gathered will contribute to its 'richness'. Some skills are more critical to safety and operational requirements while the same skills may be more or less frequently practiced. These points are raised for the assessors to consider when choosing an assessment method and developing assessment instruments. Sample assessment instruments are included for Assessors in the Assessment Guidelines of this Training Package.

**Critical aspects
of evidence
required to
demonstrate
competency in
this unit** **9.2)**

Before the critical aspects of evidence are considered all prerequisites shall be met.

Evidence for competence in this unit shall be considered holistically. Each element and associated Performance Criteria shall be demonstrated on at least two occasions in accordance with the "Assessment Guidelines – UET12". Evidence shall also comprise:

- A representative body of Performance Criteria demonstrated within the timeframes typically expected of the discipline, work function and industrial environment. In particular this shall incorporate evidence that shows a candidate is able to:
 - Implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures as specified in the Performance Criteria and range; and
 - Apply sustainable energy principles and practices as

- specified in the Performance Criteria and range; and
- Demonstrate an understanding of the essential knowledge and associated skills as described in this unit to such an extent that the learner's performance outcome is reported in accordance with the preferred approach; namely a percentile graded result, where required by the regulated environment; and
- Demonstrate an appropriate level of employability skills; and
- Conduct work observing the relevant Anti Discrimination legislation, regulations, policies and workplace procedures; and
- Demonstrated performance across a representative range of contexts from the prescribed items below:

Range of tools/equipment/materials/procedures/workplaces/other variables		
Group No	The minimum number of items on which skill is to be demonstrated	Item List
A	At least three of the following:	Time domain reflectometry Popie Differential TDR radar Current impulse Murray loop Varley loop Radio detection Capacitance/inductance Continuity tests Insulation tests Voltage detection
B	At least one occasion	Dealing with an unplanned event by drawing on essential knowledge and associated skills to provide appropriate solutions incorporated

		in the holistic assessment with the above listed items.
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Context of and specific resources for assessment **9.3)**

This unit should be assessed as it relates to normal work practice using procedures, information and resources typical of a workplace. This should include:

- OHS policy and work procedures and instructions.
- Suitable work environment, facilities, equipment and materials to undertake actual locating of faults in underground power cables.

In addition to the resources listed above, in Context of and specific resources for assessment, evidence should show demonstrated competency working below ground, in limited spaces, with different structural/construction types and method and in a variety of environments.

Method of assessment **9.4)**

This Competency Standard Unit shall be assessed by methods given in Volume 1, Part 3 “Assessment Guidelines”.

Note:

Competent performance with inherent safe working practices is expected in the Industry to which this Competency Standard Unit applies. This requires that the specified essential knowledge and associated skills are assessed in a structured environment which is primarily intended for learning/assessment and incorporates all necessary equipment and facilities for learners to develop and demonstrate the essential knowledge and associated skills described in this unit.

**Concurrent
assessment and
relationship with
other units**

9.5)

There are no concurrent assessment recommendations for this unit.

Range Statement

RANGE STATEMENT

10) This relates to the unit of competency as a whole providing the range of contexts and conditions to which the Performance Criteria apply. It allows for different work environments and situations that will affect performance.

This Competency Standard Unit shall be demonstrated in relation to the diagnosis and location of faults as it relates to underground power cables (Distribution and Transmission) and includes the receipt of the relevant permit(s).

Relevant cable specifications and standards may include but are not limited to cable ageing effects, test voltage de-rating, velocity of propagation, insulation, screened, armoured, burial status drawings, network diagrams, maker's installations, cable age and/or service history, owners/clients requests.

Cable fault test procedures may include but are not limited to time domain reflectometry (TDR), TDR radar, digital arc reflection, differential digital arc reflection, current impulse test (thumper test), differential current impulse, decay, differential decay, pool of potential in earth (POPIE), Murray loop test (including Fisher modification), radio detection, Varley loop test, capacitance inductance test.

Test equipment may include but are not limited to the calibration certificated for test equipment being current and valid for AF signals, bridges, pulse echo techniques, capacitors, seismophone, POPIE.

Hazards associated with the testing and location procedures may include but are not limited to environmental, traffic, chemical, fuel gas, warning notices, water or gas flooding, test voltages, public barriers.

Range of testing required may include but are not limited to the order in which testing will be applied, from where tests are to be applied, communication arrangements and who will be directing the tests.

Selected test procedures may include but are not limited to recognised standard test methods, client requirements.

Recorded results of the tests may include but are not limited to the requirements specified by the client or enterprise.

Results interpreted may include but are not limited to physical location notes, depth and distance.

Identified actual fault location may include but are not limited to the reports and test data, within how many metres of the measured position the fault was actually located, relationship between type of fault and possible cause, location and protection relay operations, known events related to the fault.

Correcting the cable fault may include but is not limited to providing recommendations for corrective action, preventative action.

The following constants and variables included in the element/Performance Criteria in this unit are fully described in the Definitions Section 1 of this volume and form an integral part of the Range Statement of this unit:

RANGE STATEMENT

- Appropriate and relevant persons (see Personnel)
- Appropriate authorities
- Appropriate work platform
- Assessing risk
- Assessment
- Authorisation
- Confined space
- Diagnostic, testing and restoration
- Documenting detail work events, record keeping and or storage of information
- Drawings and specifications
- Emergency
- Environmental and sustainable energy procedures
- Environmental legislation
- Environmental management documentation
- Established procedures
- Fall prevention
- Hazards
- Identifying hazards
- Inspect
- Legislation
- MSDS
- Notification
- OHS practices
- OHS issues
- Permits and/or permits to work
- Personnel
- Quality assurance systems
- Requirements
- Testing procedures
- Work clearance systems

Unit Sector(s)

Not applicable.

Competency Field

Competency Field 11)

Industry Specific Cross-Discipline Units