Australian Government

Assessment Requirements for UEEEL0039 Design, install and verify compliance and functionality of general electrical installations

Release: 2

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Modification History

Release 2. Updated superseded imported Pre-Requite units.

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least two separate occasions and include:

- applying relevant work health and safety (WHS)/occupational health and safety (OHS) requirements
- safely measuring the parameters for the whole or any part of a direct current (d.c.) circuit
- safely isolating circuits/equipment, including:
  - preparing a safe work method statement (SWMS) or job safety analysis (JSA) for effective safe isolation
  - identifying source of supply to be isolated
  - applying switching-off, lock-out and tagging procedures
  - applying safe methods for confirming isolation
- determining maximum demand and selecting cables for an installation, including mains, sub-mains and final sub-circuits
- selecting suitable equipment and switchgear for a particular installation or part of an installation for compliance with industry standards
- determining the maximum fault-loop impedance for a circuit
- determining protective conductor and active conductor sizes for each circuit to ensure earth fault-loop impedance is sufficiently low to operate the circuit protective device
- installing and terminating consumer's mains for an installation in accordance with AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) and local supply authority requirements, including:
  - unprotected consumers mains to minimise the risk of short circuit current
  - drawing-in, placing and fixing cables
  - cable and conductor terminations
  - correct preparation for fitting and connection of electricity network operator equipment
  - ensuring correct polarity
- selecting and installing control and protection devices in accordance with AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

- installing and terminating sub-circuit cabling at switchboards and connection to accessories, including:
  - drawing-in, placing and fixing cables
  - application of accessories
  - correct interconnection between switchgear, protection devices and links
  - use of adequately sized cables
  - correct marking of equipment
  - clear identification of circuit neutral conductors
  - correct polarity
- completing visual inspection of installations for compliance with industry standards
- conducting and reporting mandatory testing to ensure:
  - insulation resistance of mains, sub-mains and final sub-circuits in accordance with regulatory requirements
  - earth continuity of the main earthing conductor, protective earthing conductors, combined protective earthing and neutral (PEN) conductors, and bonding conductors in accordance with regulatory requirements
  - polarity of active, neutral and earth conductors in accordance with regulatory requirements
  - correct connections of active, neutral and protective earthing conductors are tested to ensure no short circuits between conductors, no transposition of conductors that could result in the earthing system or exposed conductive parts becoming energised, and no interconnection of conductors between different circuits, in accordance with regulatory requirements
  - verification that earth fault-loop impedance limitations are not exceeded in accordance with regulatory requirements
  - residual current devices (RCDs) have been correctly installed, their function verified, and the isolation of all switched poles verified in accordance with regulatory requirements
- identifying causes of non-compliance from test results
- identifying and rectifying faults in electrical circuits and equipment.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of:

- electrical safety, including:
  - safety workplace procedures for working on electrical systems, circuits and apparatus
  - safe working practices as a normal part of carrying out electrical installation work
  - isolation and lock-out workplace procedures
  - tools and equipment needed to conduct electrical installation compliance inspection and testing
  - relevant emergency response plan and first aid requirements

    - selection and use of fire extinguishers to control an electrical fire at an accident site
- WHS/OHS, including:
    - legislation and regulations and the fundamental principles that apply
    - identifying potential workplace hazards
    - procedures for undertaking safety checks
    - working with a group to identify effective hazard control measures
    - working with a group to modify and/or develop safe work methods
    - techniques for the identification, control and reporting of hazardous substances/materials
    - awareness and reporting of asbestos, silica and hazardous gases
    - legal responsibilities for employers and employees
    - WHS/OHS practices
    - employers' and employees' own "duty of care"
    - safety committees and their role
    - development, modification and application of SWMS or JSA
    - purpose and process of reporting WHS/OHS incidents
    - safety procedures for working with electrical circuits and equipment
    - procedures for safe and effective isolation of electrical supply
    - regulations for the supervision of apprentices and trainees
    - selection and use of fire extinguishers to control electrical fire at an accident site
- methods to rescue a person in contact with live electrical conductors or equipment, including:
    - safety of the rescuer
    - establishing the source voltage level
    - rescue process 'dos' and 'don'ts'
- application of emergency first aid requirements for an electric shock victim, including:
    - calling for help
    - initiating first aid
    - applying cardiopulmonary resuscitation (CPR)
- dangers of high voltage (HV) equipment and distribution systems, including:
    - step, touch and induced voltages
    - sources of induced voltage and stored energy
    - creepage and clearance requirements
    - application of safe working procedures in the vicinity of HV equipment
- effects of electric current, including:
    - physiological effects of current
    - principles by which an electric current can produce heat, light, motion and a chemical reaction
- single path d.c. circuits including:
    - arrangement of energy source, protection device, switch and load in a circuit
    - purpose of each component in the circuit
    - consequences of open circuits, closed circuits and short circuits

- multiple path d.c. circuits, including:
  - circuit configurations and connection of energy source, protection device, switch and load in a circuit
  - relationship between the parameters of voltage, current, resistance and power dissipation in the whole or any part of the circuit
  - methods of determining circuit behaviour for variation in any of the parameters from measured and calculated values
- alternating voltage and current generation, phase relationships, energy in an alternating current (a.c.) circuit, including:
  - sinusoidal voltage generation and resulting current
  - terms: period, maximum value, peak-to-peak value, instantaneous value, average value, root-mean-square (RMS) value and frequency
  - three phase generation
  - relationship between the phase voltages generated in a three phase alternator and the conventions for identifying each
  - method of determining the phase sequence or phase rotation of a three phase supply
  - methods of determining power and energy supplied by three phase circuits
- techniques to read, sketch and interpret electrical diagrams, including:
  - conventions used in documenting electrical information
  - interpreting schematic, block and wiring diagrams, plans and schedules
  - sketching and marking up electrical drawings and diagrams
- safe isolation of equipment, including:
  - requirements and techniques for preparation of a SWMS or JSA for effective safe isolation
  - safe methods for identifying source of supply to be isolated
  - switching-off, lock-out and tagging procedures
  - safe methods for confirming effective and safe isolation
  - following safe testing procedures
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements for dealing with unused conductors and equipment
- fundamental safety principles of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules), including:
  - definition of terms
  - direct contact with live parts
  - indirect contact with live parts
  - thermal effects of current
  - over-current
  - earth faults
  - abnormal voltages
  - spread of fire
  - mechanical injury

  - external influences
  - fundamental principles of installation design; selection and installation of equipment; means of compliance (including alterations, additions and repairs), and verification of compliance
- protective and functional earthing, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - purpose of protective and functional earthing
  - parts of a protective earthing system
  - earthing arrangements, earthing of equipment and equipotential bonding
  - methods of determining the earth fault-loop impedance for a circuit
  - alternate earthing systems only when required by local regulatory authorities (e.g. TT low voltage supply earthing system in dairy sheds in New Zealand)
- protective earthing conductor and active conductor sizes for each circuit to ensure earth fault-loop impedance is sufficiently low to operate the circuit protective device
- multiple earthed neutral (MEN) system and its application, including:
  - protective earthing (PE) and neutral (N) conductors in a consumer's installation and their relationship to the protective earth neutral (PEN) conductor in the electricity distributor's system or sub-main to an outbuilding
  - importance of the MEN link when a fault occurs
  - likely consequences of the absence of the MEN link or high impendence in the PEN conductor when a fault occurs
  - requirements for installation of a MEN link in an installation and an outbuilding
- control and protection requirements for installations and equipment, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - minimum fault levels specified by electricity distributors
  - method for assessing prospective short circuit current
  - devices for protection against overload and short circuit current
  - methods and arrangement for protection against short circuit currents, overload and earth leakage currents
  - coordination of overload and short circuit protection devices
  - coordination between conductors and overload protection devices
  - causes of over-voltage and under-voltage
  - device requirements for protection against over-voltage and under-voltage
  - selection and installation of RCDs
  - limitation of an RCD to protect against contact with live parts
  - devices for functions of isolation, emergency, mechanical maintenance and functional control
- AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements for installation of separated extra-low voltage (SELV) and protected extra-low voltage (PELV) systems, including:

- purpose and configuration of PELV and SELV
- earthing requirements and testing of SELV and PELV circuits

- cable selection for single and three phase mains and sub-mains for single and multiple installations including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - AS/NZS 3008.1.1 Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation condition requirements for selection of cables
  - methods of determining maximum demand
  - selecting cables for a given situation based on:
    - suitability of the cable insulation
    - installation methods and external influences affecting cable current-carrying capacity
  - fault-loop impedance
  - effects of harmonic current on cable current-carrying capacity
  - installation methods and external influences affecting cable current-carrying capacity
  - voltage-drop limitation
  - short circuit performance consideration
- cable selection for final sub-circuits, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - AS/NZS 3008.1.1 Electrical installations - Selection of cables Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation condition requirements for selection of cables
  - maximum demand on final sub-circuits
  - selecting cables for a given situation based on:
    - suitability of the cable insulation
    - installation methods and external influences effecting cable current-carrying capacity
  - effect of earth fault-loop impedance and voltage-drop limitations on circuit route length
- installation of electrical equipment in given damp situations, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - areas specified as damp situations
  - limitation on the installation of equipment in classified zones
  - selection and location of equipment suitable for installation in given classified zones
  - use of RCD, SELV and PELV for damp situations
  - equipotential bonding in showers and bathrooms and swimming and spa pools
- methods for the installation, modification and testing of electrical installations and equipment for construction and demolition sites, complying with AS/NZS 3012 Electrical installations - Construction and demolition sites and applicable workplace safety legislation, including:
  - supply requirements

  - switchboards for the purpose of construction and demolition
  - protection of circuits
  - construction wiring
  - lighting
  - socket outlets
  - circuits for lifts
  - calibration of instruments
  - inspection and testing methods
  - initial and periodic inspection and testing
- installation of aerial conductors and underground wiring, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - types and application of aerial conductors
  - aerial span limitations and required clearances
  - selection of aerial supporting poles/post and struts for a given application
  - use and requirements of catenary support systems
  - acceptable cable types and protection for underground wiring categories
  - underground wiring depth and protection
  - underground wiring clearances from other services
- electrical installations in hazardous areas, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - types of areas classified as a hazardous area
  - standards to which the selection, installation, inspection and maintenance of electrical equipment shall comply
  - additional training required to work competently with electrical equipment for hazardous areas
- installation and termination requirements for electrical cables, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - typical cable routes through buildings, structures and premises
  - application of wiring accessories
  - drawing-in, placing and fixing of cables
  - cable and conductor terminations
  - maintaining fire rating integrity
  - application of flat thermoplastic sheathed (TPS), circular TPS, steel wire armoured (SWA), fire rated and flexible cables
- requirements for the installation and connection of consumers mains, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) and local supply authority requirements
  - underground and overhead consumers mains

  - terminating consumers mains at pillars, pits, mains connection boxes and consumers switchboard
  - unprotected consumers mains to minimise the risk of short circuit current
  - bonding conductors where required
  - ensuring correct polarity
- termination of sub-circuit cabling at switchboards and connection to components, including:
  - correct interconnection between switchgear, protection devices and links'
  - correct preparation for fitting and connection of local supply authority equipment
  - use of adequately sized cables
  - correct marking of equipment
  - clear identification of circuit neutral conductors
  - correct polarity
- AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements and supply authority requirements to install final sub-circuit wiring into switchboards and connection to switchboard equipment
- location of switchboards and arrangement of switchboard equipment in installations, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - accessibility and restricted locations of switchboards
  - identification of main switchboards
  - construction requirements of switchboards
  - arrangement and identification of switchboard equipment
  - arrangement and installation of metering equipment
  - switchboard wiring and fire-protective measures
  - protection against switchboard internal arc faults
- key safety issues of transformers and AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements, including:
  - risks and safety control measures associated with connection and disconnection of instrument transformers
  - safe working procedures when connecting and testing transformers
  - requirements and restrictions on the installation and use of transformers
- electric motor selection, starting method and overload protection, including:
  - types of motor enclosures suitable for given environmental conditions
  - criteria for selecting motor starters and overload protection
  - types and connection arrangements for direct-on-line, reduced voltage starters and variable speed drives
  - thermal, magnetic and thermistor overload protection methods
- legislated regulations, including:
  - legislation and regulations that require installations and equipment to be inspected and tested to ensure they are safe

- responsible persons/bodies for ensuring electrical installations are safe
- results of tests that show an electrical installation is safe for connection to supply

- verification of compliance of an electrical installation, including:
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) requirements
  - requirements for visual inspection to determine installation compliance with relevant specific installation standards
  - AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) mandatory test requirements and the application of mandatory tests following guidance of AS/NZS 3017 Electrical installations - Verification guidelines
- mandatory testing of an electrical installation including:
  - earth continuity, insulation resistance, polarity, sub-mains and final sub-circuits, correct circuit connections, earth fault-loop impedance and RCD operation
  - functional tests to ensure active/s and neutral for the same circuit are clearly identified with their circuit protection device
  - tests that show all circuits and devices operate as intended
  - techniques to determine fault level at a particular point in an installation
- documentation, including:
  - results of tests conducted on an installation to comply with requirements and ensure the installation is safe
  - documentation of the results of testing an installation as required by the electricity distributor
  - documentation of periodic inspection and testing of construction site wiring and equipment in accordance with requirement
  - documentation of periodic testing and inspection of electrical equipment, including tagging requirements
- systematic method of commissioning and decommissioning electrical equipment and installations, including:
  - commissioning, including:
    - circuit voltage testing
    - phase rotation and polarity checks
    - systematic loading up
    - correct installation functioning
    - instrument/control parameter checks
    - dangers of mechanical damage to cables and equipment
  - decommissioning, including:
    - identification of all circuits
    - impact on other equipment
    - isolation
    - tagging
    - testing

    - securing and earthing where required
    - safe removal of equipment and termination of unused cable
    - dangers of mechanical damage to cables and equipment
- diagnosing and rectifying faults in electrical apparatus and associated circuits, including:
    - recognising symptoms of open circuit, short circuit, incorrect connections, insulation failure, unsafe condition, apparatus/component failure and related mechanical failure
    - methods and tests to identify faults in circuits and/or equipment
    - ensuring fault rectification/repair and/or equipment replacement complies with AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules) and other relevant standards.

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessors must also hold a current 'Unrestricted Electricians Licence' issued in an Australian state or territory to assess the units of competency relating to the Electrical Regulatory Authorities Council (or their successor) Essential Performance Capabilities for licensing and that require a licence to practice.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must occur in workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated workplace operational situations that replicate workplace conditions. It is recognised that, in some circumstances, assessment in part or full can occur outside the workplace. However, it must be in accordance with industry and regulatory policy.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or other simulations
- relevant and appropriate materials, tools, facilities, equipment and personal protective equipment (PPE) currently used in industry
- applicable documentation, including workplace procedures, equipment specifications, regulations, relevant industry standards, codes of practice and operation manuals.

Links

Companion Volume implementation guides are found in VETNet - - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6