Government of Western Australia
North Metropolitan TAFE

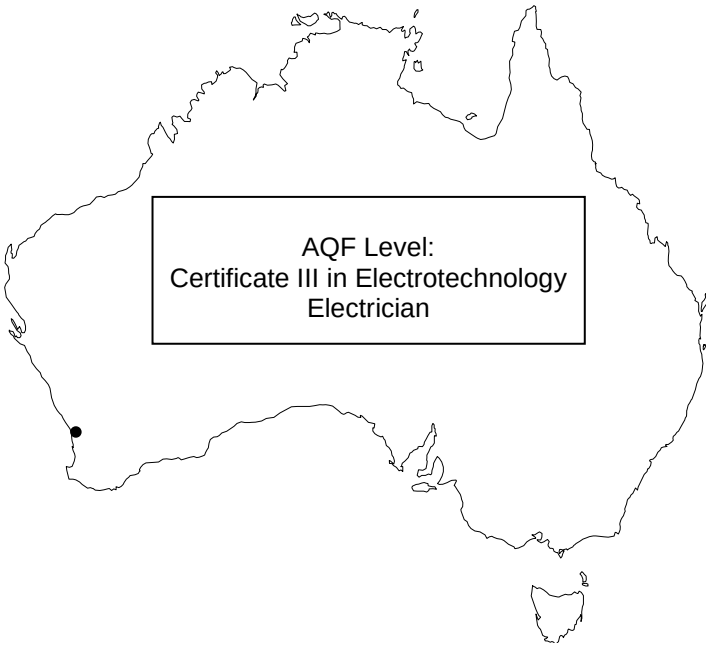
UEE 11 Training Package Support Material
(Non-Endorsed Component)

Based on:
National Electrotechnology Industry Standards

Resource Book

UEENEEG103A
UEENEEG104A

Stage 4 Cluster



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North Metropolitan TAFE

Stage Four Cluster comprises of the following Competencies

UEENEEG103A Install low voltage wiring and accessories

UEENEEG104A Install appliances, switchgear and associated accessories for low voltage electrical installations

Version 1 – April 2015
Version 2 – August 2018 – alignment to AS/NZS 3000:2018

Acknowledgements

This Unit Guide has been prepared by North Metropolitan TAFE Lecturers.

It is intended for North Metropolitan TAFE students only.

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UEENEEG103A Install low voltage wiring and accessories

UEENEEG104A Install appliances, switchgear and associated accessories for low voltage electrical installations

C O N T E N T S

Work Completed:

Section	Topic	Completed
1	Wiring Systems Work sheet	
2	Caravan Park Installation Exercise	
	Special Situation Work sheet	
3	Safety Services Work sheet	
4	Damp Situations Work sheet	
5	ELV Installations Work sheet	
6	Installation Testing Documentation Work sheet	
	Installation Testing Documentation Project	
	Commissioning Installations Work sheet	
8	Written assessment; KS01-EG103 & KS01 –EG104 Practical Assessment: see Section 1 - Wiring Project	

References

- AS/NZS 3000 (Current edition) – Wiring Rule (Standards Australia)
- HB 301 – 2001 Electrical Installations: Designing to the Wiring Rules
- AS/NZS 3008.1.1 (Current edition) – Electrical Installations- Selection of Cables
- WA Electrical Requirements (Current edition)
- Electrical Wiring Practice (7th ed.) Pethebridge, K. & Neeson, I.

Competency Standard Units

UEENEEG103A Install low voltage wiring and accessories

Prerequisite Units
Granting competency in this unit shall be made only after competency in the following units has been confirmed.

UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace.
UEENEEE102A	Fabricate, dismantle, assemble of electrotechnology components.
UEENEEE104A	Solve problems in d.c circuits.
UEENEEE105A	Fix and secure electrotechnology equipment.
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications.
UEENEEE137A	Document and apply measures to control OHS risks associated with electrotechnology work.
UEENEEG006A	Solve problems in single and three phase low voltage machines.
UEENEEG033A	Solve problems in single and three phase electrical apparatus and circuits.
UEENEEG063A	Arrange circuits, control and protection for general electrical installations.
UEENEEG101A	Solve problems in electromagnetic devices and related circuits.
UEENEEG102A	Solve problems in low voltage a.c. circuits.
UEENEEG106A	Terminate cables, cords and accessories for low voltage circuits.
UEENEEG107A	Select wiring systems and cables for low voltage general electrical installations.
UEENEEG108A	Trouble-shoot and repair faults in low voltage electrical apparatus and circuits
UEENEEG109A	Develop and connect electrical control circuits.

Elements and Performance Criteria

ELEMENT		PERFORMANCE CRITERIA	
1	**Prepare to install wiring and accessories.**	**1.1**	OHS procedures for a given work area are identified, obtained and understood.
		1.2	Health and safety risks are identified and established risk control measures and procedures in preparation for the work are followed.
		1.3	Safety hazards that have not previously been identified are noted and established risk control measures are implemented.
		1.4	Installation of wiring is prepared in consultation with other affected by the work and sequenced appropriately.
		1.5	The nature and location of the work is determined from documentation or other appropriate person to establish the scope of work to be undertaken.
		1.6	Cable routes are planned within the constraints of the building structure, significants and requirements.
		1.7	Material needed for the installation work is obtained in accordance with established procedures and checked against job requirements.
		1.8	Tools, equipment and testing devices needed to for the installation work are obtained in accordance with established procedures and checked for correct operation and safety.
		1.9	Preparatory work is checked to ensure no damage has occurred and complies with requirements.
2	**Install wiring and accessories.**	**2.1**	OHS risk control measures and procedures for carrying out the work are followed.

ELEMENT		PERFORMANCE CRITERIA	
		2.2	The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures.
		2.3	Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures.
		2.4	Wiring and accessories are installed to comply with technical standards and job specifications and requirements with sufficient excess to affect terminations.
		2.5	Accessories are installed straight and square in the required locations and within acceptable tolerances.
		2.6	Cables and conductors are terminated at accessories in accordance with manufacture's specifications and regulatory requirements.
		2.7	Ongoing compliance and safety inspection of installed wiring systems and testing of installed circuits is undertaken.
		2.8	Defects revealed through on-going compliance and safety inspection and tests are rectified.
		2.9	Cable installation and termination is carried out efficiently without unnecessary waste of materials or damage to apparatus, circuits or the surrounding environment and using sustainable energy practices.
		2.10	Unexpected situations are dealt with safely and with the approval of an authorised person.
3	**Completion and report installation activities.**	**3.1**	OHS work completion risk control measures and procedures are followed.
		3.2	Work site is cleaned and made safe in accordance with established procedures.
		3.3	'As-installed' cables/wiring and accessories is documented and an appropriate person or persons notified in accordance with established procedures.

Required Skills and Knowledge

KS01-EG103A	**Installation of Wiring Systems**

Evidence shall show an understanding of the installation of wiring systems that comply with standards to an extent indicated by the following aspects:

T1 Standards, codes and requirements applicable to the installation of wiring systems encompassing:

- Cables and methods of mechanical protection and support
- Protection against and from other services.
- Prohibited cable locations
- Building codes affecting the installation of cables in buildings, structures and premises (limitation on penetration of structural elements, maintenance of fire protection integrity, and wiring above suspected ceilings)
- Issues affecting electrical installations in heritage buildings and premises (limitation on penetration of structural and finished elements, accessing cable routes, types and colour of exposed accessories).

T2 Use of other installation standards called up by the Wiring Rules for special situations encompassing:

- Standards that apply to Electro-medical treatment areas.
- Additional requirements for construction and demolition sites.
- Relocatable installations and their site supply
- Additional requirements for caravan park.
- Additional requirements for marinas and pleasure craft at low voltage.
- Additional requirements for shows and carnivals.

T3 Hazardous areas encompassing:

- Conditions that apply in an areas that require them to be classified as a ‘Hazardous area’.
- Responsibility for classifying a hazardous area
- Awareness of standards called up by the Wiring Rules for selection of equipment and installations in Hazardous areas. (AS/NZS 3000 requirements for hazardous areas).

T4 Requirement for the installation of cables and accessories in damp situations and ELV installations encompassing:

- Restricted zones around baths, showers, fixed water containers, pools, sauna heaters and fountains/water features for given installations.
- Selecting equipment suitable for installation in given damp situations.
- Voltage range that defines extra-low voltage.
- 'Separated extra-low voltage (SELV) system' and a 'Protected extra-low voltage (PELV) system".
- AS/NZS 3000 requirements for selecting extra-low voltage systems and devices for a range of installations and conditions.

T5 Aerial cabling encompassing:

- Describe the types of aerial cabling.
- State the AS/NZS 3000 and local supply authority requirements for aerial cabling.
- Termination of aerial cables in accordance with AS/NZS 3000 and local requirements.
- Installation of consumers mains for connection via overhead consumers terminals in accordance with AS/NZS 3000 and local requirements.
- Testing of installed cables compliance with Australian Standards.

T6 Underground cabling encompassing:

- Describe permissible underground cabling systems.
- Identify other underground services.
- State the AS/NZS 3000 and local supply authority requirements for underground cabling.
- List the advantages and disadvantages of underground wiring systems
- Selection of underground consumers mains in accordance with AS/NZS 3000 and local requirements.

T7 Techniques for installing cables and wiring systems encompassing:

- 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.
- Inspecting and testing installed and terminated cables to ensure they comply with continuity and insulation resistance and are safe to connect to the supply.

G103A Work Performance Tasks:

UEENEEG103A Install low voltage wiring and accessories

1. Performance requirements:

1a. Related to the following elements:

1. Prepare to install wiring and accessories.
2. Install wiring and accessories.
3. Completion and report installation activities.

1b. For each element demonstrate performance:

- across a representative body of performance criteria,
- on at least 2 occasions,
- autonomously and to requirements,
- within the timeframes typically expected of the discipline, work function and industrial environment.

2. Representative range includes the following:

All listed tasks related to performance across a representative range of contexts from the prescribed items below:

The minimum number of items on which skill is to be demonstrated Group No		**Item List**
A.	At least three of the following:	**Wiring system enclosures and supports** • Non metallic conduit • Metallic conduit • Ducting • Trunking • Cable tray/ladder • Posts/poles/struts • Catenary
B.	At least four of the following:	**Cable types** • Thermoplastic insulated cable (TPI) • Thermoplastic sheathed flat cable (TPS) • Thermoplastic sheathed circular cable (TPS) • Armoured cable (SWA) • Fire rated cable (HT or HF or MIMS) • Flexible cables • Aerial cable
C.	At least five of the following:	**Circuit purpose** • Consumers mains • Submains • Alternative supply • Lighting • Socket outlets • Single phase fixed appliance • Single phase motor • Three phase motor • Control

UEENEEG104A Install appliances, switchgear and associated accessories for low voltage electrical installations

Prerequisite Units
Granting competency in this unit shall be made only after competency in the following units has been confirmed.

UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace
UEENEEE102A	Fabricate, dismantle, assemble of electrotechnology components
UEENEEE104A	Solve problems in d.c circuits
UEENEEE105A	Fix and secure electrotechnology equipment
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications
UEENEEE137A	Document and apply measures to control OHS risks associated with electrotechnology work
UEENEEG006A	Solve problems in single and three phase low voltage machines
UEENEEG033A	Solve problems in single and three phase electrical apparatus and circuits
UEENEEG063A	Arrange circuits, control and protection for general electrical installations
UEENEEG101A	Solve problems in electromagnetic devices and related circuits
UEENEEG102A	Solve problems in low voltage a.c. circuits
UEENEEG103A	Install low voltage wiring and accessories
UEENEEG106A	Terminate cables, cords and accessories for low voltage circuits
UEENEEG107A	Select wiring systems and cables for low voltage general electrical installations
UEENEEG108A	Trouble-shoot and repair faults in low voltage electrical apparatus and circuits
UEENEEG109A	Develop and connect electrical control circuits

Elements and Performance Criteria

Elements		Performance Criteria	
1	**Prepare to install appliances, switchgear and associated accessories.**	**1.1**	OHS procedures for a given work area are identified, obtained and understood.
		1.2	Health and safety risks are identified and established risk control measures and procedures in preparation for the work are followed.
		1.3	Safety hazards that have not previously been identified are noted and established risk control measures are implemented.
		1.4	Installation is prepared in consultation with others affected by the work and sequenced appropriately.
		1.5	The nature and location of the work is determined from documentation or appropriate person to establish the scope of work to be undertaken.
		1.6	Locations of appliances, switchgear and accessories is planned within the constraints of the building structure, significants and requirements.
		1.7	Material needed for the installation work is obtained in accordance with established procedures and checked against job requirements.
		1.8	Tools, equipment and testing devices needed to for the installation work are obtained in accordance with established procedures and checked for correct operation and safety.
		1.9	Preparatory work is checked to ensure no damage has occurred and complies with requirements.
2	**Install appliances, switchgear and**	**2.1**	OHS risk control measures and procedures for carrying out the work are followed.

	associated accessories.	**2.2**	The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures.
		2.3	Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures.
		2.4	Appliances, switchgear and accessories are installed to comply with technical standards and job specifications and requirements with sufficient access to affect terminations, adjustment and maintenance.
		2.5	Accessories are installed straight and square in the required locations and within acceptable tolerances.
		2.6	Wiring is terminated at appliances, switchgear and accessories in accordance with manufacture's specifications and functional and regulatory requirements.
		2.7	Ongoing compliance and safety inspections of the installed appliances, switchgear and accessories is undertaken.
		2.8	Defects revealed through on-going compliance and safety inspection are rectified.
		2.9	Installation is carried out efficiently without unnecessary waste of materials or damage to apparatus, circuits, the surrounding environment or services and using sustainable energy principles.
		2.10	Unexpected situations are dealt with safely and with the approval of an authorised person.
3	**Completion and report installation activities.**	**3.1**	OHS work completion risk control measures and procedures are followed.
		3.2	Work site is cleaned and made safe in accordance with established procedures.
		3.4	'As-installed' appliances, switchgear and accessories is documented and an appropriate person or persons notified in accordance with established procedures.

Required Skills and Knowledge

KS01-EG104A	**Installation of appliances, switchgear and accessories**

Evidence shall show an understanding of the installation of appliances (current-using equipment) and accessories to an extent indicated by the following aspects:

T1 Installation standards, codes and requirements applicable to installing electrical equipment encompassing.

- Protection against thermal effects
- Connection of electrical equipment (appliances, switchgear and accessories include switchgear and controlgear, switchboards, socket-outlets, lighting equipment and accessories, lamps and luminaires, smoke and fire detectors, cooking appliances, appliances producing hot water or steam, room heaters, electric heating cables for floors and ceilings, space heating, duct heaters, electricity converters, motors, transformers, capacitors, and batteries).
- Required and permitted locations current-using equipment and accessories
- Control, switching and over current and RCD protection

T2 Terminal configuration for connection of phase, neutral and protective earthing conductors for each type of equipment.

T3 Building codes affecting the installation of current-using equipment and accessories in buildings, structures and premises encompassing:

- Maintenance of fire protection integrity, requirements for emergency services (safety services) and the like.

T4 Issues affecting electrical installations in heritage buildings and premises encompassing:

- Limitation on types and colour of exposed accessories.

G104A Work Performance Tasks:

UEENEEG104A Install appliances, switchgear and associated accessories for low voltage electrical installations

1. Performance requirements:

1a. Related to the following elements:

1. Prepare to install appliance, switchgear and associated accessories.
2. Install appliances, switchgear and associated accessories.
3. Completion and report installation activities.

1b. For each element demonstrate performance:

- across a representative body of performance criteria,
- on at least 2 occasions,
- autonomously and to requirements,
- within the timeframes typically expected of the discipline, work function and industrial environment.

2. Representative range includes the following:

All listed tasks related to performance across a representative range of contexts from the prescribed items below:

Group No	**The minimum number of items on which skill is to be demonstrated**	**Item List**
A.	Each of the following: **Installation and connection of accessories**	• Installation of main switches, protection devices and links on a main switchboard for the installation of metering. • Installing and connecting of custom switchboard • Socket outlets • Lighting equipment and accessories • Luminaires
B.	At least four of the following: **Installing and connection of appliances**	• Cooking appliances • Smoke and fire detectors • Water heaters and controls • Three phase motor starters and control switches • Fixed electric heating system (room heaters) • Transformers • Appliances producing hot water of steam • Electric heating cables for floors and ceilings • Trace heating • Duct heating • Electric converters • Capacitors • Batteries

UEENEEG105A Verify compliance and functionality of low voltage general electrical installations

Prerequisite Units
Granting competency in this unit shall be made only after competency in the following units has been confirmed.

UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace
UEENEEE102A	Fabricate, dismantle, assemble of electrotechnology components
UEENEEE104A	Solve problems in d.c circuits
UEENEEE105A	Fix and secure electrotechnology equipment
UEENEEE107A	Use drawings, diagrams, schedules, standards, codes and specifications
UEENEEE137A	Document and apply measures to control OHS risks associated with electrotechnology work
UEENEEG006A	Solve problems in single and three phase low voltage machines
UEENEEG033A	Solve problems in single and three phase electrical apparatus and circuits
UEENEEG063A	Arrange circuits, control and protection for general electrical installations
UEENEEG101A	Solve problems in electromagnetic devices and related circuits
UEENEEG102A	Solve problems in low voltage a.c. circuits
UEENEEG103A	Install low voltage wiring and accessories
UEENEEG104A	Install appliances, switchgear and associated accessories for low voltage electrical installations
UEENEEG106A	Terminate cables, cords and accessories for low voltage circuits
UEENEEG107A	Select wiring systems and cables for low voltage general electrical installations
UEENEEG108A	Trouble-shoot and repair faults in low voltage electrical apparatus and circuits
UEENEEG109A	Develop and connect electrical control circuits

Elements and Performance Criteria

ELEMENT		PERFORMANCE CRITERIA	
1	**Prepare to inspect and test an electrical installation.**	**1.1**	OHS measures for the site are identified, obtained and understood.
		1.2	Established OHS risk control measures and procedures in preparation for the work are followed.
		1.3	Safety hazards, which have not previously been identified, are noted and established risk control measures are implemented.
		1.4	Documentation or deemed to comply standard on which installation is based is reviewed and understood.
		1.5	Appropriate personnel are consulted to ensure the work is coordinated effectively with others involved on the work site.
		1.6	Tools, equipment and testing devices needed to verify compliance are obtained in accordance with established procedures and checked for correct operation and safety.
		1.7	Preparatory work is checked to ensure no damage has occurred and complies with requirements.
2	**Visually inspect and conduct safety testing on the installation.**	**2.1**	OHS risk control measures and procedures for carrying out the work are followed.
		2.2	The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures.
		2.3	Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures.

ELEMENT		PERFORMANCE CRITERIA	
		2.4	Wiring is checked for suitability for the environments in which they are installed and suitably protected from damage or overheating.
		2.5	Cable conductor sizes are confirmed as meeting current-carrying capacity requirements and voltage-drop and fault-loop impedance limitations.
		2.6	Protection methods and devices are validated as meeting co-ordination requirements for overload and short-circuit protection.
		2.7	Switchgear and control gear is validated as being appropriately rated and meeting functional requirements.
		2.8	Evidence that electrical equipment complies with safety requirements is cited.
		2.9	Earthing system components are checked that they are correctly located and conductors correctly sized.
		2.10	Marking on switchboards are checked for accuracy and clarity and comply with requirements.
		2.11	Mandatory tests are conducted to verify that: earthing conductor resistance is sufficiently low; insulation resistance is sufficiently high; all polarities are correct; and circuit connections are correct as per AS/NZS3000.
		2.12	Testing is conducted to verify that: fault-loop impedance is sufficiently low and residual current devices operates as intended as per AS/NZS3000.
3	**Report inspection and test findings.**	**3.1**	OHS risk control work completion measures and procedures are followed.
		3.2	Work site is cleaned and made safe in accordance with established procedures.
		3.3	Non-compliance defects are identified and reported in accordance with established procedures.
		3.4	Recommendations for rectifying defects are made in accordance with established procedures.
		3.5	Mandatory documentation is completed in accordance with established procedures.

Note: KS01-EG105A Electrical installations — verification and testing will be assessed as part of this cluster.
KS02 – EG105A Electrical installations and equipment — principles and requirements will be assessed in the Capstone.

Required Skills and Knowledge

KS01-EG105A	**Electrical installations — verification and testing**
Evidence shall show an understanding of electrical installations testing and verification to an extent indicated by the following aspects:	
T1	**Electrical safety encompassing:**
•	Safety procedures for working on electrical systems, circuits and apparatus.
•	Safe working practices as a normal part of carrying out electrical installation work
•	Isolation and lockout procedures
•	Tools and equipment needed to conduct electrical installation compliance inspection and testing.
T2	**Legislated regulations encompassing:**
•	Legislation and regulations that require installations and equipment to be inspected and tested to ensure they are safe.

- The person/bodies responsible for the various aspects of ensuring electrical installations are safe.
- Results of tests that show an electrical installation is safe for connection to the supply.
- Results of periodic inspection and tests that show construction site wiring and equipment is safe to use.
- Results of periodic inspection and tests that show electrical equipment are safe to use.

T3 Visual inspection of installations for compliance with the Wiring Rules encompassing:

- Protection requirements
- General condition
- Consumers mains/submains
- Switchboards
- Wiring systems
- Equipment and accessories
- Earthing

T4 Testing installations encompassing:

- Tests to ensure: insulation resistance is adequate; earth continuity is such that it will ensure the operation of protection devices under earth fault conditions; polarity of active/s and neutral for mains, submains and final subcircuits is correct; there is no transposition of earthing and neutral conductors; fault-loop impedance is sufficiently low; RCD for correct operation and sensitivity.
- 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.
- Tests to determine the fault level at a particular point in an installation.

T5 Documentation encompassing:

- Results of tests conducted on an installation to comply with requirements and ensure the installation is safe.
- Documents of the results of testing an installation as required by the local supply authority.
- Documents of periodic inspection and testing of construction site wiring and equipment in accordance with requirement.
- Documents of periodic testing and inspection of electrical equipment including tagging requirements.

KS02-EG105A Electrical installations and equipment — principles and requirements (Assessed in Capstone)

Evidence shall show an understanding of electrical installations and equipment principles and requirements to an extent indicated by the following aspects:

T1 Effects of electric current encompassing:

- Physiological effects of current.
- Basic principles by which an electric current can produce heat, light, motion and a chemical reaction.

T2 Single path practical circuit encompassing:

- Arrangement of energy source, protection device, switch and load in a circuit.
- The purpose of each component in the circuit.
- Consequences of an open-circuits, closed-circuits and short-circuits.

T3 Single-source multiple-path d.c. circuits encompassing:

- Circuit configurations and connection.
- Relationship between the parameters of voltage, current, resistance and power dissipation in the whole or any part of the circuit.
- Safely measuring the parameters for 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.

T4 Alternating voltage and current generation, phase relationships, energy in an a.c. circuit encompassing:

- Sinusoidal voltage generation and resulting current.
- The terms period; maximum value; peak-to-peak value; instantaneous value; average value; root-mean-square (r.m.s.) value; and frequency.
- Three-phases 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.

T5 Fundamental safety principles of the AS/NZS 3000 Part 1 (Section 1) and deemed to comply solution given in Part 2 encompassing:

- Definition of terms
- Fundamental safety principles of protection against direct and indirect contact with live parts; thermal effects; overcurrent; earth faults; abnormal voltages; spread of fire; mechanical injury and external influences.
- Fundamental principles of installation design; selection and installation of equipment; means of compliance (including alterations, additions and repairs) and verification of compliance.

T6 Electric motor selection, starting method and overload protection encompassing:

- 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 and reduced voltage starters.
- Thermal, magnetic and thermistor overload protection methods.

T7 Ability to apply AS/NZ 3000 requirements for protective and functional earthing encompassing:

- Purpose of protective and functional earthing.
- Parts of the protective earthing systems.
- Earthing arrangements, earthing of equipment and equipotential bonding.
- Methods of determining the maximum fault loop impedance for a circuit.
- Selection of protective conductor and active conductor sizes for each circuit to ensure earth-fault loop impedance is sufficiently low to operate the circuit protective device.

T8 MEN system and its application encompassing:

- The roles of the 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.
- The importance of the MEN link when a fault occurs.
- The likely consequences of the absence of the MEN link or high impendence in the PEN conductor when a fault occurs.
- The requirements for installation of an MEN link in an installation and an outbuilding.

T9 Knowledge of the application of transformers encompassing:

- Transformers used in distribution and transmission systems and large consumer installations.
- Transformers used in welding machines.
- Applications in appliances
- Risks and safety control measures associated with connection and disconnection of instrument transformers
- Safe working procedures when connecting and testing transformers.
- AS/NZS 3000 requirements and restriction on the installation and use of transformers.

T10 Ability to apply AS/NZ 3000 requirements for protection of circuit against overcurrent and abnormal voltages encompassing:

- Minimum fault levels specified by electricity distributors
- Methods and arrangement for protection against short-circuit currents and overload currents.
- Coordination of overload and short-circuit protection devices.
- Coordination between conductors and overload protection devices.
- Causes of over and under-voltage.
- Device and requirements for protection against over and under-voltage.

T11 Additional protection by use of RCDs and use of extra-low voltage for basic and fault protection encompassing:

- Limitation of an RCD to protect against contact with live parts
- AS/NZS 3000 requirements for use of RCDs.
- Conditions for use of extra-low voltage to provide for basic and fault protection
- AS/NZS 3000 requirements for installation of SELV and PELV systems

T12 Ability to select cables for single and three phase mains and sub-mains for single and multiple installations that comply with requirements of AS/NZS 3000 and AS/NZS 3008.1 encompassing:

- Methods of determining maximum demand.
- Types of cables available.
- Installation methods and external influences effecting cable current-carrying capacity
- Voltage drop limitation
- Short-circuit performance consideration.

T13 Ability to select cables for final sub-circuits that comply with requirements of AS/NZS 3000 and AS/NZS 3008.1 encompassing:

- Maximum demand of final sub-circuits.
- Types of cables available.
- Installation methods and external influences effecting cable current-carrying capacity
- Effect of earth-fault loop impedance and voltage drop limitations on circuit route length.
- Short-circuit performance considerations.

T14 Ability to apply AS/NZS 3000 requirements for control and protection of installations encompassing:

- Devices for functions of isolation; emergency; Mechanical maintenance and functional control.
- Method for assessing prospective short circuit current.
- Devices and arrangement for protection against overload and short-circuit current.
- Additional protection by RCD
- Protection against switchboard internal arc faults.

T15 Ability to apply AS/NZS 3000 requirements for the installation of electrical equipment in given damp situations encompassing:

- Limitation of installation of equipment in classified zones.
- Selection and location of equipment suitable for installation in given classified zones.
- Additional protection by RCD.
- Equipotential bonding in showers and bathrooms and swimming and spa pools.

T16 Ability to install, modify and test electrical equipment for construction and demolition sites, complying with AS/NZS 3012 and applicable workplace safety legislation encompassing:

- Supply and installation requirements.
- Protection of circuits.
- Initial and periodic inspection and testing
- Portable tool safety testing and tagging system in accordance with AS/NZS 3760.

T17 Knowledge of AS/NZS 3000 requirements for the installation of aerial conductors and underground wiring encompassing:

- 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 layer and protection
- Underground wiring clearances from other services

T18 Knowledge of AS/NZS 3000 requirements for electrical installations in hazardous areas encompassing:

- Types of areas classified as a hazardous area
- Standards to which the selection, installation and maintenance of electrical equipment shall comply.
- Additional training required to work competently with electrical equipment for hazardous areas

T19 Ability to verify compliance of an electrical installation in accordance with AS/NZS 3000 encompassing:

- Visual inspection to determine whether the installation complies with requirements set out in Section 2 to 7 of AS/NZS 3000 and relevant specific installation standards.
- Mandatory tests following guidance given in AS/NZS 3017

T20 Ability to perform effective safe isolation of any equipment encompassing:

- Preparation of a 'safe work method statement' (SWMS) or Job Safety Analysis (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

T21 Ability to apply AS/NZS 3000 requirements to install and terminate thermoplastic insulated cables; elastomer sheathed cables; XLPE sheathed cables; and high temperature cables; armoured cables; and neutral screened cables in a wide range of applications.

T22 Ability to perform the circuit tests required for electrical cables in a range of installations and final sub-circuit encompassing:

- Following safe testing procedures.
- Tests to show if the earth continuity and earth-fault loop impedance are sufficiently low.
- Testing to show if insulation resistance is sufficiently high.
- Testing to show if the polarity and circuit connections are correct.

T23 Ability to install final sub-circuit wiring into switchboards and connect to switchboard equipment in accordance with AS/NZS 3000 and electricity distributor's requirements.

T24 Ability to apply AS/NZS 3000 and electricity distributor's requirements for the installation and connect consumers mains encompassing:

- Installing of underground and overhead consumers mains
- Terminating consumers mains at pillars, pits mains connection boxes and consumers switchboard.
- Install unprotected consumers mains to reduce the risk of short-circuit current to a minimum.
- Installing bonding conductors where required.

T25 Ability to read, sketch and interpret electrical diagrams encompassing:

- Purpose and characteristics of schematic, block and wiring diagrams, plans and schedules.
- Conventions used in documenting electrical information
- Read and interpret schematic, block and wiring diagrams, plans and schedules
- Sketch electrical diagrams using conventional symbols

T26 Knowledge and understanding occupational safety and health encompassing:

- Basics of Occupational Safety and Health regulations
- Legal responsibilities for employers and employees
- Employers' and employees' own "duty of care".
- Safety committees and their role

T27 Knowledge and understanding of the requirements for personal safety in the workplace encompassing:

- Purpose and use of Safe Work Method Statements (SWMS) or Job Safety Analysis (JSA).
- Purpose and process of reporting 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.

T28 Process in rescuing a person in contact with live electrical conductors or equipment and the primary importance of the safety of the rescuer.

T29 Application of emergency first aid requirements for an electric shock victim encompassing:

- Calling for help.
- Applying cardiopulmonary resuscitation (CPR).
- Selection and use of fire extinguishers to control electrical fire at accident site**.**

T30 Dangers of high voltage equipment and distribution systems encompassing:

- Step and 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.

T31 Systematic method of commissioning and decommissioning electrical equipment and installations encompassing:

- Commissioning safety procedures
- Circuit voltage testing
- Phase rotation checks
- Functional testing
- Instrument and control parameter settings
- Decommissioning safety procedures.
- Identification of circuits with their control and protection devices.
- Impact of isolation on other parts of an installation.
- Tagging, testing and earthing.
- Safe removal of equipment.

T32 Diagnosing and rectifying faults in electrical apparatus and associated circuits encompassing:

- Faults such as open-circuit; short-circuit; incorrect connections; insulation failure; unsafe condition; apparatus/component failure; related mechanical failure;
- Apparatus such as control devices; fixed appliances/accessories; lighting; electrical machines motors and controls; socket outlets, transformers; protection and metering devices.
- Circuits such as those supplying fixed appliances; lighting; socket outlets; motors and controls circuits; transformers; electronic or computer based equipment.

Workplace Rules:

Rule 1	Follow the instructions
Rule 2	Tolerate ambiguity
Rule 3	Meet your obligations

Note: This information and current details of critical aspects for each competency standard unit (CSU) in this qualification can be found at the Australian Training Standards website www.training.gov.au**.**

Stage Four Cluster of G103A and G104A

Delivery and Assessment Plan

Name of Lecturer: _____

Contact Details: _____

Delivery Mode/s: □ Face to Face □ On-Line □ Blended Delivery □ Other

Using:

- AS/NZS 3000 (Current edition) – Wiring Rule (Standards Australia)
- H B 301 – 2001 Electrical Installations: Designing to the Wiring Rules
- AS/NZS 3008.1.1 (Current edition) – Electrical Installations- Selection of Cables
- WA Electrical Requirements (Current edition)
- Electrical Wiring Practice (7th ed.) Pethebridge, K. & Neeson, I.

Session	Nominal Duration	Program of Work (Topics to be covered)	Primary Reference
1A	1 hr	Introduction to Cluster, assessment methods, duration, resources, RPL Applications	Lecturer
1B	3 hrs	Section 1 - Wiring Systems	Resource Book
2	4 hrs	Section 2 – Special Situations	Resource Book
3	4 hrs	Section 3 – Safety Services	Resource Book
4	2 hrs	Section 4 – Damp Situations	Resource Book
4	2 hrs	Section 5 – ELV Installations	Resource Book
5	2 hrs	Section 6 – Installation Testing Documentation	Resource Book
6	2 hrs	**Written Assessment**	RSAK – KS01 – EG103A RSAK – KS01 – EG104A RSAK – KS01 – EG105A
	12 hrs	**Practical Assessment**	Resource Book – Section 1 Wiring Activity

I acknowledge that I have received and read this Delivery and Assessment Plan Student Name:_____ Signature: _____ Date: _____		
Lecturer Name	Lecturer Signature	Date

Assessment Strategy

Conditions of Assessment:

Normally learning and assessment will take place in an integrated classroom/ laboratory environment.

It is essential to work through the worksheets and activities in this workbook and follow the guidance of your lecturer. The worksheets and practical activities provide the required skills and knowledge outlined in this Cluster and assist you in achieving competency.

Assessment Methods:

Written Assessment – based on the Require Skills and Knowledge (RSAK) of KS01 – EG103A, KS01 – EG104A & KS01 – EG105A. You must achieve a mark of 75% or more in this assessment.

Observed Practical Assessment – based on the Elements, Performance Criteria and Range Statements of these Competency Units; UEENEEG103A, UEENEEG104A and UEENEEG105A. You must achieve a mark of 100% in this assessment.

On-Job-Training:

It is expected that the off-job component of these competency units will be complemented by appropriate on-job development involving exposure to re-occurring workplace events and supervised experiences. (See Work Performance Tasks.) You are required to log your on-the-job training in your 'Q-Tracker' account.

Sufficiency of Evidence:

In all instances competency is to be attributed on evidence sufficient to show that a person has the necessary skills required for the scope of work. These include:

- Task skills - performing individual tasks
- Task management skills - managing a number of different tasks
- Contingency management skills - responding to irregularities and breakdowns in routines
- Job/role environment skills - dealing with the responsibilities and expectations of the work environment including working with others.

Evidence must demonstrate that an individual can perform competently across the specified range of activities and has the required skills and knowledge underpinning the competency.

LABORATORY SAFETY INSTRUCTIONS

Students working in Laboratories at this campus do so, on condition that they agree to abide by the following safety instructions. Failure to observe the safety instructions may result in immediate suspension.

1. No circuit is to be plugged in or switched on without specific permission of the lecturer in charge of the class. A circuit must be switched off and tested for zero volts before any connection leads are removed. The DANGER TAG PROCEDURE must be used at all times.

2. Do not leave any circuit switched on any longer than necessary for testing. Do not walk away and leave the circuit switched on.

3. Report any broken, damaged or unserviceable equipment to your lecturer.

4. All of your wiring must be disconnected at the end of each practical class or as each project is completed.

5. Make all connections in a safe manner with an appropriate connecting device. Unshielded 4 mm banana plugs are not to be used for wiring.

6. Switch off, remove the plug from the socket and attach your danger tag to the plug top before working on the project. It is not sufficient to simply turn the supply switch off.

7. When disconnecting your wiring from a connection made under a screw, undo the screw- do not cut the wires off.

8. Observe the correct colour code for all wiring projects.

9. Check your circuit for short circuits with your multimeter before asking your lecturer to switch on. Check the checker before and after EACH check.

10. Skylarking is not permitted at any time.

11. Proper clothing and footwear must be worn at all times when you attend this campus. Thongs, sandals and singles alone are not permitted. **Safety boots or safety shoes must be worn in workshops, laboratories and installation skills areas**.

12. Where a project sheet is issued for a practical project, complete each step in the Procedure before moving on to the next step.

13. Draw all diagrams in pencil so that they can be easily changed or corrected. Mark off each connection on your circuit or wiring diagram as it is made.

14. Check the function and range before taking a reading with a multimeter.

15. Make sure that it is YOUR plug before you insert it into a socket outlet.

16. Always switch a multimeter OFF or to the highest possible AC volts range when you have finished using it.

Student's Signature _____ Date: _____

WORKSHOP SAFETY INSTRUCTIONS

Students working in workshops and installation skills areas at this college do so on condition that they agree to abide by the following safety instructions. Failure to observe the safety instructions may result in immediate suspension.

1. Personally owned eye protection must be worn AT ALL TIMES. Other safety equipment including hearing protection must be worn when applicable to a particular task.

2. Loose clothing must not be worn when working on fixed or portable machines. Hairnets must be worn where applicable. Clothing must cover the upper arms and body.

3. Enclosed footwear must be worn at all times on this campus. Thongs or sandals are not permitted. **Safety boots or safety shoes must be worn in workshop and installation skills areas**.

4. Tools and safety equipment are issued from the tool store on request. It is your responsibility to ask for the correct item (Size, Type and Tool). Check to see that you have been given the correct item before using it. If in doubt ask your LECTURER, not the storeperson.

5. Report any broken, damaged or unserviceable equipment to your Lecturer. Do not use damaged tools or machines.

6. Clean down the machines immediately after use. All tools must be cleaned before returning them to the store.

7. Skylarking is not permitted at any time.

8. Always use protective vice jaws when cutting off material in a bench vice.

9. Accidents resulting in cuts, abrasions or other personal injury must be reported to your Lecturer immediately - no matter how minor they may seem. A first-aid kit is available in the tool store.

10. Never leave a machine unattended when it is running. Do not allow yourself to be distracted when operating a machine.

11. Read all safety signs and notices and follow the instructions.

12. Do not use a fixed or portable machine unless you have been instructed in its proper use.

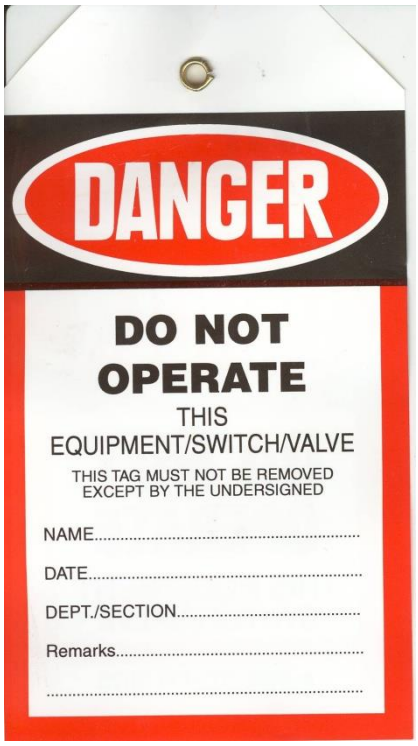
13. Read all risk assessment documentation provided (JSAs) and conduct a relevant risk assessment process before performing any task.

Student's Signature _____ Date: _____

Danger Tag Procedure

Use of Danger Tags

If you have a practical task to do and there is a possibility that you could be injured if someone turns on the electricity, then you **MUST** fasten a red danger tag to the machine main isolation switch, circuit-breaker or the equipment plug top.



Each danger tag you use must clearly show; your name, your section (class) and the date.

Nobody must operate the danger tagged switch or control point until the job is made safe and the danger tag has been removed.

Your lecturer will check your task before you are allowed to remove your danger tag.

Only the person who is named on the tag and attached the tag, is allowed to remove it.

Points to Watch

Make absolutely sure the switch/circuit-breaker/plug top is the correct one to tag. If you have any doubts, ask your lecturer.

Make sure that you have switched the isolator to **OFF** position before you attach your danger tag.

Fasten the danger tag securely.

The purpose of using Danger Tags is to prevent electrical accidents from happening.

Failure to follow Danger Tag Procedures when working on practical activities and practical assessments will result in a **Not yet competent** comment recorded for this Cluster.

Student's Signature _____ Date: _____

JOB SAFETY ANALYSIS WORKSHEET

JSA No.: _____ Date:

Risk: H = High
S= Significant
M = Medium
L = Low

	A	B	C	D	E
1	H	H	H	S	S
2	H	H	S	S	M
3	H	H	S	M	L
4	H	S	M	L	L
5	S	S	M	L	L

Probability:
A – common or repeating occurrence
B – known to occur or "It has happened"
C – could occur, "I've heard of it happening"
D – not likely to occur
E – practically impossible

Consequences:

People:
1 – fatality or permanent disability
2 – lost time injury or illness
3 – medical treatment
4 – first aid treatment
5 – incident report only

Environment:
1 – toxic release off site with detrimental effect
2 – off site release with no detrimental effect
3 – off site release contained with outside assistance
4 – on site release immediately contained
5 – no environmental impact

STEP NO	JOB STEP List the steps required to perform the task in the sequence they are carried out.	POTENTIAL HAZARD Against each step list the potential risk/ hazards that could cause injury / damage when the task step is performed.	Probability	Consequence	Risk Rank L S M H	REQUIRED HAZARD CONTROL For each hazard identified list the control measures required to eliminate or minimise the risk of injury.	RESPONSIBILITY Nominate the person who will be required to action the control measures
1							

Job Safety Analysis Work Team Sign-on/ Review Register

Personnel are required to sign this register to indicate they have read, understand and will adhere to the requirements of the JSA

This JSA covers:				JSA No	
Name	Employee Signature	Date	Name	Employee Signature	Date

Typical Isolation Procedure

Step	Action
1	**Advise the person in charge** of the work location that power to an electrical machine is to be disconnected and negotiate a convenient time.
2	**Switch the machine off** at the isolating switch adjacent to it. Attach a Danger Tag. Write your name, the date and the time on the danger tag.
3	**Identify** the relevant circuit on the sub distribution board.
4	**Isolate** the supply by switching the circuit breaker to the off position. **Lock it in the OFF position.**
5	Attach a 'Danger Do Not Operate' **Danger tag** to the identified circuit breaker to warn others that the circuit must not be re-energised. Write your name, the date and the time on the danger tag.
6	**Check the test instrument** (a multimeter on volts scale) to see that it is working properly on a known voltage source. A powered socket outlet could be used to conduct this test.
7	**Test for zero volts** at the motor terminals. Test between all actives, from all actives to neutral (if connected), and from all actives to earth.
8	**Re-check the test instrument** (usually a multimeter on volts scale) to see that it is working properly on a known voltage source.
9	**Double check** all conductors using a voltage stick to check de-energisation of conductors. Note – a volt-stick should never be used as the primary method of testing for zero volts.
10	**Disconnect** and remove ALL cables from the motor terminals.
11	**Insulate** all disconnected cables with tape and leave them in a safe and tidy condition e.g. Enclosed in a junction box.
12	**Remove** the motor from its mounting.
13	If the task is not completed in the same shift, remove your Danger Tag and attach an **Out of Service Tag**
14	**Advise the person in change** (supervisor) that the work is completed.

NOTE: This procedure is **only a guide.** Each isolation procedure should be produced to suit each individual task. A **JSA (Job Safety Audit)** should be completed before starting an isolation procedure.

The above procedure is modelled on the isolation procedures outlined in Standard AS/NZS 4836:2011 and the WA Code of Practice for Persons working on or near energised electrical installations (2018).

Wiring Systems

Task:

Demonstrate a knowledge of wiring systems suitable for a range of electrical installation.

Why:

Electrical installations typically consist of more than one type of wiring system. An electrician needs to be aware of the types of wiring system so that he/she can select the ones most appropriate to the given conditions.

To Pass:

1. You must correctly answer the questions on the Work Sheets provided and achieve a mark of 75% or more in a written competency assessment.

2. You must satisfactorily complete the set tasks.

3. You must achieve 100% in a final competency test for each practical assessment.

Equipment

Simulated electrical installation panels.

References

* Electrical Wiring Practice (7th ed.), Pethebridge, K. & Neeson, I.
* AS/NZS 3000:2018 - Wiring Rules. Standards Australia
* AS/NZS 3008.1.1 - Electrical installations. Selection of cables.
* WA Electrical Requirements:2014.
* WA Distribution Connections Manual (4th ed.) 2013
* AS/NZS 4836.2011 - Safe working practice on low-voltage electrical installations
* Code of Practice for Persons working on or near energised electrical installations (2018) WA Office of Energy.

Wiring Systems

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

AS/NZS 3000:2018 Wiring Rules

Section 1 Scope, application and fundamental principles
Section 3 Selection and installation of wiring systems

Electrical Wiring Practice

Chapter 3 Regulations and Standards

Fundamental requirements (Wiring Rules Part 1)

Chapter 7 Wiring and Cabling Systems

Cable routes through buildings, mechanical protection of wiring systems and common types of wiring systems.

AS/NZS 3008.1.1 - Electrical installations. Selection of cables.

Clause 3.4 Installation conditions

2. Read the Summaries and practise answering the questions provided on the Work Sheets. Refer to other relevant texts if you feel it is necessary.

3. Answer the questions given on the Work Sheets. Use a separate answer sheet or sheets for each Work Sheet. Note that you are required to answer ALL questions correctly, although not necessarily at the same time.

4. Complete the projects in this manual.

5. Submit your answers to the Work Sheets to your Lecturer for discussion and assessment.

Wiring Systems

1. A wiring system is an arrangement of electrical conductors which provide a path for the current from a voltage source to a consuming device. Most extra-low (not exceeding 50 V a.c.) and low voltage (exceeding 50 V but not exceeding 1000 V a.c.) installations consist of insulated cables run in some type of enclosure, or supported in such a way as to provide protection against electric shock or overheating. Most completed installations consist of more than one type of wiring system.

2. The selection of a type of wiring system for a particular part of an installation requires consideration of the following main factors:

   a. Adequate protection against electric shock.

   b. Protection against external influences and environmental conditions such as mechanical damage, local heat sources, or exposure to the weather. See AS/NZS 3000:2007 Clause 3.3.

   c. Mutual detrimental influences such as heating of adjacent cables, or electrical interference affecting data or communications cables or equipment.

   d. Selection of conductors to satisfy current carrying capacity, voltage drop and other minimum size requirements.

   e. Reliability and electrical continuity of connections, joints and terminations.

   f. Identification of conductors and enclosures (by colour or other means).

   g. Protection against fire and the spread of fire.

   h. The type of building or structure.

   i. The type and amount of mechanical protection required for the cables.

   j. The appearance of the wiring system.

   k. The accessibility of the wiring.

   l. The cost of the installation.

   m. Future alterations which may be required.

   n. Special requirements, such as the presence of moisture, water, flammable materials, chemicals, explosive gases or explosive dust.

   o. The normal operating voltage of the installation.

   p. The amount of ventilation available.

   q. Specific regulatory requirements - such as on construction sites (See AS 3012 Clause 8.1).

3. The most commonly used wiring systems/cables are outlined below, using terminology found in AS/NZS 3000 and other relevant publications. The detailed requirements for most systems are contained in the Wiring Rules - see Table 3.1

a. **Aerial Wiring Systems** Insulated or bare cables run in air and supported on suitable poles and associated equipment.

b. **Armoured Cables** Cables with wire armouring to protect the internal conductors from mechanical damage.

c. **Busbars** Large bare or covered solid copper or aluminium rectangular conductors for carrying large currents - typically behind large switchboards.

d. **Busways** Solid copper or aluminium conductors rigidly supported in an overhead insulated enclosure, with plug-in access points at intervals.

e. **Cable Trays** Galvanised perforated steel trays used to support insulated sheathed cables, usually in areas not likely to be disturbed.

f. **Catenary Supported Cables** Insulated and sheathed cables run in air clipped to a stranded galvanised steel wire strung between two anchor points.

g. **Ducts** A square or rectangular enclosure for large insulated cables.

h. **Festoon Lighting** Specially manufactured double insulated lampholders attached to flat sheathed cable in such a way that sharp pins penetrate the insulation and sheathing during installation to make contact with the conductors within. Commonly referred to as 'party lights'.

i. **Flat Cables** Cables in which the insulated conductors are manufactured side-by-side, usually requiring special insulation displacement connectors. Commonly used in extra-low-voltage data cabling with up to about 25 cores.

j. **Flexible Metallic and Non-metallic Conduits** Flexible circular pipes with associated accessories. Used as an enclosure for insulated cables.

k. **Flexible Cords** A special type of flexible insulated and sheathed cable suitable for connecting to portable electrical devices. Available in a single insulated form typically used for internal wiring in machines.

l. **Mineral Insulated Metal Sheathed (MIMS) Cables** Between 1 and 7 single strand copper conductors embedded in a compressed insulating powder inside a tubular copper sheath. Can be covered with an outer PVC serving. Requires special accessories for terminating.

m. **Neutral Screened Cables** Insulated and sheathed cables with an outer screen of conducting material suitable for connecting to the neutral.

n. **Rigid Metallic and Non-metallic Conduit** Rigid circular pipes with associated accessories. Used as an enclosure for insulated cables.

o. **Sheathed Cables** Single insulated single core or multi-core cables enclosed in an insulated sheath to provide double insulation.

p. **Track Lighting** Extruded aluminium channel with an internal insulating material containing the active and neutral conductors. It has plug-in facilities along its entire length - for use with associated accessories.

q. **Trailing Cables** Sheathed flexible cords and cables designed for use with moving machinery.

r. **Trunking** A metallic or non-metallic square or rectangular trough for housing insulated cables.

s. **Undercarpet Wiring** Special flat cable designed to be installed under a carpet.

t. **Underground Wiring** Three wiring systems (Category A, B and C) for installing cables underground under various conditions.

u. **Unsheathed Cables** Single insulated flexible cord or flexible cable intended for installation in a protective enclosure such as conduits or trunking.

4. Particular care needs to be taken when repairing or modifying an existing wiring system because it is possible for terminals or parts to be alive for some unexpected reason - such as incorrect connections, faulty components or damaged wiring.

General Installation Processes

5. Installation of wiring systems involves several inter-related activities that are performed at appropriate times as the work progresses. In general the processes are those involved in most other electrical work and include:

#	Activity
1	Appropriate personnel are consulted
2	Materials are obtained
3	Preparatory work is checked
4	Tools and equipment are obtained
5	OH&S procedures are followed
6	Isolation is checked
7	Unplanned events are responded to
8	Ongoing checks of quality of work are undertaken
9	Inspection, testing and commissioning is completed
10	Work completion is notified

5. Read the following sections in AS/NZS 3000:2018 - Wiring Rules

Section 1 Scope, application and fundamental principles
Section 3 Selection and installation of wiring systems
Table 3.1 Cable types and their application in wiring systems

6. Read the following section in AS/NZS 3008.1.1 - Electrical installations. Selection of cables:

Clause 3.4 Installation conditions
Clause 3.5 External influences on cables

7. Read the following sections in Pethebridge and Neeson Volume 1:

Chapter 7 Wiring and Cabling Systems

- 7.1 Wiring and cable routes through buildings and structures
- 7.2 Wiring and cabling systems
- 7.3 Installing wiring systems
- 7.4 Enclosed wiring and cables
- 7.5 Underground systems
- 7.6 Aerials and catenary systems

Wiring Systems

1. What are four factors which must be considered when selecting a wiring system for a particular installation?

2. Describe eight different types of wiring system and give a typical example of where each one could be used.

3. What is the main potential safety hazard when modifying or repairing an existing wiring system?

4. What are the four general installation conditions specified in AS/NZS 3008.1.1

5. What are eight of the general external influences which affect the current carrying capacity of electrical cables in an installation as specified in AS/NZS 3008.1.1?

6. What are four of the general external influences which can cause damage to electrical cables in an installation? Give the AS/NZS 3000 Clause number.

7. List the 10 general processes involved in the installation of wiring systems in a typical installation.

8. What is the fundamental difference between a Category A and Category B underground wiring system according to AS/NZS3000?

9. What is an acceptable method of identifying an electrical underground wiring system according to the AS/NZS3000?

10. What is the minimum depth of cover above an underground mains conduit? Provide an AS/NZS3000 reference that shows your answer.

11. Does the AS/NZS 3000 allow bare aerial conductors to be attached to a building if they will be within arm's reach? Provide an AS/NZS 3000 clause number to support your answer.

12. What is the minimum current rating for a consumer's mains of a single phase non domestic installation according to WAER? What is the minimum size of the underground mains for this installation?

13. Where a wiring system penetrates a fire barrier such as a wall ceiling or floor of a building, what are the AS/NZS 3000 requirements to maintain the fire rating of the barrier? Provide an AS/NZS 3000 clause number to support your answer.

14. What are the fire protection measures that wiring system openings in electrical switchboards must maintain according to AS/NZS3000? Provide an AS/NZS 3000 clause number to support your answer.

G103A, G104A & G105A Wiring Project

Objective

To install different wiring systems to comply with G103A, G104A and G105A unit requirements on a wiring panel to comply with a client's specifications, all relevant regulatory requirements and the generally accepted principles of safe and sound practice.

Equipment

Simulated electrical installation wiring panel
Cables and accessories as required
Installation test instruments
Hand tools and PPE as required

AS/NZS 3000:2018 and AS 3008.1.1:2017
WA Electrical Requirements
Sample Electrical Safety Certificate
Electrical accessory catalogues

Procedure

1. Examine the wiring panel diagram and confirm with your lecturer (the client) which particular wiring system(s) you need to install. Plan the installation to ensure that Occupational Safety and Health (OS&H) policies and procedures are followed.

2. Consult appropriate personnel to ensure that the work is coordinated effectively with others involved on the work site.

3. Obtain the cables, accessories, test equipment and hand tools necessary to complete the specified work in accordance with job requirements.

4. Check the tools, equipment and testing devices for correct operation and safety.

5. Have your preparatory work checked by your Lecturer, and discuss how you plan to proceed with the installation.

6. Install the wiring in accordance with requirements without damage or distortion to the surrounding environment or services. Obtain approval from your Lecturer before any contingencies are implemented. Carry out on-going checks of the quality of your work in accordance with the requirements of safe and sound practice.

7. Inspect your completed installation to ensure that it conforms to the specifications and to all relevant regulatory requirements.

8. Test your completed installation using appropriate test equipment and record the results.

Type of Test	Test Device	Expected Result	Actual Result	OK

9. Have your wiring and test results checked by your Lecturer.

10. Disconnect your wiring and prepare all accessories for re-use where practicable. Clean up the work area and ensure that all equipment is left in a safe condition.

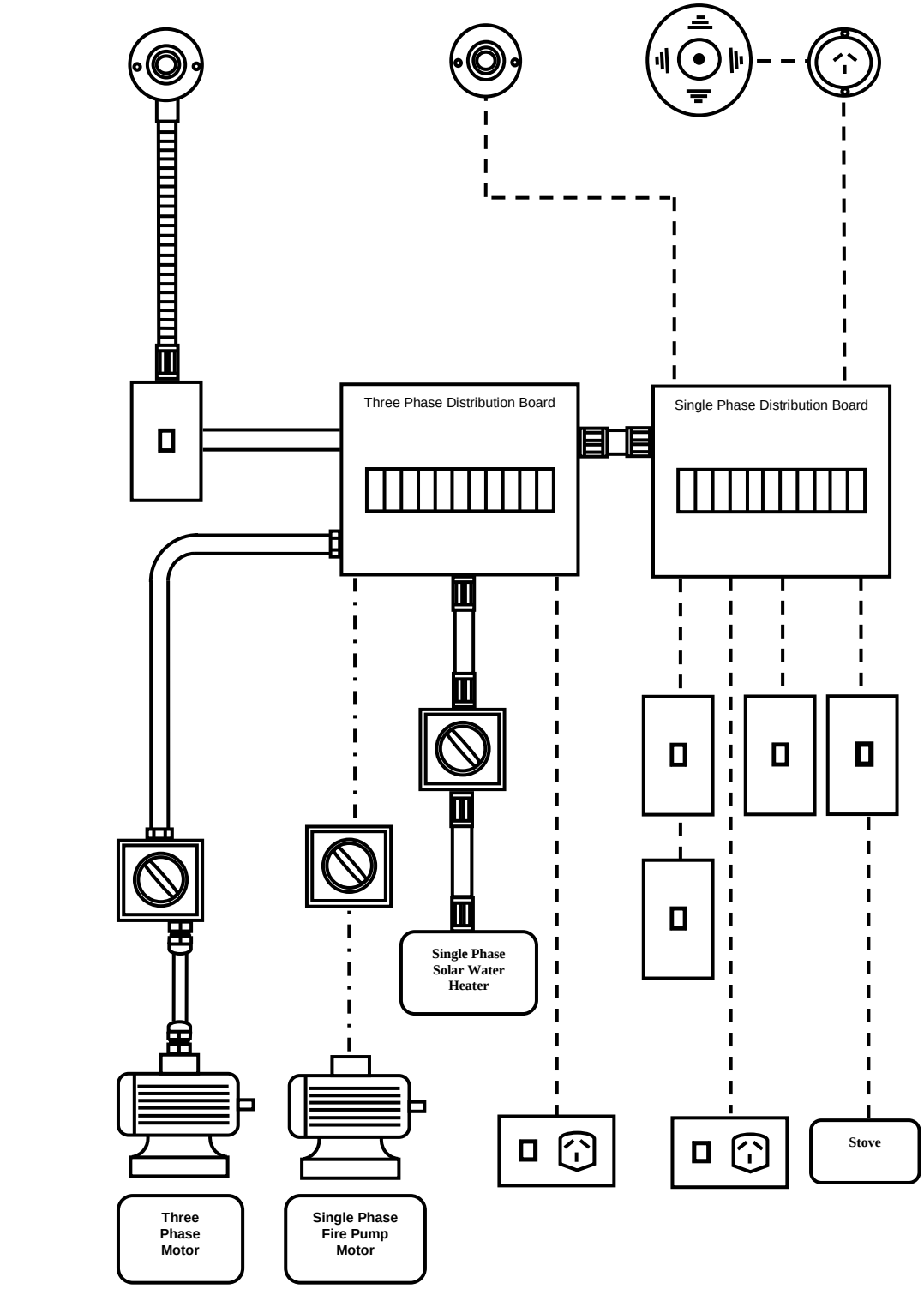
11. Complete the sample Electrical Safety Certificate using fictitious data as required.

12. Make a list of the cable and accessories used to complete this project.

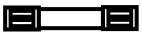
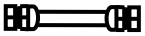
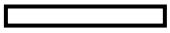
Assessment (Wiring Project):

Satisfactory:		Not Yet Satisfactory:	

Lecturer: _____ Date: _____


Three Phase Distribution Board
Single Phase Distribution Board
Single Phase Solar Water Heater
Three Phase Motor
Single Phase Fire Pump Motor
Stove


Main Earth

WIRING SYSTEMS	
Metal conduit 20mm wired with Thermoplastic insulated cable (TPI) (Three phase motor circuit)	
PVC conduit 25mm for submains wired with TPI. (Between the two switchboards)	
PVC conduit 20mm wired with TPI. (Solar HWS circuit)	
Flat thermoplastic sheathed (TPS)	
Fire rated cable (HT or HF) (Fire pump circuit)	
Flexible cable (Three phase motor circuit)	
PVC flexible conduit 20mm (corri) wired with TPI	
Trunking wired with TPI	

Special Situations

Task:

To demonstrate knowledge of special installations and locations that shall comply with additional requirement of the Wiring Rules and/or other standards.

Why:

All electricians must be aware of the special situations to which special installation conditions apply.

To Pass:

1. You must correctly answer the questions on the Work Sheets provided and achieve a mark of 75% or more in a written competency assessment.

2. You must satisfactorily complete the set tasks.

3. You must achieve 100% in a final competency test for each practical assessment.

Equipment

Sample electrical accessories.

References

* Electrical Wiring Practice (7th ed.),Pethrbridge, K. & Neeson, I.
* AS/NZS 3000:2018 - Wiring Rules. Standards Australia
* AS/NZS 3008.1.1:2017 - Electrical installations. Selection of cables.
* WA Electrical Requirements (Current edition).
* Heritage Council of WA
* AS/NZS 4836.2011 - Safe working practice on low-voltage electrical installations
* Code of Practice for Persons working on or near energised electrical installations (2018) WA Office of Energy.

Special Situations

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

WA Health (Public Buildings) Regulations 1992

AS/NZS 3000:2018 Wiring Rules

Appendix A List of referenced documents
Clause 7.7 Hazardous areas
Clause 7.2 Safety Services
Clause 7.8 Specific electrical installation standards

Electrical Wiring Practice (7th ed.) Vol. 2

Chapter 8 Damp situations and other specific electrical installations
- Section 8.2 Installations in hazardous areas – page 237
- Section 8.3 Installations for transportable structures and sites – page 240
- Section 8.4 Shows and carnivals – page 243
- Section 8.5 Medical treatment areas – page 243
- Section 8.6 Marina electrical installations – page 246
- Section 8.7 Construction and demolition sites – page 248

AS/NZS 3001:2008 Electrical installations – Relocatable premises (including caravans and tents) and their site installations.

AS/NZS 3003:2011 Electrical Installations – Patients areas

AS/NZS 3004.1:2008 Electrical installations - Marinas and recreational boats – Part 1: Marinas

AS/NZS 3012:2010 Electrical installations - Construction and demolition sites

AS/NZS 2381.1:2005 Electrical equipment for explosive gas atmospheres –
- Selection, installation and maintenance

AS/NZS 60079.10.1:2009 Classification of hazardous areas- Explosive gas atmospheres

AS/NZS 60079.10.2:2011 Classification of hazardous areas- Explosive dust atmospheres.

2. Read the Summaries and practise answering the questions provided on the Work Sheets. Refer to other relevant texts if you feel it is necessary.

3. Answer the questions given on the Work Sheets. Use a separate answer sheet or sheets for each Work Sheet. Note that you are required to answer ALL questions correctly, although not necessarily at the same time.

4. Complete the projects in this manual.

5. Submit your answers to the Work Sheets to your Lecturer for discussion and assessment.

Special Situations

1. In general, the requirements of AS/NZS 3000 are applicable to all consumer's electrical installations in Australia and New Zealand. Where there are specific or special requirements for additional safety from the risk of electric shock or fire, additional standards apply.

2. Appendix A of AS/NZS 3000 lists many of these standards (those referenced within the Wiring Rules) for both equipment and installation purposes.

Public Buildings

3. The WA Health (Public Buildings) Regulations 1992 specify special requirements for lighting and lighting control in public buildings. It covers such aspects as:

a.	Exit signs	Clause 16
b.	Lighting levels	Clause 28
c.	Position of luminaires	Clause 28
d.	Switches controlling lighting	Clause 30
e.	External lighting requirements	Clause 31
f.	Emergency lighting	Clause 32
g.	General lighting for auditoriums	Clause 38
h.	Safety lighting	Clause 39
i.	Construction of luminaires	Clause 40
j.	Stage equipment	Clause 42
k.	Lighting in classrooms	Clause 50

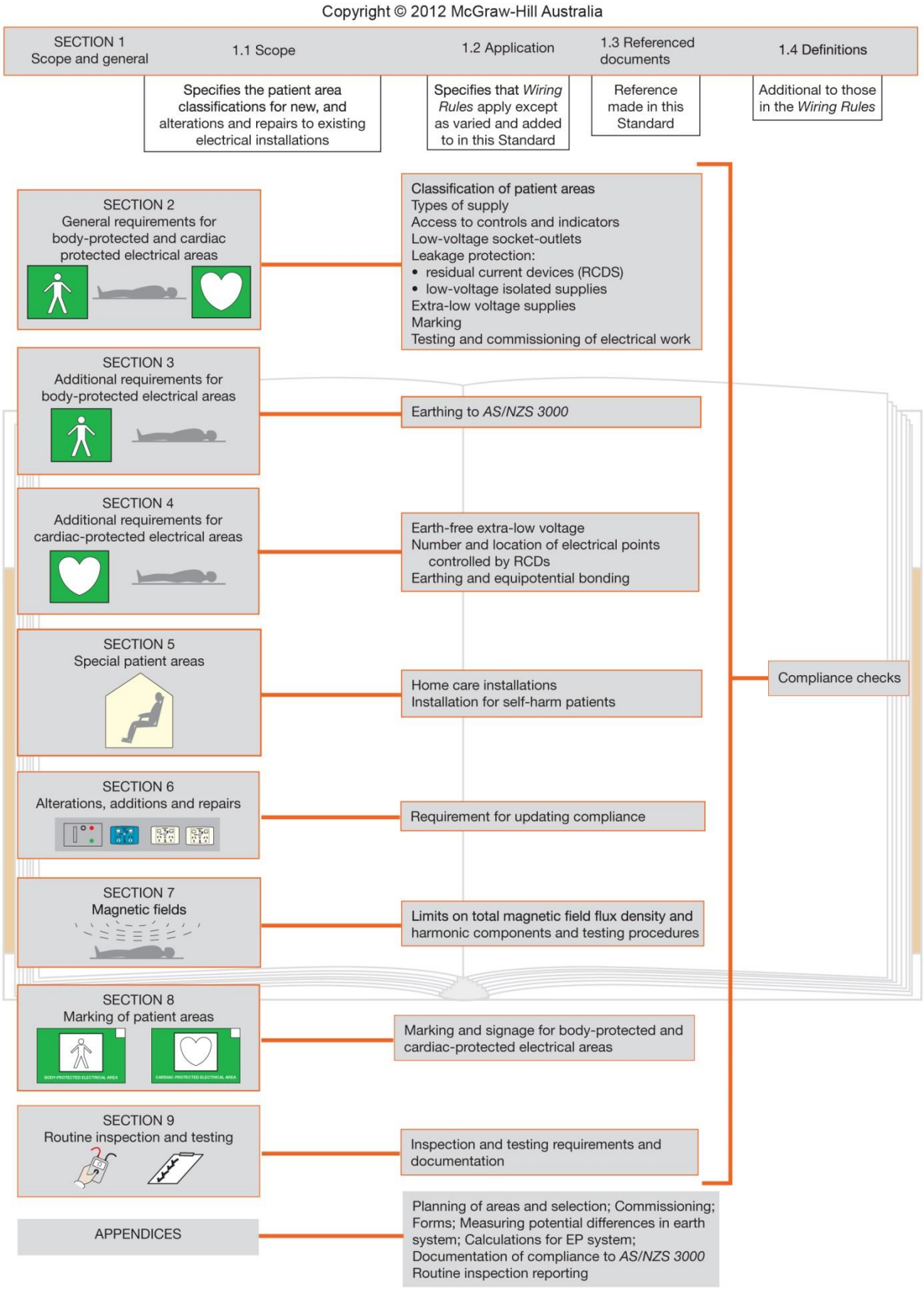
4. Although a typical electrician is not likely to be required to design the lighting for a public building he or she may be required to carry out maintenance work at various times. Therefore you need to know that there are special requirements for lighting in public buildings so that any maintenance work conforms to the requirements.

5. You need to obtain a copy of the Health (Public Buildings) Regulations 1992 from the college library so that you can study the detailed requirements.

Electrical Installations in Medical Treatment Areas

6. Doctor's surgeries, hospitals and other buildings where medical procedures are performed, require the electrical installation to conform to AS/NZS 3003 *Electrical installations-Patient areas* as well as AS/NZS 3000. Read Electrical Wiring Practice- Vol.2 Section 8.5.

An Overview of the content of AS/NZS 3003 Electrical Installations – Patient areas



Electrical Installations in Heritage Buildings

7. All Australian Heritage listed buildings are covered by the Burra Charter. The Burra Charter defines the basic principles and procedures to be followed to conserve places of cultural heritage significance in Western Australia.
The guiding principles are:
• do as much as necessary to care for the place and make it useable; but otherwise
• change as little as possible so that its cultural significance is retained.

A careful approach, based on a sound knowledge and understanding of the historic place, is at the core of good heritage conservation practice.

8. When maintaining a heritage building, careful consideration needs to address how the particular item of work is likely to affect the cultural significance of the historic place. A heritage listing does not mean that a place becomes frozen in time. Other than in exceptional circumstances, where a place is highly significant as a 'museum piece', making considered changes to a heritage place to allow new or continued use is actively encouraged.
When assessing the impact of repair and components and detailing how well the new matches the old in size, profile, physical properties, colour, finish, texture and so on.

9. Early electric installations typically provided a central ceiling light in each room and a two-pin power socket with rotary switch in the more important rooms - power demand was minimal, with little more than reading lamps and maybe an electric fan being used. Electric bells also became popular, particularly in the larger buildings to signal staff, and it is not uncommon for the old indicator board to have survived. Light switches were located at the ceiling outlet and operated by a cord, or brought down to a position near the door. The electricity meter and fuses (often just one power fuse and one light) were usually located on an exposed wooden board in a readily accessible position near an external door or on the front veranda. In updating the electrical installation to meet modern demands and codes, and in carrying out renovations generally, valuable evidence of these earlier services is preserved by retaining any disused hardware - switchboards, switches, sockets, bell pushes, and so on.

Precautions

10. Exercise extreme caution if old rubber-insulated (VIR) wiring is still in use in older buildings. VIR cables can remain intact and serviceable for decades if undisturbed, but age turns the rubber very brittle and any movement of the cables can cause it to disintegrate and the wiring to short circuit. This form of wiring is generally considered NOT to comply with current AS/NZS 3000 standards and should be checked by a qualified electrician who can advise on the adequacy or otherwise of the wiring, particularly if the building has been recently acquired.

11. Early installations may not be earthed, adding to their danger. Other potential problems that should be checked are the mechanical wear of switches, wear, arcing or corrosion of electrical contacts and any sign of abnormal deterioration.

New installations in Heritage Buildings

12. Renewal of electrical installations of Heritage buildings should have regard for the historic fabric of the place. Often, a little thoughtfulness in the layout of these services can avoid unnecessary damage, particularly if they are to be chased into walls. Careful planning can also avoid unsightly exposed runs of cabling or piping internally and externally to the building.

WA Heritage Council Guidelines for maintenance work on "Listed" Buildings

13. Before starting work on a Heritage Listed Building, you should seek advice from the WA Heritage Council, but the following tasks do not require Heritage Council approval:

Building maintenance that does not involve the removal of, or damage to, the existing fabric of the building or the use of new materials.

Replacement of utility services (e.g. electrical circuits) using existing routes or voids that does not involve the removal of, or damage to, the fabric of the building.

Installation of a temporary security fence, scaffold, hoarding or surveillance system that does not affect the fabric of a building, the landscape or archaeological features of the land.

Caravan Parks

14. A typical caravan park consists of permanent structures such as an office, delicatessen, amenities block, toilets, ablutions and security lighting. It also has facilities for providing a temporary supply to movable premises such as caravans.

15. In general, the electrical installation in a caravan park must comply with the requirements of the Wiring Rules, but some variations and/or additional requirements are specified in AS/NZS 3001. The installation of wiring and equipment in the movable premises themselves are also subject to requirements of AS/NZS 3000 and AS/NZS 3001 if they are to be connected to a 240 volt supply.

16. The Work Sheet and planning exercise for this Section are intended to draw attention to specific aspects of an electrical installation in a caravan park and the related requirements of AS/NZS 3000 and AS/NZS 3001. You will need to refer to a copy of AS/NZS 3001 to complete the Work Sheet and the installation exercise.

Exercise

17. Refer to the site plan of the Caravan Park Installation. Plan the installation of the wiring in the installation so that it conforms to the relevant requirements of AS/NZS 3000 and AS/NZS 3001. All wiring for the mains and submains is to be installed underground in clean sandy soil. No additional annexes or tents are permitted on the site. Make valid assumptions for any detail not provided.

18. The installation consists of:

a. A timber framed fibro-cement clad site office with a concrete slab floor and corrugated galvanised iron roof. The main switchboard is located in the site office. The site office has the following connected load:

   2 twin 240 volt 36 watt fluorescent luminaires (0.5 amps each).
   4 240 volt double 10 amp single phase socket outlets.
   1 fixed wired reverse cycle 240 volt 12 amp air conditioner.

b. A timber framed fibro-cement clad amenities block with a concrete slab floor and corrugated galvanised iron roof. A distribution board is located as shown on the site plan.
   The amenities block has the following connected load:

   10 240 volt double 10 amp single phase socket outlets.
   8 twin 240 volt 36 watt fluorescent luminaires (0.5 amps each).
   6 single phase 240 volt 3.6 kW clothes dryers.
   6 single phase 240 volt 15 amp socket outlets.

c. Six weatherproof (IP 23) distribution pillars, each with four 240 volt 15 amp socket outlets (one for each caravan site). A separate 16 A, 30 mA MCB/RCD Combo is provided for each 15 A outlet.

19. Complete the following summary of planning detail. Show the calculations, assumptions and any other detail in a logical sequence on a separate sheet of paper so that it can be checked by others. Remember, when you need to perform this task on the job it needs to be thoroughly checked to see that it complies with the relevant requirements.

Consumer's Mains

Maximum demand: _____

Minimum permissible size (copper):_____

Type of cable:_____

Site Distribution Board Submains:

Maximum demand: _____

Minimum permissible size (copper): _____

Type of cable: _____

Installation conditions: _____

Calculated maximum voltage drop: _____

Amenities Distribution Board Submains:

Maximum demand: _____

Minimum permissible size (copper): _____

Type of cable: _____

Installation conditions: _____

Calculated maximum voltage drop: _____

Site Distribution Pillar (Number 6):

Maximum demand: _____

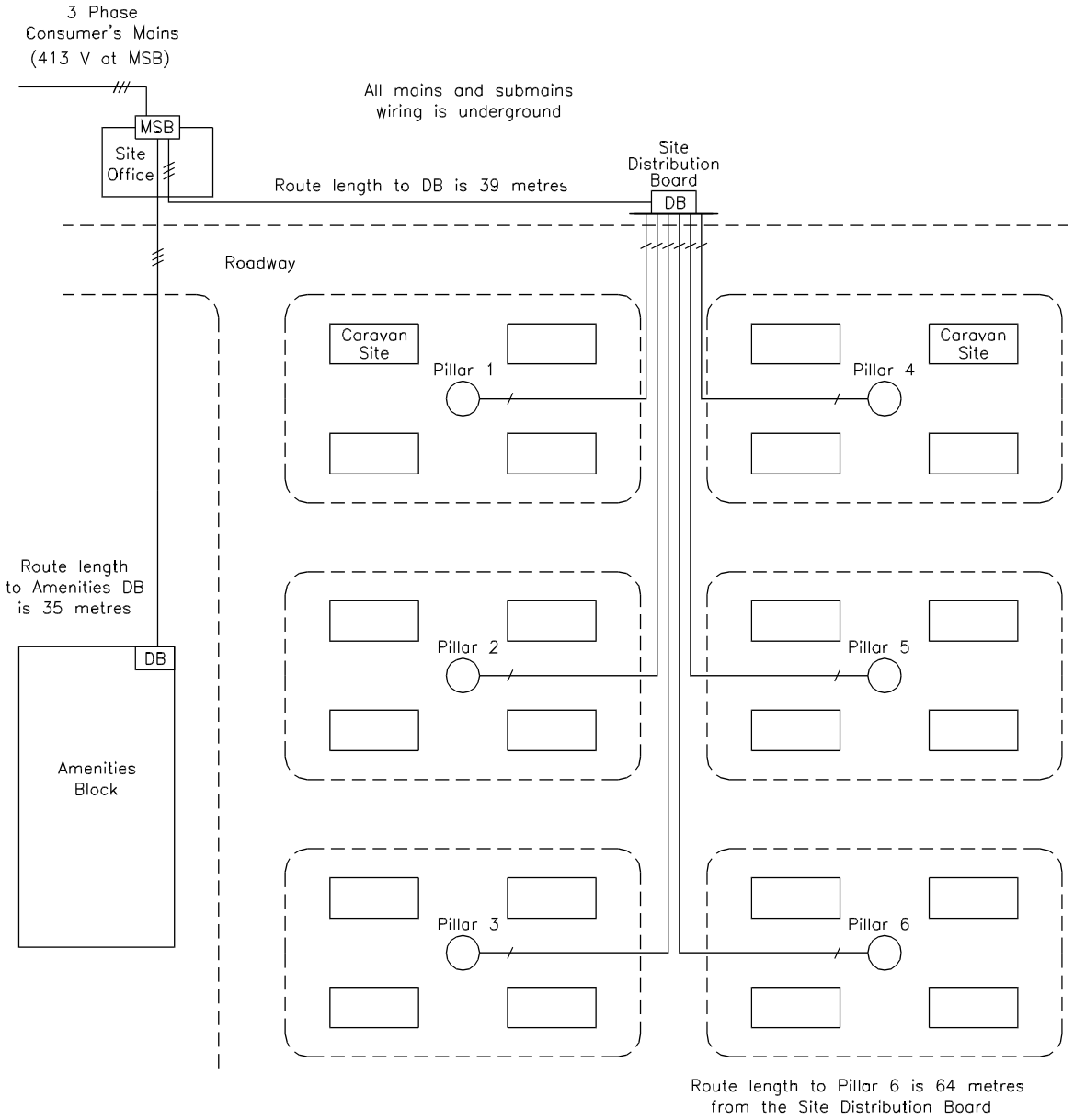
Minimum permissible size (copper): _____

Type of cable: _____

Installation conditions: _____

Calculated maximum voltage drop: _____

Caravan Park Installation Site Plan



Boating Marinas

20. This section relates to electrical installations in boating marinas as defined in AS/NZS 3004.1:2008. A marina is any wharf, jetty, pier or floating pontoon arrangement intended for berthing or mooring one or more pleasure craft.

21. Marinas require special consideration with regard to electrical installations because of the presence of:

a. a corrosive, salt-laden atmosphere.
b. water spray.
c. water level variation.
d. high temperatures.
e. dissimilar metals immersed in an electrolyte, resulting in electrolytic corrosion.

22. AS/NZS 3004.1 is arranged in four sections:

Section 1 - Scope and General
Section 2 – Marina Electrical Installations
Section 3 – Connection of Recreational Boats to Marina Low Voltage Electrical Installations.
Section 4 - New or Additional Installations.

23. The Wiring Rules requires that electrical installations in boating marinas comply with of AS/NZS 3004. AS/NZS 3004 requires that electrical installations in marinas and recreational boats be carried out in accordance with the Wiring Rules except as varied in AS/NZS 3004.

24. The Work Sheet for this topic is intended to draw attention to the major electrical requirements of AS/NZS 3004. You will need to refer to a copy of AS/NZS 3004 to complete the Work Sheet.

Hazardous Areas

25. Hazardous areas are areas in which an explosive atmosphere is present or may be expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical equipment (See AS/NZS 3000 Clause 7.7). The purpose of the special precautions is to prevent electrical devices and their associated wiring systems from becoming a source of ignition as a result of arcing, heating or other operational features.

26. In general terms, potentially explosive atmospheres include those which consist of a significant quantity of flammable, combustible or explodable gas, vapour, liquid, flyings or dust.

27. The Wiring Rules recognises two general hazardous areas:

a. Flammable gas or vapours.

b. Combustible dust, fibres or flyings.

28. Detailed classifications of hazardous areas are contained in AS/NZS60079.10.1 for explosive gas atmospheres and in AS/NZS 60079.10.2 for explosive dust atmospheres. Note that the classification of a hazardous area generally rests with the occupier – see AS/NZS 3000 Clause 7.7.2.1.

29. The AS/NZS 60079.10.1:2009 edition includes, in Annexes ZA and ZB, all of the examples of area classification. Annex ZC provides requirements that apply where it is decided to use Equipment Protection Levels (EPLs) as a basis for equipment selection and installation.

Section 7 of AS/NZS 3000 also calls up other AS/NZS 60079 series standards with reference to the selection of equipment for use in hazardous areas, the installation of electrical equipment in hazardous areas, the competency of people working in hazardous areas and the maintenance and inspection of equipment in hazardous areas.

Explosion Protection Techniques

30. In situations where it is not possible to avoid installing electrical equipment and wiring systems in hazardous areas, various methods of preventing an explosion can be employed. The basic types are:

a. Exclusion - prevent hazardous material from entering electrical equipment.

b. Containment - confine an explosion within the electrical equipment.

c. Dilution - ensure good ventilation to decrease gas concentration.

d. Ignition source not present - equipment designed to avoid being an ignition source.

e. Energy limitation - equipment cannot produce enough energy for ignition.

31. Explosion protection techniques are often specified in the form of a code such as 'Ex d' (Flameproof) on equipment or associated documentation. Electrical Wiring Practice Volume 2 (7th ed.), Figure 8.2 contains a detailed discussion of these techniques.

Electrical Equipment used in Hazardous Areas

32. Clause 7.7.2.4 of AS/NZS 3000 requires compliance with various parts of the AS/NZS 60079 series. AS/NZS 60079.14:2009 (Explosive atmospheres – Part 14 - Electrical Installations- design, selection and erection) provides more essential information relating to the installation of equipment in hazardous areas where flammable gases or vapours may be present. All equipment and wiring systems in hazardous areas must comply with the requirements of these standards. AS/NZS 60079.14 also provides information on specific occupancies in Appendix ZA. Examples of specific occupancies are; Petrol dispensing stations, aircraft hangers, oil refineries. These types of installations require specialised electrical equipment and specialised training of electrical tradespeople to work in these electrical installations.

33. Specialised electrical equipment used in Hazardous areas will be labelled to show the method used for explosion protection, the explosion gas grouping and the surface temperature the equipment is not permitted to exceed. The following table provides information on specialised equipment for hazardous areas

TABLE 1

EXPLOSION PROTECTION	TYPE OF PROTECTION	GAS GROUP	TEMPERATURE CLASSIFICATION
Exd-	Flameproof	I (methane - mining only)	T1 –450^{O}C
Exi-	Intrinsically safe	IIA (Propane)	T2-300^{O}C
Exp-	Pressurisation	IIB (Ethylene)	T3-200^{0}C
Exe-	Increased safety	IIC (Hydrogen)	T4-135^{0}C
Exm-	Encapsulation		T5-100^{0}C
Exn-	Non-sparking		T6- 85^{0}C
Exs-	Special Protection		
Exo-	Oil Immersed		
Exq-	Powder/sand filled		
Exv-	Ventilation		

Special Situations

Standards:

1. Name the Australian standard that applies to electrical installations on construction and demolition sites.

2. Name one equipment standard that applies to plugs and sockets.

Public Buildings:

3. Is it permissible to position a luminaire with a bare lamp less than 2.4 metres from the floor in a public building used for entertainment?

4. Where must the switches for general auditorium lighting be located in a public hall?

5. What is the minimum permissible number of circuits which can be installed for general lighting of public areas in a public building used for entertainment?

Caravan Parks:

6. Is it permissible to use a Category C underground wiring system in a caravan park in areas where pegs and stakes are likely to be driven?

7. What is the minimum permissible depth of laying for a Category B underground wiring system to a tent site in a caravan park?

8. Is it permissible to use hard drawn bare copper cable for overhead wiring in a caravan park?

Boating Marinas:

9. What are three of the special environmental factors which require special consideration when working on electrical installations in boating marinas?

10. What portions of a boating marina are not permitted to have aerial or catenary wiring?

11 Which Australian Standard provides information relating to mains voltage installations in boating marinas?

Hazardous Areas:

12. What AS/NZS 3000 classification is assigned to areas where combustible dust is likely to create an electrical hazard?

13. What AS/NZS 3000 classification is assigned to areas where flammable gases are present or likely to be present?

14. What are two of the 'specific occupancies' of hazardous areas which are the subject of discussion in the AS/NZS60079.14?

15. Ex i, Ex h, and Ex v are symbols used to indicate particular methods of protection of electrical equipment in hazardous areas. What does the 'Ex' stand for?

16. Who is generally responsible for the classification of hazardous areas?

17. Define a hazardous area.

Other Special Situations

18. What two Australian Standards must electrical installations in medical treatment areas comply with?

19. Before starting working on a Heritage Listed Building in Perth, what organisation needs to be consulted before commencement?

20. What type of wiring system was extensively used in older building is now considered dangerous?

Special Situations – Safety Services

Task:

To demonstrate knowledge of electrical safety services installations that shall comply with additional requirement of the Wiring Rules and/or other standards.

Why:

All electricians must be aware of the special situations to which safety service installation conditions apply.

To Pass:

1. You must correctly answer the questions on the Work Sheets provided and achieve a mark of 75% or more in a written competency assessment.

2. You must satisfactorily complete the set tasks.

3. You must achieve 100% in a final competency test for each practical assessment.

Equipment

Sample electrical accessories.

References

* Electrical Wiring Practice (7th ed.),Pethrbridge, K. & Neeson, I.
* AS/NZS 3000:2018 - Wiring Rules. Standards Australia
* AS/NZS 3008.1.1:2017 - Electrical installations. Selection of cables.
* WA Electrical Requirements (Current edition).
* AS/NZS 4836.2011 - Safe working practice on low-voltage electrical installations
* Code of Practice for Persons working on or near energised electrical installations(2018). WA Office of Energy.

Special Situations - Safety Services

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

AS/NZS 3000:2018 Wiring Rules

Appendix A List of referenced documents
Clause 4.6 Smoke and Fire Detectors
Clause 7.2 Safety Services
Clause 7.8 Specific electrical installation standards

Electrical Wiring Practice (7th ed.) Vol. 2

Chapter 2 Electrical installations for Safety Services – Fire Protection and Evacuation Equipment
- Section 2.1 Fire safety in buildings
- Section 2.2 Fire safety standards and regulations
- Section 2.3 Fire detection, alarm and warning systems
- Section 2.5 Safety services (fire safety) – installation arrangements

2. Read the Summaries and practise answering the questions provided on the Work Sheets. Refer to other relevant texts if you feel it is necessary.

3. Answer the questions given on the Work Sheets. Use a separate answer sheet or sheets for each Work Sheet. Note that you are required to answer ALL questions correctly, although not necessarily at the same time.

4. Complete the projects in this manual.

5. Submit your answers to the Work Sheets to your Lecturer for discussion and assessment.

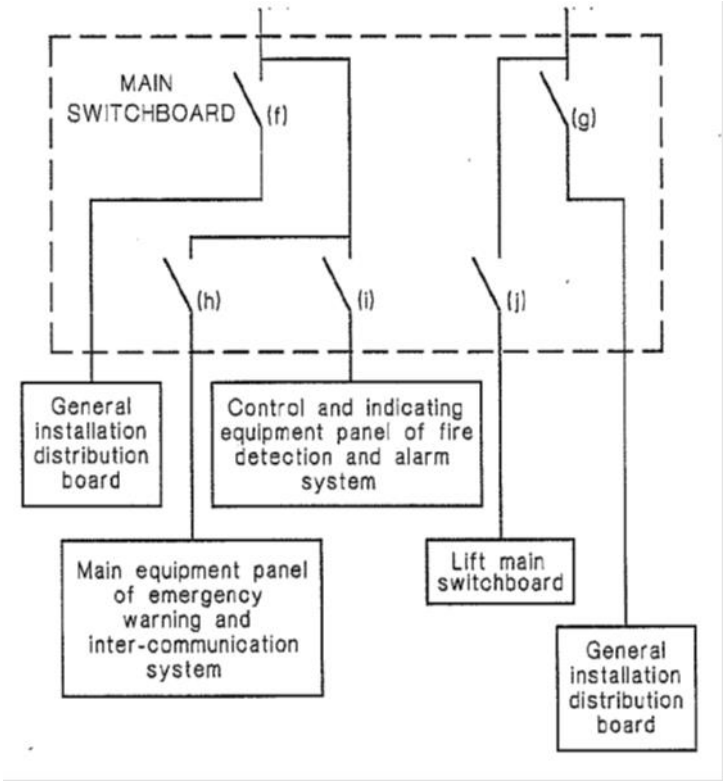
Special Situations – Safety Services

1. In general, the requirements of AS/NZS 3000 are applicable to all consumer's electrical installations in Australia and New Zealand. Where there are specific or special requirements for additional safety from the risk of electric shock or fire, additional standards apply.

Public Buildings – Commercial Installations

2. Although a typical electrician is not likely to be required to design the design of safety circuits for a public building he or she may be required to carry out maintenance work at various times. Therefore you need to know that there are special requirements for safety circuits such as fire pumps, fire detection and control and lift circuits in public buildings so that any maintenance work conforms to the requirements.

3. At the main switchboard of large electrical installations, safety services such as; fire detection and fire-fighting systems, evacuation systems and lifts must be controlled separately from the main switch(es) that control general electrical services in the building. By controlling safety services independently, ensures that the electrical supply is not inadvertently disconnected from electrical equipment that is required to operate during emergency conditions.



Control of Electrical Services on a Main Switchboard

Note:
Main switches f & g control general electrical services – switched off in an emergency
Main switches h, i & j separately control various safety services

4. Main switches controlling safety circuits shall identify the equipment it supplies, such fire pumps, marked ‘IN THE EVENT OF FIRE, DO NOT SWITCH OFF’ and identified by contrasting colour from other equipment on that switchboard. Where the main switchboard supplies a safety equipment sub board, no switch shall be placed between the two switchboards that can isolate the safety equipment (see AS/NZS 3000 clause 7.2.4.2 *Interposing switches*)

5. Wiring systems for safety circuits must comply with AS/NZS 3000 clause 7.2.7, to maintain a power supply to all safety service equipment when that wiring system is exposed to fire.

Fire Pump Circuits

6. Fire pump motor circuits must comply with AS/NZS 3000 clause 7.2.9. The isolating switch for the fire pump must be adjacent to the pump and must be locked in the on position.

7. Fire pump control circuits are wire differently than conventional motor control systems, for example: the fire pump control circuit Active conductor is wired directly to the contactor coil and any control switch is in the neutral conductor. No overload protection device shall be inserted between the pump controller and the motor.

Fire Detection Equipment

8. In commercial and industrial installations, the electrical tradesperson will come across a number of different devices to detect fire. These devices can be either smoke detectors, carbon monoxide detectors, heat detectors or flame detector alarms. Read Electrical Wiring Practices – Vol. 2, Section 2.3 Fire detection, alarm and warning systems.

A commercial smoke detector used in offices

These commercial devices are not be confused with those used for domestic dwellings.

They operate from an extra-low voltage (ELV) supplied through a two-pair cable that carries the communication in the second pair.

Each unit has a dedicated address that enables the system to identify the location of an alarm.

Indicator flashes periodically to show that the smoke detector is active.

9. In domestic installations it has been mandatory for many years to install smoke detectors. AS/NZS 3000 suggest that smoke and fire detectors are connected to a lighting final sub-circuit rather than connected to a dedicated alarm circuit. The use of the lighting final sub-circuit provides monitoring that the main supply is available, as failure of the lighting circuit would be indicated by the lack of illumination, see AS/NZS 3000 clause 4.6.

10. There are two main types of smoke alarms, with the difference being their smoke sensing technology. These technologies are called ionisation and photoelectric smoke sensors and they react differently to a fire. Photoelectric technology is generally more sensitive to the large smoke particles that tend to be produced by smouldering fires. Most residential dwelling fires tend to produce large amounts of visible smoke. This is why photoelectric smoke alarms are considered superior to ionisation technology in providing early warning in a residential house fire.

Special Situations – Safety Services

1. Why is it important to have the control of Safety Services identified on the main switchboard of a commercial building?

2. According to AS/NZS 3000, what the requirements of wiring systems that supply safety services? Provide clause number.

3. According to AS/NZS 3000, can conductors supply safety services be enclosed in the same conduit as conductors supplying general power and light services? Provide clause number.

4. According to AS/NZS 3000, can a fire pump isolation switch be left in the off position? Provide clause number.

5. According to AS/NZS 3000, is it usual practice to have over temperature protection for fire pump motors? Provide clause number.

6. Name two common types of smoke detectors used in domestic installations. What is an example of smoke detector nuisance 'tripping' in a domestic situation?

7. According to AS/NZS 3000, why is it good practice to connect smoke detectors to a lighting circuit? Provide clause number.

Delineation and Selection of Equipment for Damp Situations

Task:

To delineate damp situations and select equipment for installation in damp situations to comply with the requirements of the Wiring Rules.

Why:

All equipment installed in damp situations must be able to operate safely under normal operating conditions and anticipated fault conditions.

To Pass:

1. You must correctly answer the questions on the Work Sheets provided and achieve a mark of 75% or more in a written competency assessment.

2. You must satisfactorily complete the set tasks.

3. You must achieve 100% in a final competency test for each practical assessment.

Equipment

Samples or graphics of equipment used in damp situations.

References

* Electrical Wiring Practice (Volume 2) 7th edition. Pethebridge, K. & Neeson, I.
* AS/NZS 3000:2018 - Wiring Rules. Standards Australia
* AS/NZS 3008.1.1:2017 - Electrical installations. Selection of cables.
* WA Electrical Requirements: 2014.
* AS/NZS 4836.2011 - Safe working practice on low-voltage electrical installations
* Code of Practice for Persons working on or near energised electrical installations (2018). WA Office of Energy.

Delineation and Selection of Equipment for Damp Situations

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

AS/NZS 3000:2018 - Wiring Rules

Clause 1.4.44 and Section 6 Damp situations

Electrical Wiring Practice Volume 2 (7th ed.)

Chapter 8 Damp Situations and other Specific Electrical Installations
Section 8.1 Damp situations

2. Read the Summaries and practise answering the questions provided on the Work Sheets. Refer to other relevant texts if you feel it is necessary.

3. Answer the questions given on the Work Sheets. Use a separate answer sheet or sheets for each Work Sheet. Note that you are required to answer ALL questions correctly, although not necessarily at the same time.

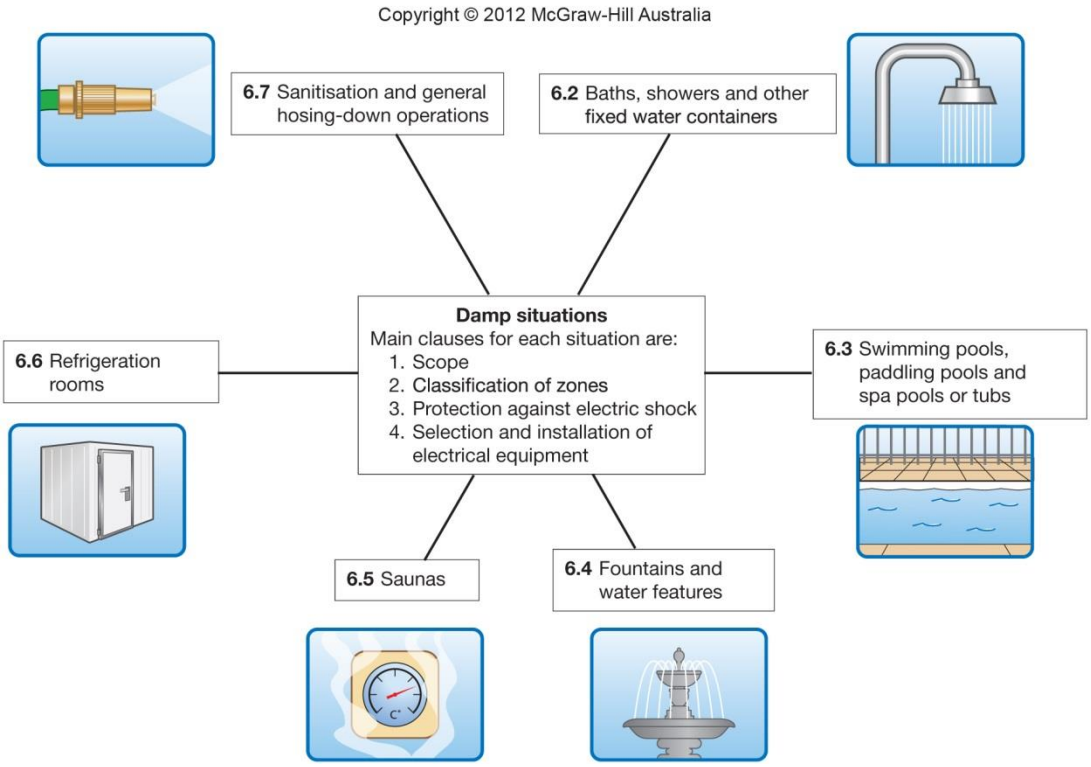
4. Complete the projects in this workbook.

5. Submit your answers to the Work Sheets to your Lecturer for discussion and assessment.

Delineation and Selection of Equipment for Damp Situations

1. Section 6 of the Wiring Rules contains the requirements for installations in damp situations and other areas where special installation requirements must be met. The defined special situations include situations where moisture is either permanently present or intermittently present, i.e:

   a. Swimming pools.
   b. Spa pools.
   c. Baths, showers and other fixed water containers.
   d. Fountains and water features.
   e. Refrigerated rooms.
   f. Sauna baths.
   g. General hosing areas.



2. The Work Sheets for this Section are intended to provide you with the opportunity to use the Wiring Rules and Electrical Wiring Practice to become familiar with the location of various requirements for swimming pools and damp situations.

International Protection Ratings

3. Electrical accessories installed in damp situations are required to conform to an International Protection Rating (IP Rating) as provided for in AS/NZS 3000 (see appendix G – Degrees of protection of enclosed equipment).

Classification of Zones for Damp Situations

4. The delineation damp situations is based on the AS/NZS 3000 classifications of zones. The zones determine the degree of increased risk of electric shock and provide guidance for the selection and installation of electrical equipment within the specified locations.

5. In general, Zone 0 is the area of the interior of the water container while Zone 1, Zone 2 and Zone 3 extend both horizontally and vertically from Zone 0. These classifications are detailed in the Wiring Rules as follows:

   a. Clause 6.2 for locations containing baths, showers and other water containers.

   b. Clause 6.3 for locations containing swimming, paddling and spa pools and tubs.

   c. Clause 6.5 where sauna heating equipment is installed.

   d. Clause 6.4 for fountains and water features and their surrounds.

   e. Clause 6.6 recognises only one zone which comprises all the space within a refrigeration room.

   f. Clause 6.7 recognises a single zone based on the dimensions and limits of the area affected by hosing down operations at a location.

Selection of Equipment for Damp Situations

6. Equipment installed in damp situations must be fit for the purpose and additionally comply with the zoning classification designated for the particular location. Enclosures for electrical equipment in damp situations must be appropriate for the prevailing environmental conditions of the zone.

7. An International Protection (IP) rating is assigned to a particular zone. The degrees of protection provided under IP classifications uses the letters IP followed by two numbers. The first number indicates the degree of protection from contact and the second indicates the degree of protection from the ingress of liquids. For example, the classification IP56 would indicate complete protection against contact with live parts (5) and protection from water from high pressure water jets (6).

8. Appendix G of the Wiring Rules details the IP classifications and gives examples of their applications.

Delineation and Selection of Equipment for Damp Situations

1. Which Figure in AS/NZS 3000 shows the dimensions relating to the pool zone's around a swimming pool?

2. Which Figure in AS/NZS 3000 shows the dimensions relating to the ‘restricted zone' around a bath?

3. What is the minimum permissible size of equipotential bonding conductor within a pool zone?

4. Where may socket outlets be installed in a pool zone for the connection of equipment?

5. What is one method of supply for luminaires immersed in water in a swimming pool?

6. What are the installation requirements for low voltage fixed wiring that terminates in a pool zone?

7. Under what circumstances does steel fence around a pool need to be bonded to exposed metal in the pool zone?

8. Is it permissible to install socket outlets within the restricted zone of a bathroom?

9. Select an appropriate IP rating for a light switch which is to be installed in a Zone 1 area near a swimming pool.

10. How must luminaires be designed and constructed for use in refrigerated rooms?

11. What type of wiring systems are permitted where hosing-down operations are carried out?

12. The Wiring Rules detail special requirements for fountains and water features. Where do these requirements NOT apply in these situations?

13. What temperature must cables be able to withstand in Zone 3 of a sauna?

Selection of Equipment for ELV Installations

Task:

Select equipment for extra-low voltage (ELV) installations to comply with the requirements of the Wiring Rules.

Why:

All extra-low voltage (ELV) installations must comply with the wiring rules and be able to operate safely under normal operating conditions.

To Pass:

1. You must correctly answer the questions on the Work Sheets provided and achieve a mark of 75% or more in a written competency assessment.

2. You must satisfactorily complete the worksheets.

3. You must achieve 100% in a final competency test for each practical assessment.

Equipment

Samples of electrical accessories.

References

* Electrical Wiring Practice (7th ed.). – Pethebridge, K. & Neeson, I.
* AS/NZS 3000:2018 - Wiring Rules. Standards Australia
* AS/NZS 3008.1.1:2017 - Electrical installations. Selection of cables.
* WA Electrical Requirements:2014.
* AS/NZS 4836.2011 - Safe working practice on low-voltage electrical installations
* Code of Practice for Persons working on or near energised electrical installations (2018). WA Office of Energy.

Selection of Equipment for ELV Installations

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

AS/NZS 3000:2018 - Wiring Rules

Clause 1.4.128 Voltage (definition)
Clause 7.5 Extra low voltage electrical installations

Electrical Wiring Practice Volume 2 (7th edition)

Chapter 8 Damp Situations and other specific electrical installations
Section 8.1 Protection against electric shock – page 229

2. Read the Summaries and practise answering the questions provided on the Work Sheets. Refer to other relevant texts if you feel it is necessary.

3. Answer the questions given on the Work Sheets. Use a separate answer sheet or sheets for each Work Sheet. Note that you are required to answer ALL questions correctly, although not necessarily at the same time.

4. Complete the projects in this manual.

5. Submit your answers to the Work Sheets to your Lecturer for discussion and assessment.

Selection of Equipment for ELV Installations

1. The selection of equipment for ELV installations is based on several considerations, including:

   a. Compliance with AS/NZS 3000.

   b. Sources of extra low voltage supply:
      Separated extra low voltage SELV
      Protected extra low voltage PELV

   c. Segregation and arrangement of circuits.

   d. Voltage drop in conductors.

   e. Control and protection from overcurrent and overvoltage.

   f. Special considerations of types of plugs and sockets.

   g. Types of wiring systems.

Voltage Range

2. Clause 1.4.128 of the Wiring Rules defines extra low voltage as 'Differences in potential normally existing between conductors and between conductors and earth as not exceeding 50 volts a.c. or 120 volts ripple-free d.c.

3. Persons carrying out electrical work at ELV do not require to be licensed under the Electricity (Licensing Regulations 1991) as these voltages are considered to be less likely to create hazards such as severe electric shock or damage to property.

Separated Extra-low Voltage Installations (SELV)

4. Clauses 7.5.2 to 7.5.5 require SELV installations to make provision for:

   a. Supplies to be electrically separated from the main source of supply. The sources may be from an isolating transformer or from completely separate supplies such as a battery, generating set or certain electronic supplies.

   b. Electrically separated sources of supply which are not connected at any point to earth.

   c. Additional protection for voltages exceeding 25 V a.c. or 60 V ripple-free d.c.

Protected Extra-low Voltage Installations (PELV)

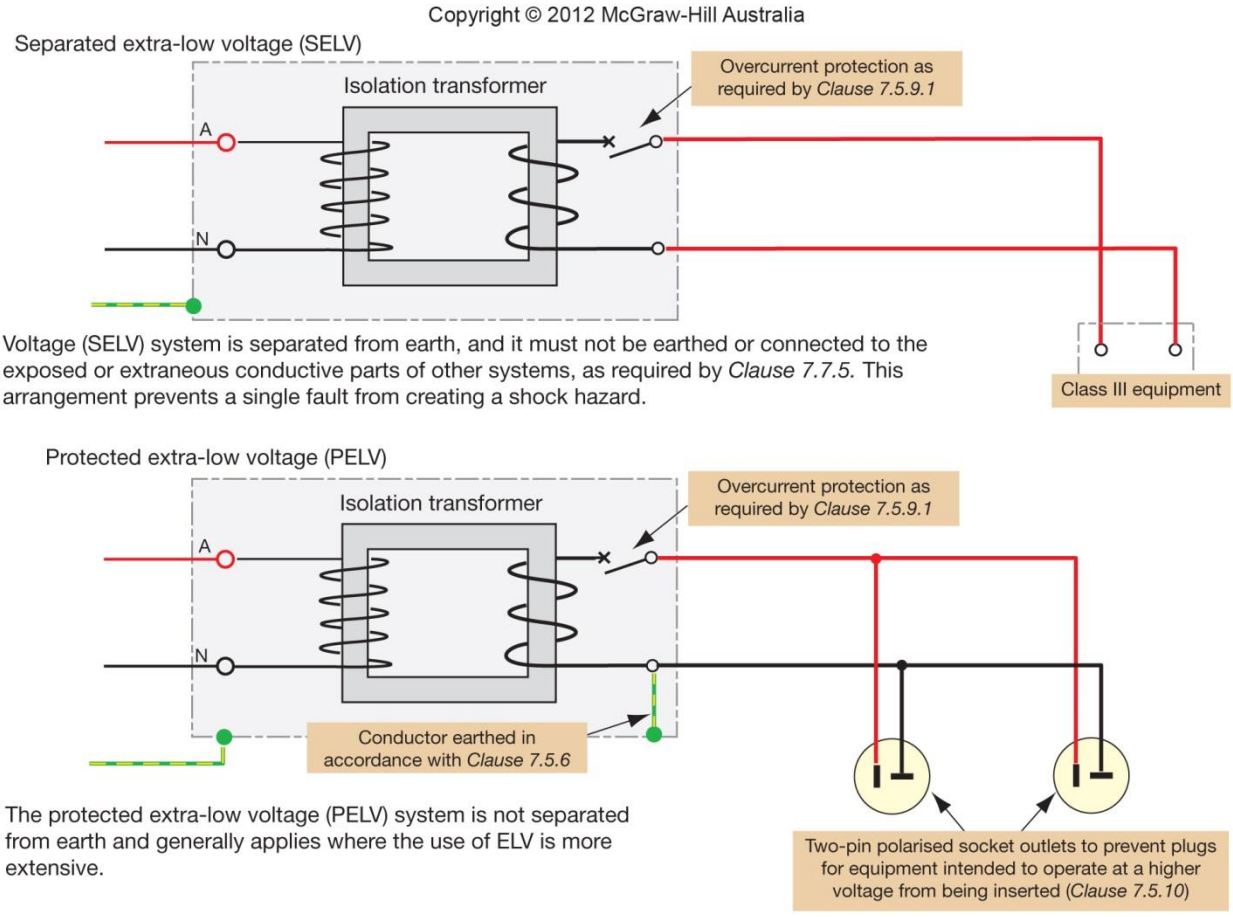
5. Clauses 7.5.2 to 7.5.4 and 7.5.6, of the Wiring Rules require PELV installations to make provision for:

   a. Electrically separated sources of supply as for SELV systems above.

   b. Where connected to earth, separation of circuits is not required.

   c. Additional protection from direct contact is required where deemed necessary.

Comparison of SELV and PELV Power Systems



Voltage Drop

6. Clause 7.5.7 of the Wiring Rules requires the volt drop not to exceed 10% of the nominal value of the voltage when the circuit is operating at its normal operating current.

Plugs and Sockets

7. The selection of ELV equipment such as plugs and sockets must be made consistent with the assigned voltage and type of equipment being installed. Clause 7.5.10 of the wiring rules requires that:

   a. Plugs shall not be able to enter socket outlets of other voltages.

   b. A socket outlet shall not accept plugs of other voltages.

   c. Socket outlets must not have a contact for a protective earth wire.

Wiring Systems

8. Conductors and insulation of cables for ELV installations shall be suitable for the purpose and need not be further protected unless installation conditions so demand – see Wiring Rules Clause 7.5.11.

9. Clause 3.9.8.3 of the Wiring Rules gives the requirements for segregation of circuits of different voltage levels.

Selection of Equipment for ELV Installations

1. What is meant by SELV and PELV?

2. Is it permissible for SELV circuits to be connected to earth? Give the Wiring Rules Clause number.

3. What is the maximum allowable voltage drop for conductors in ELV installations?

4. List three requirements for plugs and sockets used in ELV installations.

5. How far must ELV cables be buried in the ground? Give the Wiring Rules clause number.

6. Which clause in the Wiring Rules specifies requirements for installing ELV cables in the same wiring enclosure as low voltage cables?

7. Is it permissible to install a standard 240 volt 10 amp three flat-pin socket outlet to supply a 12 volt garden light in a domestic installation? Give the Wiring Rules Clause number.

Installation Test Documentation

Task:

To complete the documentation necessary to report results of an installation test to the supply authority in WA.

Why:

You must be able to report the results of safety tests on an installation to the supply authority before the installation can be connected to the supply.

To Pass:

You must correctly answer the questions on the Work Sheets provided and achieve a mark of 75% or more in a written competency assessment.

Equipment

Sample Energy Safety documentation

References

WA Electrical Requirements, 2014
WA Electricity (Licensing) Regulations, 1991

Installation Test Documentation

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

Electricity (Licensing) Regulations 1991

Regulation 51	Preliminary notice
Regulation 52	Notice of completion
Regulation 53	Work other than by electrical contractors and unlicensed persons
Regulation 54	Signing of notices

Note: The notices are available from Office of Energy and Western Power offices.

2. Read the Summary and answer the questions provided on the Work Sheet(s). Use a separate answer sheet or sheets for each Work Sheet. Refer to other relevant texts if you feel it is necessary.

3. Submit your answers to the Work Sheets to your Lecturer for discussion and assessment.

Installation Test Documentation

1. The WA Electricity (Licensing) Regulations 1991 require an electrical contractor to submit a Preliminary Notice at least 3 working days before notifiable electrical installing work is commenced, and a Notice of Completion within 3 days of completion of the electrical work. It is important to document design and installation details so that they can be traced back to their source in the event of a query at some time in the future. The completed Notices must be forwarded to the relevant electricity network operator.

2. Pads of matched, individually numbered forms are available from the WA Office of Energy Safety or a District Office on request. The serial number of a Notice of Completion must match the serial number of the Preliminary Notice for the same electrical installing work.

3. The certification of electrical work must include all parts associated with supply of electricity in the particular installation. The signature and A Grade Electrical Mechanic's licence number of the person who declares that the installation meets the relevant requirements is required on each type of form. Apprentices, licensed electrical fitters, permit holders and restricted licence holders are not permitted to sign the checking and testing declaration on Completion Notices.

Note:

"Notifiable work" means electrical installing work other than:

a) Maintenance work, unless that work requires the disconnection and reconnection of the supply of electricity to the electrical installation concerned or the replacement of service apparatus; or
b) The alteration of a final sub-circuit; or
c) The addition of a single final sub-circuit

Preliminary Notice/Notice of Completion

4. Preliminary Notices and Notices of Completion are issued in pads of serially numbered matching sets, together with adhesive-backed Installation Test Certificates. The general instructions for completing the forms are on the back of the front cover.

5. Each Preliminary Notice (green) has a matching Completion Notice (yellow) and a white file copy of the Completion Notice. Copies of each of the pages which make up the pads (including the instructions inside the front cover) are reproduced on the pages which follow in the following order:

   a Instructions for Preliminary Notices/Notice of Completion
   b. Preliminary Notice (green on originals).
   c. Completion Notice (yellow on originals).
   d. Installation Test Certificate.

Preliminary Notice (green on originals)

Government of **Western Australia**
Department of **Commerce**
Energy*Safety*

Preliminary Notice

No. 3218601

This Notice must be completed and sent to the relevant network operator at the required time, as prescribed in the *Electricity (Licensing) Regulations 1991.*

1 Details of installation, network operator and retailer

New Installation (tick)		Alteration/Addition (tick)	

Owner/occupier Name: _____ Telephone: _____			Builder Name: _____ Telephone: _____		Meter No. (if existing)
Lot No.	Unit No.	Street No.	Street name	Suburb/Town	Post code
Directions to location (please provide sufficient information)				GPS location (where remote)	
Network operator (name)		Ref No.	Electricity retailer (if new connection)	Customer Ref No.	

2 Details of completed electrical work (Circle installation type; indicate number of items in each category unless indicated otherwise)

Domestic	Commercial	Industrial	Mine site	Construction/ demolition site	Unmetered supply	Other	Single phase 240v	Single phase 480v	Three phase LV	LV CT metering	High Voltage	Overhead supply	Underground supply

Work scope		Substations		Consumers mains		Main switchboards		Distribution boards		Sub-mains		Final sub-circuits	
No. of units		Hazardous areas? (Y/N) (details in comments)		No. of points of supply (WAER s3.6)		Alternative supply? (e.g. generator, PV)		No.		Type		Rating	
Lighting points		10 amp socket outlets		>=15 amp socket outlets		Water heaters		Stoves/ovens/ hotplates		Motors (No., kW)		Calc. maximum demand (amps)	
Pool/spa equipment		Air conditioning/ refrigeration equip		RCDs		Smoke alarms		Other fixed electrical equipment		Type, kW		Consumers mains size (sq mm)	

Work description & comments:

3 General information (Please circle. If "Yes" to any of the questions, provide details)

Is there any electrical work for which you are not responsible?	Yes	No	If "Yes", provide details:
Is network operator attendance at site required?	Yes	No	

Please do not write in this area

For submission of Preliminary Notice:

Nominee Name: _____

Nominee Signature: _____

Date: _____

Details of electrical contractor / in-house electrical installer

Business Name:

Business Address:

Phone Number:

Email Address:

Facsimile Number:

EC/IH Licence No ____ ____ ____ ____ ____ ____ ____

(Show EC or IH Prefix):

Preliminary Notice – Original – Network Operator Copy

VERSION 2

ESWA E001 0915

Completion Notice (yellow on originals)

Government of **Western Australia**
Department of **Commerce**
Energy*Safety*

Notice of Completion No. 3218601

This Notice must be completed and sent to the relevant network operator at the required time, as prescribed in the *Electricity (Licensing) Regulations 1991*.

1 Details of installation, network operator and retailer

New Installation (tick)		Alteration/Addition (tick)	

Owner/occupier Name: _____ Telephone: _____			Builder Name: _____ Telephone: _____		Meter No. (if existing)
Lot No.	Unit No.	Street No.	Street name	Suburb/Town	Post code
Directions to location (please provide sufficient information)				GPS location (where remote)	
Network operator (name)		Ref No.	Electricity retailer (if new connection)	Customer Ref No.	

2 Details of completed electrical work (Circle installation type; indicate number of items in each category unless indicated otherwise)

Domestic	Commercial	Industrial	Mine site	Construction/ demolition site	Unmetered supply	Other	Single phase 240v	Single phase 480v	Three phase LV	LV CT metering	High Voltage	Overhead supply	Underground supply

Work scope		Substations		Consumers mains		Main switchboards		Distribution boards		Sub-mains		Final sub-circuits	
No. of units		Hazardous areas? (Y/N) (details in comments)		No. of points of supply (WAER s3.6)		Alternative supply? (e.g. generator, PV)		No.		Type		Rating	
Lighting points		10 amp socket outlets		>=15 amp socket outlets		Water heaters		Stoves/ovens/ hotplates		Motors (No., kW)		Calc. maximum demand (amps)	
Pool/spa equipment		Air conditioning/ refrigeration equip		RCDs		Smoke alarms		Other fixed electrical equipment		Type, kW		Consumers mains size (sq mm)	

Work description & comments:

3 General information (Please circle. If "Yes" to any of the questions, provide details)

Is there any electrical work for which you are not responsible?	Yes	No	If "Yes", provide details:
Is network operator attendance at site required?	Yes	No	

4 Certification of electrical installing work (Please circle)

a) Are you aware of any parts of the electrical installation that do not meet the requirements of the *Electricity (Licensing) Regulations 1991* or are unsafe?	Yes	No	If "Yes", provide details:
b) Does the installation fully comply with Part 2 of the "Wiring Rules" (and therefore a 'Part 1 solution' has not been used)?	Yes	No	If "No", provide details:
c) Has the electrical installing work subject of this Notice been connected to the electricity supply?	Yes	No	If "Yes", provide date installation connected and energised:
d) If not connected to electricity supply, is the electrical installing work subject of this Notice safe and ready to be connected?	Yes	No	If "No", provide date work completed and why it cannot be connected:

e) The electrical installing work subject of this Notice has been checked and tested and found to comply with the *Electricity (Licensing) Regulations 1991*, by the following electrician:

Name (please print): _____ EW ___ ___ ___ ___ ___ ___ Date tested: ___ / ___ / ___

f) I certify that:
i) this Notice has been duly completed;
ii) the electrical installing work subject of this Notice has been completed; and
iii) any such electrical installing work carried out by an electrical worker or workers complies with the *Electricity (Licensing) Regulations 1991*.

For submission of Preliminary Notice:
Nominee Name: _____
Nominee Signature: _____
Date: _____

Details of Nominee
Surname: _____ (Please Print)
Signature: _____
EW Licence No: EW ___ ___ ___ ___ ___ ___
Date (Notice of Completion): _____

Details of electrical contractor / in-house electrical installer
Business Name:
Business Address:
Phone Number:
Email Address:
Facsimile Number:
EC/IH Licence No ___ ___ ___ ___ ___ ___ ___ ___
(Show EC or IH Prefix):

Notice of Completion – Original – Network Operator Copy

VERSION 2

ESWA E001 0915

INSTALLATION TEST CERTIFICATE

Installation Address _____

I confirm that I have carried out the checks and tests of this electrical installation as required by the Electricity (Licensing) Regulations 1991.

_____
Signature of "A" Grade Electrical mechanic

_____
Date E.W. Licence No.

This work has been carried out for and on behalf of

Electrical contractor's name and licence No.

Note: 1. The Electrical Mechanic is responsible for the issue of this Test Certificate.
2. This Test Certificate is to be fixed to the inside of the meter enclosure.

DON'T MEDDLE WITH ELECTRICITY -
ALWAYS USE A LICENSED ELECTRICAL CONTRACTOR

Electrical Safety Certificate

Regulation 52B of the *Electricity (Licensing) Regulations 1991* requires an electrical contractor who carries out **any** electrical installing work to complete a certificate of compliance. The certificate of compliance (Electrical Safety Certificate) must be provided to the customer within 28 days of completion of the work. Copies of electrical safety certificates are to be retained by the electrical contractor for a period of five years. Copies of electrical safety certificates are not to be sent to the Network Operator.

Sample of correctly completed Electrical Safety Certificate

Department of Consumer and Employment Protection
EnergySafety

Approved Form – Issued July 2008

ELECTRICAL SAFETY CERTIFICATE

Electricity (Licensing) Regulations 1991, Regulation 52B

This certificate warrants that the electrical installing work described below is safe and complies with the *Electricity (Licensing) Regulations 1991*.

This Electrical Safety Certificate is the certificate of compliance referred to in Regulation 52B of the *Electricity (Licensing) Regulations 1991*. This regulation requires that the electrical contractor/authorised[1] electrician completing electrical installing work must, within 28 days of completing the work, provide a certificate of compliance in respect of the work to the person for whom the work was carried out.

Installation details

Owner/Occupier Name	H Bryant	Meter No.	N/A
Address	159 Anstey Street, South Perth		
New Installation (Y/N)	Y	Alteration/Addition (Y/N)	N
Other			

Details of work completed (indicate a number/rating where relevant)

General description of the work: Whole of installation except for air-conditioners and pool installation.

The following detailed information MUST ALSO be provided – indicate the number or rating in each category

Lights	23	Water Heaters	2
Socket Outlets	19	Motors	0
Cooking Appliances	2	Air Conditioners	0

Details of any defects observed (alterations and additions only)

N/A

Certification by authorised[1] electrician who completed the work

I certify that the electrical installing work that is subject of this certificate has been completed, checked and tested and, at the time of testing, met the requirements of the *Electricity (Licensing) Regulations 1991* and is safe.

Name (please print)	HARRY JAMESON
Signature	H Jameson
Licence No.	EW 2034 12

Details of electrical contractor

Licence No.	EC 009897
Business Name	XYZ ELECTRICAL
Business Address	206 BROADWATER GARDENS SOUTH LAKE
Phone No.	0417 942 919
Facsimile No.	9287 3090

Date: 01/07/08

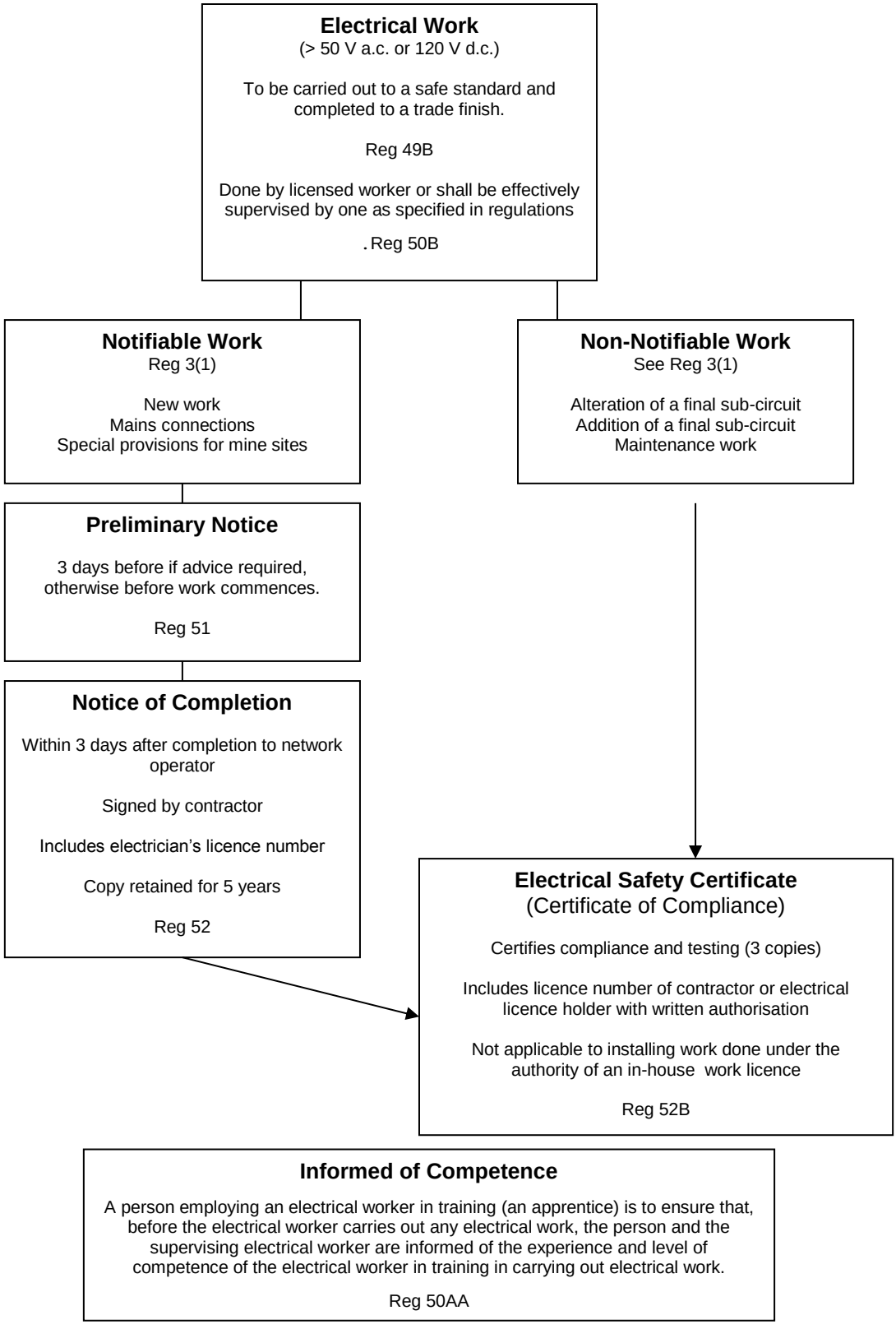
[1] Authorised pursuant to Regulation 52B(5) of the *Electricity (Licensing) Regulations 1991*

CUSTOMER COPY

SAMPLE

Electrical Work Documentation Summary

See Electricity (Licensing) Regulations 1991 (As amended August 2008)



Installation Test Documentation

1. What are the names of the two documents which must be submitted to the Supply Authority in relation to a new domestic electrical installation?

2. What is the name of the document which must be submitted to the Client if an additional single phase socket outlet is installed in a typical domestic installation?

3. How many working days before a new electrical installation is commenced must the Preliminary Notice be submitted to the Supply Authority?

4. How many working days after a new electrical installation is completed must the Completion Notice be submitted to the Supply Authority?

5. Who is required to sign the Checking and Testing/Defect Declaration on a Completion Notice - the employer or the licensed electrical worker?

6. How many working days after electrical work is completed in an electrical installation must the Electrical Safety Certificate be submitted to the person for whom the work was carried out?

7. Is a final year apprentice permitted to sign the Checking and Testing/Defect Declaration on a Completion Notice?

8. Why is it important to record details of the design and equipment used in an electrical installation?

Installation Test Documentation

Objective

To complete the necessary documentation for reporting test results to the supply authority.

Equipment

Sample Preliminary Notice.
Sample Notice of Completion.
Sample Electrical Safety Certificate.

Procedure

1. Complete the following forms using the samples given earlier in this Section. Use the results of tests you have performed during this module where possible, and add appropriate fictitious data where necessary.

   a. Preliminary Notice.

   b. Notice of Completion.

   c. Electrical Safety Certificate.

2. Submit your forms to your Lecturer for comment and assessment.

Question

1. To what address should a Preliminary Notice be sent for electrical work in the Perth metropolitan area?

   _____

   _____

   _____

Commissioning of Installations

1. Commissioning of an electrical installation is the process of systematically checking to ensure that it allows for safe operation, and that all components will operate as intended and according to specifications under all anticipated operating conditions. The electrical contractor is responsible for ensuring that all commissioning procedures have been carried out.

2. It is likely that some commissioning procedures may overlap those associated with inspection procedures (such as those involving checking the installation against the designers installation schedules) but a major distinction is that commissioning is usually done with power applied. In larger installations commissioning is usually carried out using a pre-prepared checklist. These commissioning checklists are signed by the person responsible and are retained as part of the documentation for the installation.

3. Commissioning procedures must be effectively coordinated with others on the worksite. All required materials, plans, tools, instruments, specifications and schedules must be available during the process. Preparatory work must be checked to ensure that no unnecessary damage has occurred and that it complies with specified requirements such as statutory regulations, codes of practice, procedures and work instructions, quality assurance systems, manufacturers' specifications, circuit/cable schedules, customer/client requirements and national and state guidelines, and policies relating to the environment.

4. Any preparatory work must be checked to ensure that no unnecessary damage has occurred and complies with the specified requirements for the installation. All occupational health and safety policies and procedures must be followed such as work clearance procedures, isolation procedures, gas and vapour precautions, monitoring/testing procedures, use of protective equipment and clothing, risk assessment mechanisms and use of codes of practice. There must be no damage or distortion to the surrounding environment or services.

5. Circuits must be checked to ensure that they are isolated where necessary using specified safe testing procedures. Unplanned events or conditions must be responded to in accordance with established procedures such as work orders/instructions, reporting procedures, improvement mechanisms, compliance requirements, safety management and OH&S practices.

6. Final inspections and performance checks against specifications must be undertaken to ensure that all equipment forming a component part of the installation is safe, functional and complies with the specifications and all mandatory requirements.

7. Completion of the commissioning process must be reported to the supervisor in accordance with established procedures, and may include verbal, written, electronic or recorded information. Commissioning usually occurs after all mandatory inspection and testing requirements have been met.

8. The following outline commissioning checklist indicates the types of activities that may be required before the installation is handed over to the owner.

Commissioning Checklist

Installation		Address	
Specification		Supervisor	
Electrician		Date	

Item	Operational Check	Remarks	Completed
1	Voltage levels		
2	Phase rotation at outlets		
3	Electric motor direction		
4	RCD check		
5	Isolating devices		
6	Lighting operation		
7	Power outlet operation		
8	Apparatus operation		
9	Systematic loading up		
10	Fire alarm systems		
11	Emergency lighting		
12	Public address systems		
13	Communication systems		
14	Data services		
15	Multiway lighting		
16	Emergency evacuation system		
17	Safety interlocks		
18	Signage		
19	Voltage drop		

Signed: _____ ABC Electrics

Owner notified on _____

Commissioning Installations

1. Who is responsible for ensuring that commissioning has been carried out on an installation?

2. What is the general distinction between commissioning and testing an installation?

3. List three examples of general occupational health and safety policies which need to be followed during the commissioning process.

4. What type of unplanned event may occur which may require an electrician to respond by referring back to his/her supervisor during the commissioning process?