Government of Western Australia
North Metropolitan TAFE

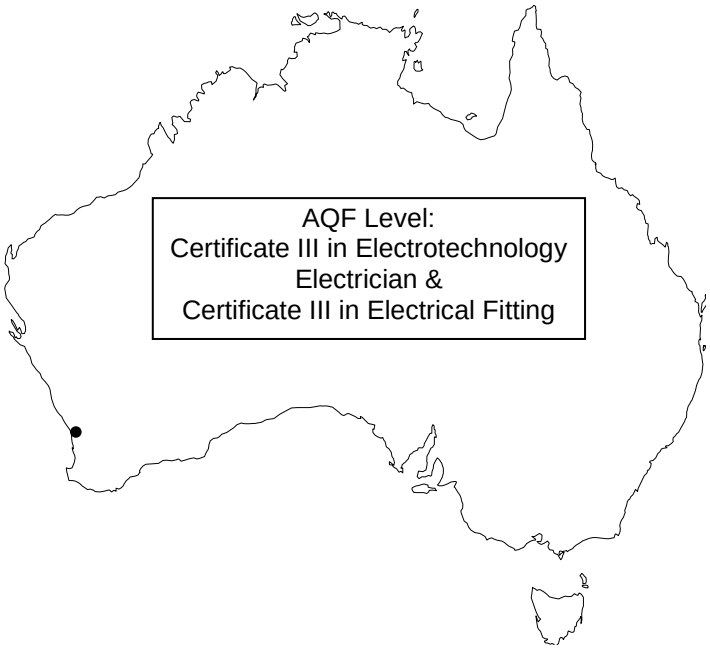
UEE 11 Training Package Support Material
(Non-Endorsed Component)

Based on:
National Electrotechnology Industry Standards

Resource Book

UEENEEE137A

Document and apply measures to control OHS risks associated with electrotechnology work



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North Metropolitan TAFE

Version 6

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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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C O N T E N T S

Training Achievement Record:

Activity	Topic	Completed
Sheet 1-1	Risk Management	
Activity 1-1	Risk Assessment Survey & Isolation procedure	
Sheet 2-1	Electrical Supplies	
Sheet 3-1	High Voltage Supplies	
Sheet 4-1	Test Equipment	
Activity 4-1	Use of Test Equipment	

References

- AS/NZS 4836 (Current edition) Safe working practices on low voltage electrical installations
- Code of Practice for Persons working on or near energised electrical installations. (Energy Safety WA)
- Safe working guidelines for electrical workers: March 2018 (Energy Safety WA)
- AS/NZS 3000 (Current edition) – Wiring Rule (Standards Australia)
- AS/NZS 3008.1.1 (Current edition) – Electrical Installations- Selection of Cables
- WA Electrical Requirements (Current edition)
- Guidelines for the Safe Management of High Voltage Electrical Installations: April 2014 (Work Safe)
- The Occupational Safety and Health Regulations 1996 (WA).
- AS 1470 (Current edition) – Health and Safety at Work-Principles and Practices.
- Electrical Wiring Practice (7th ed.) Pethebridge, K. & Neeson, I.
- Guidance note - Working in roof spaces 2018 (Worksafe WA)

Notes

Competency Standard Units
UEENEEE137A Document and apply measures to control OHS risks associated with electrotechnology work

Prerequisite Unit(s)

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

UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace

ELEMENT		PERFORMANCE CRITERIA	
1	Identify and document hazards and risks.	1.1	Hazards are identified the appropriate persons involved and in accordance with compliance procedures. Note: Typically this will relate to such things as: The type of job, Electrical conditions, Energy levels, Radiation levels, Toxic substances, Airborne particles, Pressure discharge, Explosive atmosphere, Work-site location, General work-site conditions, Specific work location, Moving parts, Tools and equipment, Workers competence and/or capacity and/or personal effects
		1.2	Risks associated with identified hazards are determined in consultation with others and documented in accordance with compliance procedures.
		1.3	Provision is made to accommodate changes to documentation should unforseen hazards be identified.
2	Assign levels of risk and develop and document control measures.	2.1	Level of risk is assigned for each identified hazard in accordance with the regulations and following compliance procedures.
		2.2	Control measures are developed for hazard, level of risk and activity to eliminate and/or mitigate the risk following compliance procedures.
		2.3	Hazard, level of risk and control measures are agreed to and documented in consultation with all involved in accordance with compliance procedures.
3	Monitor and review the control measures.	3.1	Documented control measures are made available for reference by all involved with the work.
		3.2	Control measures are modified where required in consultation with all involved with the work in accordance with compliance procedures.
		3.3	Documentation of hazards, risk control measures and their application are filed in accordance with compliance procedures.

Required Skills and Knowledge

KS01-EE137A	Risks and control measures for dealing with workplace hazards

Evidence shall show an understanding of risks and control measures for dealing with workplace hazards to an extent indicated by the following aspects:

T1 Risk management and assessment of risk encompassing:

- Principle and purpose of risk management, and
- Processes for conducting a risk assessment
- Hazard identification by job analysis and work-site inspections
- Recording hazards and assessing the risk.

T2 Hazards and risks and control measures in working on construction sites encompassing:

- Hazards include manual and mechanical handling; working at heights; working in confined spaces; noise; dusts, gases, chemicals.

T3 Hazards associated with extra-low voltage, low-voltage and high-currents encompassing:

- Arrangement of power distribution and circuits in electrical installations
- Parts of an electrical system and equipment that operate at low-voltage and extra-low voltage,
- Parts of an electrical system and equipment where high-currents are likely.

T4 Hazards and risks and control measures associated with high-voltage encompassing:

- Parts of an electrical system and equipment that operate at high-voltage,
- The terms ‘touch voltage’, ‘step voltage’, ‘induced voltage’ and ‘creepage’ as they relate to the hazards of high-voltage
- Control measures used for dealing with the hazards of high-voltage.

T5 Hazards and risks and control measures in working with low voltage equipment encompassing:

- Risks in modifying electrical installations, fault finding, maintenance and repair.
- Control measures before, while and after working on electrical installations, circuits or equipment.
- Isolation and tagging-off procedures.
- Risks and restrictions in working live.
- Control measures for working live.

T6 Hazards and risks and control measures associated with harmful, devices, materials, gases, dusts and airborne contaminant encompassing:

- Harmful devices: gas touches, welding equipment, laser equipped devises and the like.
- Harmful materials: gases (refrigerants) and some industrial cleaning agents, fibres of optical cable, thermal insulation
- Harmful airborne contaminants: fibres of thermal insulation, fibres of optical cable, fibrous cement materials, asbestos and other fibres in insulation materials.

T7 Determine the degree of the risk encompassing:

- The three recognised levels of risk are:
- High (potential to kill or permanent disability);
- Medium (potential to cause an injury or illness of a permanent nature);
- Low (potential to cause a cause minor injury requiring first aid but no permanent disability)

T8 Use control measures to eliminate or control the risk encompassing:

- Hierarchy of control measures are:
  - eliminate the risk by discontinuing the activity.
  - control the risk by redesigning the equipment
  - adopt administrative procedures
  - use of personal protective equipment.
- Control measures are formally documented in Job Safety Analysis (JSAs) or Safe Work Methods (SWMs).

T9 Engaging in monitoring and reviewing processes to ensure control measures remain valid.

E137A Work Performance Tasks:

UEENEEE137A – Document and apply measures to control OHS risks associated with electrotechnology work

Assessment Items In judging work performance it is critical that a sufficient body of evidence undertaken, repeatedly and with currency, across a range of representative activities and work functions be present in order that a valid, reliable, fair and timely judgment about an individual's performance can be made. Accordingly, in relation to this specification it is essential that an holistic approach is adopted to the gathering of evidence. The process should encompass the gathering of the following required items to assist the assessment process, and which are in accord with the Training Package Assessment Guidelines:

1. Performance requirements:

1a. Related to the following elements:
1. Identify and document hazards and risks
2. Determine risk class and document control measures.
3. Monitor and review the control measures.

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. Range:
This Work Performance Specification shall be demonstrated in relation to:
• Relevant occupational health and safety legislation, regulations and codes of practice related to electrical devices and systems and hazards present in domestic, commercial and industrial buildings, and
• Accepted industry work procedures and the specific safety procedures and work instructions for a particular workplace.

3. 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 All of the following	**Documenting and recording**	• Identifying and recording hazards • Assessing the risks • Documenting control measures (JSAs) • Reviewing and documenting variations • Recording activities • Dealing with unplanned activities

4. Techniques:
Applying techniques, procedures, information, and resources relevant to performance.

5. To requirements:
To requirements means, conformance of equipment and procedures, and their outcomes to such. It includes statutory obligations and regulations and standards called-up by legislation or regulations. Typically requirements include but are not limited to:

- statutory acts and regulations, including any licensing or registration arrangements
- codes of practice
- industry guidelines and standards
- standards called-up in specifications be they Australian/New Zealand or International
- work permits, isolation orders, job safety analysis
- job specifications
- procedures and work instructions
- quality assurance systems
- manufacturers' specifications
- maintenance manuals, schedules and specifications/standards
- sustainable energy principles and practices
- transport documentation
- skills enabling employment
- drawings and/or circuit/cable schedules
- design specifications
- customer/client requirements and specifications
- specified essential knowledge and associated skills (EKAS) (specified in units' Required Skills and Knowledge) section of the competency standard unit
- responding to an unplanned event by drawing on essential knowledge and associated skills to provide appropriate solutions
- National and State guidelines, policies and imperatives relating to the environment

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**.**

Learning and Assessment Plan

UEENEEE137A Document and apply measures to control OHS risks associated with electrotechnology work

Name of Lecturer: _____

Contact Details: _____

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

Using:

Session	Nominal Duration	Program of Work (Topics to be covered)	Primary Reference
1	1 hour	Introduction to Unit –outlining requirements	Resource Book
2	4 hours	Section 1 – Risk Assessment & worksheet	Resource Book & AS/NZS 4836
3	1 hour	Section 1 – Risk Assessment Survey	Activity Sheet 1-1 & JSA Worksheet
4	4 hours	Section 2 – Electricity Supplies	Resource Book
5	4 hours	Section 3 – High Voltage Supplies	Resource Book & WAER
6	2 hours	Section 4 – Test Equipment	Resource Book
7	1 hour	Written Assessment	KS01-EE137A
8	1 hour	Observed Practical Assessment	

I acknowledge that I have received and read this Learning 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 will provide the required skills and knowledge outlined in this Unit and assist you in achieving competency.

Assessment Methods:

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

Observed Practical Assessment – based on the Elements and Performance Criteria of this Competency Unit UEENEEE137A. You must achieve a mark of 100% in this assessment.

On-Job-Training:

It is expected that the off-job component of this competency unit 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: _____

Danger Tag Procedure

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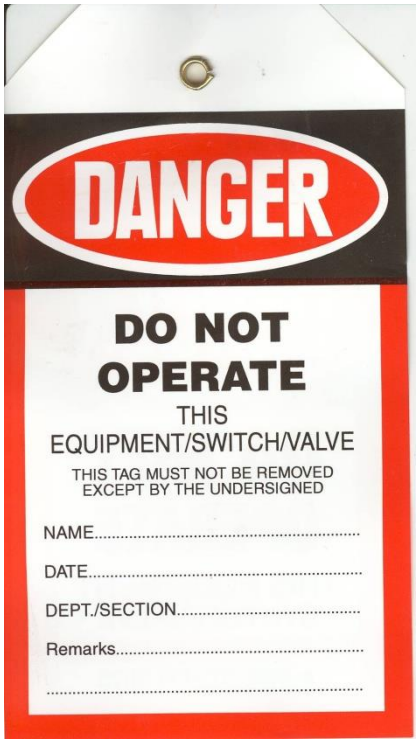
Use of Danger Tags

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 Unit of Competency – UEENEEE137A

Student's Signature _____ Date: _____

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 1 Introduction	E137A SGB 01/2014

Risk Management

Task:

Describe the general principles of risk management and risk assessment in an electrotechnology industry environment.

Why:

A detailed knowledge of risk management in electrical work is essential to avoid electrical accidents, unwanted fire and damage to property.

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 assessment based on the required skills and knowledge of UEENEEE137A.

2. You must satisfactorily complete the set activities and laboratory tasks.

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

Equipment:

Nil

References:

* AS/NZS 4836 (Current edition) Safe working on low voltage electrical installations.
* Electrical Wiring Practice (7th ed.) Pethebridge, K & Neeson, I Volume 1
* Safe working guidelines for electrical workers: March 2018 (Energy Safety WA)
* Code of Practice. Safe Low Voltage Work Practices by Electricians. EnergySafety WA.
* Code of Practice for Persons working on or near energised electrical installations. Energy Safety
* The Occupational Safety and Health Act 1984 (W.A.).
* The Occupational Safety and Health Regulations 1996 (W.A.).
* AS 1470,(Current edition) Health and Safety at Work. – Principles and Practices.
* Guidance note - Working in roof spaces 2018 (Worksafe WA)

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 1 Study Guide	E137A SGB 01/2014

Risk Management

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

Electrical Wiring Practice (7th ed.) Pethebridge, K, & Neeson, I.

Volume 1 Chapter 2 Workplace and Electrical Safety
- Section 2.1 Occupational/workplace health and safety
- Section 2.2 Workplace hazards and risk control methods

AS/NZS 4836:2011 Safe working on low voltage electrical installations.

- Section 2 Principles of Risk Management and Assessment of Risk
- Section 3 Risk Treatment
- Section 4 Re-energization of Electrical Installations and Equipment
- Section 5 Safety equipment and tools
- Section 6 Safety observers

Code of Practice for Persons working on or near energised electrical installations. EnergySafety WA

1 Scope of this Code
2 Definitions
3 Responsibilities
4 Work on electrical installations – de-energised work
5 Carrying out electrical work on or near energised electrical installations
- 5.1 Summary of requirements before electrical work is carried out
- 5.2 Risk Assessment
- 5.3 Assessment by a competent person
- 5.4 Safe work method statement (SWMS)
- 5.5 Tools and equipment
- 5.6 Safety barriers
- 5.7 Safety signs
- 5.8 Safety observers
- 5.9 Completion of work
- 5.10 Leaving work unfinished
- 5.11 Emergency planning

The Occupational Safety and Health Act 1984(W.A.) Sections 19 & 20.

2. Read the Summary and practise answering the questions provided on the Work Sheet. 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 laboratory projects in this Section.
5. Submit your answers to the Work Sheets and your completed Activity Sheets to your Lecturer for discussion.

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 1 Summary	E137A SGB 01/2014

Risk Management

1. Electricity is a generally regarded as an indispensable part of modern domestic industrial and commercial life. It is around us all the time in some form. In most cases electricity cannot be seen directly, but its effects can be seen in the form of lighting devices, heating devices, electric motors and so on. The electricity produced by supply authorities or network operators is at voltages high enough to cause death by electrocution if a person or animal comes in contact with a live part under some circumstances.

2. Electricity can also cause fire, explosions or damage to sensitive equipment if the potential hazards are not recognised and managed. All electrical workers have a legal responsibility to protect themselves and others from the risks associated with the potentially hazardous effects of electricity in the workplace.

3. The most common situations in which there is a risk of electrocution, fire or damage to property are:

   a. A person or animal coming in direct contact with a live part.
   b. A person coming in contact with a part which has become live as a result of an electrical fault condition (indirect contact).
   c. A person coming too close to a high voltage part.
   d. A person handling a sensitive electronic component without observing adequate precautions.
   e. Allowing a spark to occur in a flammable or explosive environment.
   f. Allowing electrical devices to operate under conditions outside their designed capabilities.
   g. Switching an electrical device OFF when it is in a condition where stored energy cannot be released normally.
   h. Disabling or by-passing electrical protective equipment.
   i. Failing to use the correct testing and isolation procedures before working on an electrical component.

4. In general, to work on or near electrical equipment it is first necessary to determine whether it is safe to do so. If risk assessment has indicated that risks cannot be sufficiently controlled or eliminated to enable the work to be done safely on or near electrical equipment, then work must not proceed. A typical job safety analysis (JSA) form (Also referred to as a SWMS) is shown at the end of this section.

Principles of Risk Management

5. The general principles for the management of risks associated with the use of electricity are:

   a. Identify the hazard.
   b. Assess and prioritise the risks.
   c. Apply control measures to the identified risks.

Hazard Identification

6. For the purposes of this CSU, hazards in the workplace can be classified in general as either electrical or non-electrical. Electrical hazards are those which can result in:

   a. Electrocution (by direct contact, indirect contact under fault conditions, or coming too close to high voltage equipment.
   b. Fire, explosions, flashes or burns.
   c. Damage to property due to the effects of current flow or the unintended interruption to current flow.

7. AS/NZS 4836:2011 identifies several typical sources of electric shock which may be encountered in the workplace (see Clause 2.3.2), for example:

   a. Voltages between phases and between phases and neutral.
   b. Voltages between phases and earth.
   c. Voltages across open switch contacts.
   d. Voltages across undischarged capacitors e.g.EMI filters.
   e. Voltages on disconnected conductors (particularly neutrals).
   f. Voltages caused by static electricity.
   g. The rise in earth potential in MEN systems.
   h. Induced voltages.
   i. Voltage across secondary terminals of transformers, including current transformers.
   j. Voltages between different earthing systems.
   k. Incorrect wiring connections.
   l. Faulty equipment.
   m. Voltages from other sources.
   n. Lightning.
   o. Breaking of the continuity of the incoming water supply.
   p. Voltages triggered inadvertently through the operation of switches, thermostats etc
   q. Penetration with tools or fixings of structures containing concealed conductors.

8. Non-electrical hazards are any other situation where failure to use appropriate procedures or equipment can result in injury to people or animals, or damage to property. Typical general types of hazards are listed below under six general headings:

   Physical

   Machines
   Dust
   Flammable materials
   Heat and cold
   Noise
   Vibration
   Inadequate lighting
   Working space
   Vehicles
   Adequate personal protection
   Ladders
   Scaffolding
   Elevated work platforms

Chemical
- Gases
- Fumes
- Solvents
- Chemicals
- Liquids

Ergonomic
- Tool design
- Equipment design
- Workstation design
- Materials handling techniques
- Repetitive tasks

Radiation
- Ultra-violet radiation (welding)
- Microwaves
- Electro-magnetic radiation
- X-rays
- Infra-red radiation
- Fibre-optic cable laser radiation

Psychological
- Workload
- Shiftwork
- Harassment
- Discrimination
- Dangerous environment
- Low level noise
- Mental stress

Biological
- Bacteria
- Sources of infection

Airborne contaminants

Harmful devices: gas touches, welding equipment,
laser equipped devises and the like.
Harmful materials: gases (refrigerants) and some industrial cleaning agents, fibres of optical cable, thermal insulation
Harmful airborne contaminants: fibres of thermal insulation, fibres of optical cable, fibrous cement materials, asbestos and other fibres in insulation materials

8.1 Asbestos Containing Materials

Tradespersons involved in the electrical industry may come in contact with **Asbestos Containing Materials**. It is important that they be aware of the risks especially from exposure to airborne asbestos fibres.

Asbestos is a known carcinogen. The inhalation of asbestos fibres is known to cause **mesothelioma, lung cancer and asbestosis**.

Asbestos containing materials were used extensively in Australia in the 1950s, 1960s and 1970s. Many electrical installations still contain asbestos containing materials.

These may include Air-conditioning ducts, Arc shields in electrical switchboards, Asbestos cement conduit and fuse boards, electrical heater banks, Millboard lining of switch boxes, black electrical fuse panels.

Identification of Asbestos Materials:

- **Age** - any switchboards, millboard and cement sheets pre 1988 are assumed to contain asbestos.
- **Labelling** - any boards marked (on rear of panel) 'Zelemite', 'Lebah', 'Ausbestos', etc. or with signage indicating the presence of asbestos, are assumed to contain asbestos.
- **Colour and odour** - any older black mounting boards with a smell of bitumen or coal tar are assumed to contain asbestos (asbestos has no odour but the composite binder used smells of tar).
- **Other materials** - in addition to asbestos-based electrical backing boards, other asbestos containing materials may be encountered in electrical metering installations.
- Typically, these materials include: asbestos millboard and asbestos cement (AC) sheet.
- Any cement sheet (colloquially known as 'Fibro') products encountered will be assumed to contain asbestos.
- Care should be taken to avoid disturbance of these materials.

  Note:
  Any dust encountered inside the cabinets of pre-1988 installations is assumed to be contaminated with asbestos dust.

Control measures:

1. Elimination / removal (most preferred)
2. Isolation / enclosure / sealing
3. Engineering controls
4. Safe work practices (administrative controls
5. PPE (least preferred)

Premises likely to contain asbestos should keep an accurate **register of** asbestos containing materials (**ACMs)** on the premises.

This register should be available to all tradespeople planning work activities.

Observing Safety Requirements

Safety precautions, safety equipment and procedures are of little value if the individual in the workplace ignores them or is unaware of them. You are legally responsible for your own safety and the safety of others. If you fail to observe proper safety procedures, or if you fail to take action to report or correct an unsafe situation you may be liable to prosecution - even if you are not directly involved in the work being done.

9. Several other factors can increase the hazard in specific circumstances, such as:

    a. Cramped working conditions.
    b. Confined spaces.
    c. Multiple sources of supply.
    d. Damp situations.
    e. Heat.
    f. Height.
    g. Operational pressures to carry out work or restore electricity supply.
    h. Unstable work area.
    i. Conductors or cables or equipment under tension or likely to fall.

Assessing and Prioritizing the Risks

10. All work needs to be planned and organised to minimise the risks associated with that work. The process of comparing the level of risk found during the risk analysis process with previously established risk criteria to decide whether the risk can be accepted is known as a 'risk assessment'.

11. The processes of risk identification and risk assessment need to involve all workers involved in performing the task. If risks that may have the potential to cause harm or damage are found to exist, the risks must be prioritized and appropriate control measures implemented to reduce the risks to an acceptable level

Risk Control

12. Risk control is the process of considering each hazard in turn and deciding what action is required to reduce its potential effects to an acceptable level. The sequence of events to control the hazard (known as the 'hierarchy of controls') is as follows:

    a. Eliminate the hazard, which is always the first priority, e.g. by rescheduling work to a time when it can be done de-energised).
    b. Substitution, e.g. use battery powered tools instead of mains powered.
    c. Separate the worker from the hazard, e.g. by distance or barriers.
    d. Minimise the risk through engineering
    e. Minimise the risk by administration
    f. Minimise the risk with PPE's This should not be used as the first line of defence.

13. Working near exposed energised conductors shall be considered only when an adequate risk assessment indicates that:

    a. there is no suitable alternative, and
    b. the preparations specified in Clause 3.1 of AS/NZS 4836 have been carried out.

14. Electrical safety depends upon:

    a. Appropriate job planning – Writing out a Safe work method statement (SWMS)
    b. Correct testing and isolation procedures and techniques.
    c. The use of tools, test instruments, personal protective equipment (PPE) and machinery that is fit for the purpose.
    d. The work is being carried out by competent people.

15. All electrical conductors, including earthing conductors, must be treated as energised until proven de-energised. All devices used to test for the de-energised condition must be checked for correct operation immediately before and after they are used.

Wiring Rules

16. Clause 1.5 of the Wiring Rules (AS/NZS 3000) provides information on how electrical installations must be arranged to protect users of electrical devices from the potentially hazardous effects of electricity under normal conditions.

Supervision of Trainees

17. Regulations 50 and 50 AA of the WA Electricity (Licensing) Regulations 1991, and Section 7 of AS/NZS 4836 detail supervision requirements for electrical workers.

18. Apprentices are NOT permitted to carry out live electrical work. Supervision of electrical work must be provided by a person who has a current electrical licence to carry out the work without supervision in WA.

Supervision of Electrical Apprentices

19. Electrical apprentices must be supervised!

The degree of supervision (Direct or General or Broad) requires continual assessment of an apprentice's experience and competence related to the task being undertaken. It can vary from direct to general to broad supervision, depending upon the type of work and the apprentice's progress in achieving competencies.

A gradual relaxation of supervision is logical as an apprentice develops the skills, knowledge and experience leading to a trade qualification

NOTE: Apprentices are not allowed to supervise other apprentices

Levels of supervision

20. The Electricity (Licensing) Regulations 1991 states that electrical work must be effectively supervised for the purpose of preventing danger to life and property.

21. The three levels of supervision of apprentices are defined in Regulation 50 are:

• **Direct (constant) supervision** – the personal supervision of the apprentice, at all times, on a direct (constant) basis, by a person licensed to carry out all the work without supervision. The supervising electrical worker must remain on the same work site as, and in close proximity as the apprentice.

• **General supervision** – general supervision does not require constant attendance of the supervisor. General supervision must be given by a person licensed to carry out the work without supervision. The nature of the work and the competence of the apprentice undertaking it need to be considered. Under general supervision, the supervising electrical worker must remain on the same work site, explain the task, ensure the apprentice understands the work task and carry out any isolation that may be required.

• **Broad supervision** – broad supervision does not require on-going guidance where an apprentice is carrying out familiar tasks. The supervising electrical worker does not have to remain on the same work site, but must attend the work site on a daily basis to provide initial instruction and to verify the electrical work has been carried out safely and correctly.

The following table will provide guidance to the level of supervision that an apprentice will require for the different types of work tasks during his/her on the job training.

Note: Work on any live electrical circuit or live equipment is prohibited.

Supervision Guidelines for Apprentices

Type of Work	Year of Training	Supervision Level
New electrical installations (not connected to the electricity supply)	First Year Second Year Third Year Fourth or Final Year	General General Broad Broad
Maintenance, alterations and additions to existing electrical installations. (isolated and proven de-energised by the supervising electrical worker)	First Year Second Year Third Year Fourth or Final Year	Direct General General Broad
Workshop assembly and maintenance of electrical equipment. (not connected to the electricity supply)	First Year Second Year Third Year Fourth or Final Year	General General Broad Broad
Tag and lockout procedure on de-energised installations and equipment. (isolated and proven de-energised by the supervising electrical worker)	First Year Second Year Third Year Fourth or Final Year	Direct General General Broad
Testing and fault-finding on de-energised installations and equipment. (not connected to the electrical supply or isolated and proven de-energised by the supervising electrical worker)	First Year Second Year Third Year Fourth or Final Year	Direct Direct General General
Live work	**Work on any live electrical circuit or live equipment is prohibited**	

The above information is edited from the Energy Safety Publication: *Safe working guidelines for electrical workers* (March 2018).

Consult both publications of AS/NZS 4836:2011 *Safe working on or near live low voltage electrical installations and equipment,* and the *WA Code for persons working on or near energised electrical installations,* for guidance on working near live electrical circuits or live electrical equipment.

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

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 1 Work Sheet	E137A SGB 01/2014

Isolation procedure main steps

Identify
Isolate
Verifies tester.
Checks for zero volts.
Re-checks tester.

Isolation Procedure for a given scenario

#	Action	
1	Advise the supervisor that power is to be disconnected and negotiate a convenient time.	
2	Identify the machine and switch it off at the isolating switch adjacent to it.	
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 (usually a multimeter) to see that it is working properly on a known voltage source.	
7	Test for zero volts at the motor terminals. Test between all actives, from all actives to neutral, and from all actives to earth.	
8	Re-check the test instrument to see that it is still working properly.	
9	Double check all conductors using a phase pencil or voltage stick.	
10	Disconnect all terminals and remove the cables from the motor.	
11	Insulate all disconnected terminals with tape and leave them in a safe and tidy condition.	
12	Remove the motor from its mounting.	
13	Change Danger tags to out of service tags if task is not completed by end of shift	
14	Advise the supervisor that the work is completed	

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 1 Work Sheet	E137A SGB 01/2014

Risk Management

1. What is the scope of AS/NZS 4836:2011?
2. List seven Western Australian parliamentary acts or regulations governing electrical safety, electrical licensing, occupational safety and health, and safety in mines
3. What range of a.c. voltages is defined as ‘low voltage’ in AS/NZS 4836:2011?
4. What are the three general principles of risk management as defined in AS/NZS 4836:2011?
5. List six different possible sources of electric shock as defined in AS/NZS 4836:2011?
6. List four possible sources of ignition in atmospheres where explosive gas or dust is present.
7. What is the first thing which must be done before commencing work on or near any electrical equipment?
8. If a risk assessment indicates that risks cannot be eliminated or sufficiently controlled to enable work to be done safely on or near energised equipment, can the work proceed?
9. List four factors which can increase the hazard when identifying hazards as part of a risk assessment process.
10. Before any work is done on or near energised electrical equipment a risk assessment must be carried out at the worksite to assess all risks that might have the potential to cause harm or damage. Who is required to be involved in the task of risk identification and assessment?
11. What is the main purpose of adopting a planned risk management process on an industrial worksite?
12. List six non-electrical hazards which may be present on a typical construction site and state how each one can be controlled.
13. What is meant by the term ‘risk control procedures’? State the AS/NZS Standard and Clause number.
14. List FOUR 'duties of care' which are the responsibility of the employer in relation to Occupational Safety and Health? State the reference.
15. List FOUR 'duties of care' which are the responsibility of the employee in relation to Occupational Safety and Health? State the reference.
16. List five main steps in the process of isolating and making safe in preparation for working on de-energised equipment.
17. What are the main colours of a ‘Danger – Do Not Operate’ tag?
18. Is it acceptable for a third year apprentice to supervise a first year apprentice on the job?

Notes:

Government of Western Australia North Metropolitan TAFE	**Risk Assessment**	Section 1 Activity Sheet	E137A SGB 01/2014

Risk Assessment Survey and Isolation Procedure

Objective:

To conduct a risk assessment survey in simulated workplace environment.

Equipment:

Simulated workplace environment.
Sample Work Risk Assessment form from AS/NZS 4836 Page 45

Scenario:

You are working with a licensed electrician in a motor rewinding factory installation. The task is to replace a three-phase flush-mounted circuit breaker on the 1 metre square removable control panel on the front of a particular machine. You have been asked to conduct a risk assessment survey and specify the control measures required to safely perform the task. Make valid assumptions relating to the details of the installation.

Procedure:

1. Conduct the risk assessment using the attached check-list as a guide – add any factors you think are necessary. Use any convenient headings for the blank columns at the right of check list – such as High Risk, Low Risk, None, Who, When, Item, Done etc.
2. Prepare a list of the control measures you would recommend to be used to minimise all risks.
3. Demonstrate a correct **isolation procedure** for a given scenario (as instructed by Lecturer)

Question:

1. What are the three general principles of risk management?

_____

_____

_____

Risk Assessment Survey

Name: _____ Supervisor: _____ Date: _____

Location: _____

	Sources of Electric Shock			
	Voltages between phases and between phases and neutral.			
	Voltages between phases and earth (including metalwork, damp situations, other conductive surfaces and persons nearby).			
	Voltages across open switch contacts.			
	Voltages across un-discharged capacitors.			
	Voltages on disconnected conductors (particularly neutrals).			
	Voltages caused by static electricity.			
	In Multiple Earthed Neutral (MEN) installations or systems, the rise in the earth potential in an installation due to a high resistance return path to the distribution neutral.			
	Induced voltages.			
	Voltages across the secondary terminals of transformers, including current transformers.			
	Voltages between different earthing systems.			
	Incorrect wiring connections.			
	Faulty equipment (the frame of faulty equipment may become energized).			
	Voltages from other sources of supply including illegal connections, uninterruptible power supplies and motor generators.			
	Voltages behind panels to be drilled			
	Potential high current levels			

	Potential Hazards in Explosive Atmospheres			
	(a) Electric tools, test equipment and instruments, e.g. mains and battery-powered appliances such as inspection hand lamps, drills, torches and test equipment			
	(b) Personal effects, e.g. jewellery, watches, cigarette lighters, matches, battery-operated items such as hearing aids, mobile telephones, pagers, key ring torches and transistor radios.			
	(c) Clothing made from wool, wool blends, nylons (unless treated with an antistatic process) and polyvinyl materials (especially those having a nylon base). It is possible for these materials to generate an electrical spark sufficient to ignite a flammable gas or vapour mixture.			
	(d) Actions such as—			
	(i) any form of welding or brazing;			
	(ii) use of a hacksaw;			
	(iii) drilling of any type;			
	(iv) impact of a hammer or chisel onto concrete or metal;			
	(v) rubbing or movement of plastics.			
	(vi) grinding operations			

	Other Factors			
	Hazards can be increased by:			
	(a) Cramped working conditions			
	(b) Confined spaces – reduced mobility (May require a permit)			
	(c) Multiple sources of supply.			
	(d) Damp situations.			
	(e) Heat.			
	(f) Height.			
	(g) Operational pressures to carry out work or to restore electricity supply.			
	(h) Unstable work area.			
	(i) Conductors or cables or equipment under tension or likely to fall			
	(j) Dirty or uncomfortable work			
	(k) Repetitive tasks			
	(l) Insufficient lighting			
	(m) Inadequate housekeeping			
	(n) Unexpected movement of components			
	(o) Inappropriate tester (e.g. electric fields, a.c./d.c., metallic screens)			

	Possible Risk Controls			
	Correct isolation procedures			
	Job planning			
	Eye protection			
	Hearing protection			
	Protective clothing			
	Flame resistant gloves			
	Flame retardant clothing			
	Prove isolation before and after			
	Personal protection equipment			
	Use correct tools/equipment for the purpose			
	Use of barriers, mats, distance, enclosures			
	Use of insulated tools and equipment			
	Take care in potentially hazardous location/position			
	Use safety observer			
	Maintain earth continuity			
	Have suitable rescue equipment in place			
	Additional worker training			
	Rescheduling tasks			
	Restricting access and locks			
	Improve housekeeping			
	Remove/ lock circuit protection device			
	Safety signage/tags			

	Recommended Control Measures			

Assessment (Risk assessment and Demonstrated Isolation Procedure)

Satisfactory:		Not Yet Satisfactory:	

Lecturer: _____ Date: _____

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 2 Study Guide	E137A SGB 01/2014

Electrical Supplies

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

Electrical Wiring Practice (7th ed.) Pethebridge, K. & Neeson, I.
Volume 1 Chapter 2 Workplace and Electrical Safety
Section 2.2 Workplace hazards and risk control

Code of Practice

Section 2 General Safety Obligations

2. Read the Summary and practise answering the questions provided on the Work Sheet. 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. Submit your answers to the Work Sheets to your Lecturer for discussion.

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 2 Summary	E137A SGB 01/2014

Electrical Supplies

1. Clause 1.4.128 of AS/NZS 3000:2018 (Wiring Rules) defines voltage or potential difference as follows:

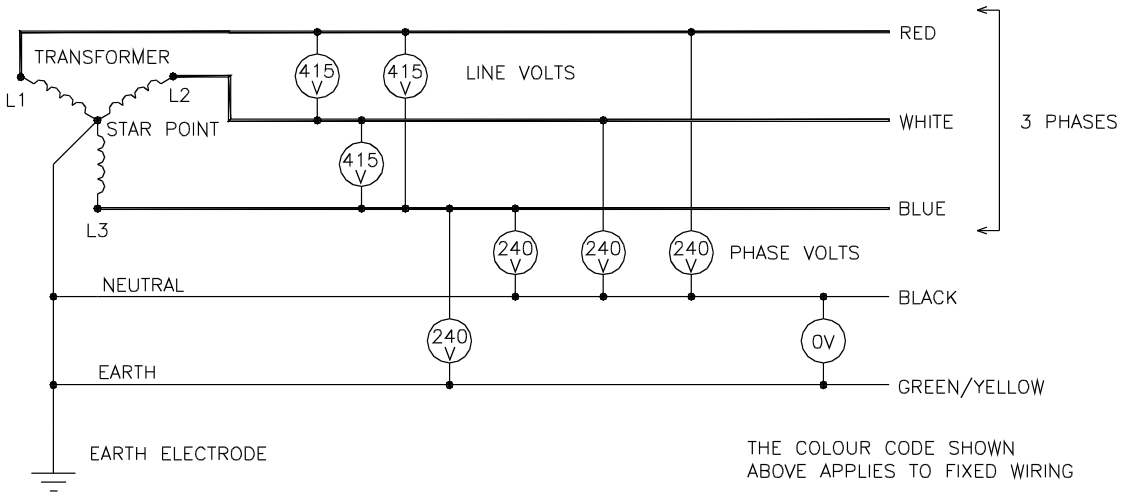
   'Differences of potential normally existing between conductors and between conductors and earth as follows:

   (a) Extra-low voltage - Not exceeding 50 V a.c. or 120 V ripple-free d.c.

   (b) Low voltage - Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.

   (c) High voltage - Exceeding low voltage.'

2. The standard electrical distribution system to individual consumers in W.A. is three phase 415 volts, 50 Hz and 240 volts single phase. The network operator's electrical distribution system has high voltages up to 330 000 volts to various regional centres. Transformers are used to raise and lower the a.c. voltage at various points within a distribution network.



3. All a.c. supplies to consumers in W.A. are potentially lethal. Most overhead conductors in a distribution system or network are not insulated. Bare live conductors are safe in these situations because they are out of reach, but they can be a hazard when handling long metal objects such as pipes or metal ladders in the vicinity.

4. Extra-low voltages are typically used to supply various types of equipment in particular installations – such as security systems, 12 volt down-lights, garden equipment, swimming pool lighting and electronic equipment. The ELV supply is usually obtained by using a transformer – the voltage and current ratings are usually visible on the outside of the transformer casing or enclosure. The output from an ELV supply does not pose the risk of electrocution, but faulty installation or components can cause fire.

Electric Shock

5. Electric shock can be, and often is, fatal. Electrical workers have a direct responsibility to protect themselves and the public from exposure to electric shock. Work should not begin on any electrical device or circuit until a suitable measuring device has been used to confirm that the circuit is dead. Although voltages less than about 30 volts are usually considered to be harmless, unintended contact between parts can result in short circuits, electrical flashes, burns, or damage to the equipment.

6. A small electric shock can cause a mild tingling sensation in the muscles of the arm, but a severe shock causes a sudden contraction of the heart muscles which can stun the victim and may have one or more of the following effects:

   a. The victim stops breathing.

   b. The victim's heart stops, or quivers rapidly without pumping blood - a condition known as ventricular fibrillation.

   c. The victim suffers severe burns.

   d. The victim suffers traumatic shock to the nervous system.

   e. The victim suffers muscular paralysis and may be unable to release his/her grip on a live machine.

Factors

7. The factors which affect the seriousness of electrical shock are:

   a. The amount of current passing through the body.

   b. The path of the current through the body.

   c. The voltage of the circuit.

   d. The duration of contact with the live part.

   e. The resistance of the body at the time of contact.

   f. The surface area of the skin in contact with the live component.

   g. The period of the cardiac cycle during which the shock occurs.

   h. The individual - some people are affected more than others.

8. It is not possible to define precisely the effects of a given current on the body, but the general effects of alternating current are shown in Figure 1.

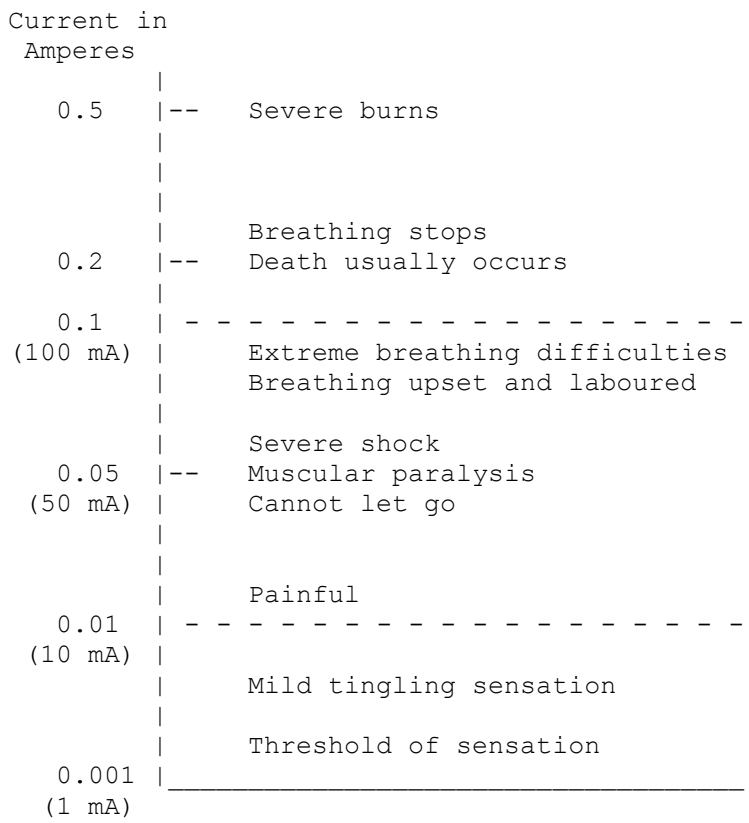


Figure 1 - General effects of electric shock

The Cardiac Cycle

9. The small electrical impulses which stimulate normal muscular contraction of the heart follow a regular pattern which can be represented on a graph known as the 'Cardiac Cycle', as shown in Figure 2.

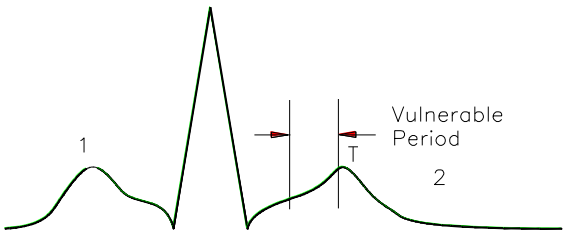


Figure 2 - The cardiac cycle

10. It is thought that there is a specific period during the cardiac cycle when the heart is most likely to be affected by an electric shock. This period is known as the 'vulnerable period', as indicated in Figure 2. If a person receives an electric shock during the vulnerable period, the probability that the heart will go into ventricular fibrillation is increased.

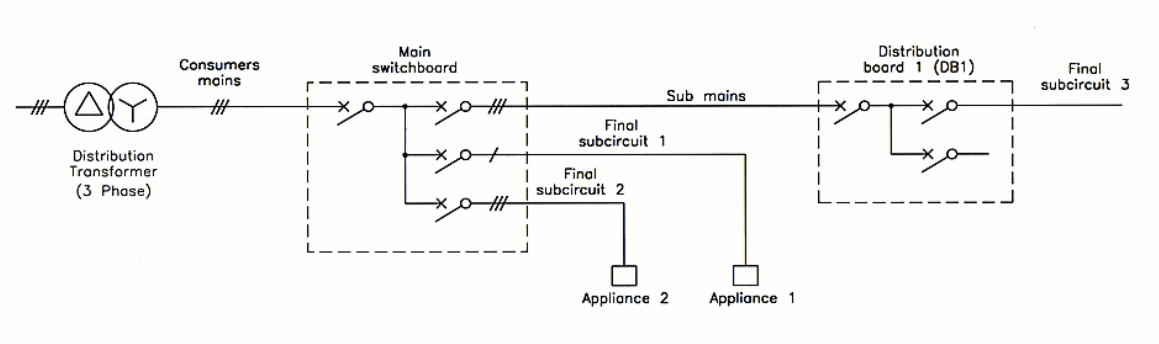
11. The existence of a period of higher vulnerability may explain why some people may suffer no long term effects from an electric shock, while others receive a shock under similar conditions and fail to recover.

Burns and Fire

12. The passage of electric current through the human body can result in severe burning of body tissue. The effects of electrical burns often contribute more to the cause of death than the electric shock itself. Short circuit faults in some installations can result in fault currents high enough to cause severe damage by electrical explosions or fire.

High Fault Currents

13. In any supply system the current available under fault conditions is much higher than the normal full load current. The diagram below shows the general arrangement of a typical 415/240 volt installation supplied from a network operator's 3-phase distribution transformer.



14. A typical distribution transformer could have a rating of 500 kVA. If a short circuit fault to earth occurred on the load side of the single phase circuit breaker at the main switchboard, the fault current (known as the prospective short circuit current) would be limited by the operational characteristics of the distribution transformer and the impedance (a.c. resistance, Z) of the consumer's mains cables.

15. If the voltage at the fault was 240 volts and the impedance (Z) of the consumer's mains cable was 0.0339 ohms, the prospective fault current (ignoring the characteristics of the distribution transformer) would be:

$$I = \frac{V}{Z} = \frac{240}{0.0339} = 7079.6 \text{ amps}$$

16. Currents of this magnitude under these conditions would cause an explosion with catastrophic damage to associated equipment and cables, so they must not be allowed to occur.

17. Active conductors shall be protected by one or more devices which automatically disconnect the supply in the event of overcurrent before such overcurrent attains a magnitude or duration that could cause danger to persons or livestock or damage to the electrical installation. See AS/NZS 3000 Clause 2.4. Fault Protection

18. The most common methods of protection against damaging currents are circuit breakers and HRC fuses. Circuit breakers and HRC fuses have a maximum fault current rating - such as 3 kA, 6 kA, or 10 kA that must not be exceeded. Detailed consideration of the process of determining prospective fault currents and selecting circuit protection devices to achieve the required level of electrical safety is beyond the scope of this competency unit.

Test Before You Touch

19. Electrical accidents can be prevented by adopting safe working practices. Two of the guiding principles which must be adopted by any electrical worker are TEST BEFORE YOU TOUCH and ALWAYS CHECK THE CHECKER. Always check that your multimeter/voltmeter is operating correctly by measuring a known voltage source before testing the isolated circuit is at zero volts to earth.

Control Measures

20. The control measures used to minimise the risk of electric shock or unwanted fire are those which form the basis of Protection for Safety in Clause 1.5 of AS/NZS 3000. The following table summarises the fundamental principles of Clause 1.5.

21. Section 6 of AS/NZS 4836 contains information relating to the use of a safety observer in situations where there is the potential to cause injury or damage when performing electrical work.

Fundamental Protection Principles - General Outline
(Refer to AS/NZS 3000:2018 Clause 1.5)

Risks			
Electric shock current		Excessive temperatures	Explosive atmospheres
Direct contact	Indirect contact		

Type of Protection	**Principles**	**Methods**
Direct contact (Basic protection) Clause 1.5.4	Prevent current flowing. Limit current to low value. Use ELV supply	Insulation, Barriers or enclosures (e.g. IP 2X). Obstacles. Placing out of reach. Use ELV
Indirect contact (Fault protection) Clause 1.5.5	Automatically disconnect supply. Prevent current flowing. Limit current to low value.	Automatic disconnection of supply. Use of double insulation (Class II). Electrical separation. Limit fault current Install RCD Use ELV
Thermal effects Clause 1.5.8	Proper design. Adequate ventilation.	Proper selection and installation. Provide adequate ventilation..
Overcurrent Clause 1.5.9	Prevent or limit overcurrent.	Automatic disconnection. Limiting current to a safe value and duration.
Earth fault current Clause 1.5.10	Prevent shock current flowing.	Install RCD. Prevent direct or indirect contact.
Abnormal voltages Clause 1.5.11	Segregation Reduce electromagnetic induction.	Protect unused conductors. Segregate circuits. Install overvoltage protection
Spread of fire Clause 1.5.12	Proper design.	Proper selection and installation.
Mechanical movement Clause 1.5.13	Restrict or control movement.	Devices to disconnect or isolate.
External influences Clause 1.5.14	Proper design	Adequate design for normal operation. Consider all external influences.

General Design Principles (Clause 1.6)		
a. Protect persons, livestock and property from harmful effects.	b. Ensure correct functioning of installation – as intended.	c. Ensure compatibility with electricity distribution system.
d. Facilitate safe operation, inspection, testing and maintenance.	e. Reduce inconvenience in the event of a fault.	f. Consider supply characteristics, maximum demand, utilization voltage and circuit arrangements.

Selection and Installation (Clause 1.7)		
a. Safe operation under normal conditions.	b. Not cause danger from shock or fire under reasonably expected conditions.	c. Be installed according to manufacturer's instructions.
d. Use safe and sound work practices.	e. Select equipment to comply with all requirements.	f. Verification of compliance with all requirements.

SGB

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 2 Work Sheet	E137A SGB 01/2014

Electrical Supplies

1. What is the name of the stationary electrical device that can raise or lower an a.c. voltage?

2. What is the meaning of the terms HV, LV and ELV when used in connection with an a.c. supply? Give the Wiring Rules Clause number.

3. What is the main potential hazard associated with ELV supplies?

4. Give three possible uses for an ELV supply for fixed wiring in a domestic installation.

5. What is the highest voltage available in the electrical distribution system in W.A?

6. What is the main damaging effect of high fault currents in an electrical circuit?

7. List four factors which affect the seriousness of an electric shock.

8. What are three of the control measures which can be taken to minimise the risk of direct contact with a live electrical part?

9. How can the voltage at which a device is intended to operate be determined in an industrial situation?

10. What is the nominal voltage between any phase and earth in a three phase four wire distribution system in W.A?

11. What is the main hazard associated with a 12 volt supply?

12. What is the main guiding safety principle which must be adopted by any person working on electrical equipment?

13. Which clause in the Wiring Rules describes the general principles relating to protection for safety?

14. What are the three main duties of a safety observer on a work-site?

15. Which Clause in AS/NZS 3000:2018 describes the requirements for devices for protection against overcurrent?

16. Name two types of electrical device that are commonly used to limit high fault currents in a typical three phase installation?

Notes:

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 3 Introduction	E137A SGB 01/2014

High Voltage Supplies

Task:

To demonstrate a knowledge of the risks associated with high voltage installations and the control measures for dealing with the risks.

Why:

High voltage installations expose workers to risks additional to the normal risks associated with potentially lethal voltages. You need to be aware of the additional risks so that you can implement procedures to allow safe operation of the high voltage electrical equipment and provide protection for both authorized personnel and the public so as to avoid electrical accidents, unwanted fire and damage to property.

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 Assessment based on the required skills and knowledge of UEENEEE137A.

2. You must satisfactorily complete the set activities and laboratory tasks.

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

Equipment:

Nil

References:

* AS/NZS 4836:2011 Safe working on low voltage electrical installations.
* Code of Practice for Persons working on or near energised electrical installations. Energy Safety
* Safe working guidelines for electrical workers (March 2018) EnergySafety WA.
* Electrical Wiring Practice (7th ed.) Pethebridge, K. & Neeson, I.
* AS/NZS 3000 - Wiring Rules. Standards Australia.
* WA Electrical Requirements. 2008
* AS 2067-1984 Switchgear assemblies for ancillary equipment for alternating voltages above 1 kV
* Western Power manual.
* Guidelines for the Safe management of high voltage electrical installations – April 2014: Energy Safety/Worksafe.
* Occupational Safety and Health Regulations 1996

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 3 Study Guide	E137A SGB 01/2014

High Voltage Supplies

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

WA Electrical Requirements.

Section 7 High voltage installations

AS/NZS 3000 Wiring Rules

Clause 7.6 High voltage electrical installations

AS/NZS 4836:2011 Safe working on low voltage electrical installations.

Section 3 Risk Treatment

Guidelines for the Safe management of high voltage electrical installations – April 2014: Energy Safety/Worksafe.

Section 4 Operation
- 4.1 HV Operating Procedures & Safety Management Plan
- 4.2 High Voltage Switching Operators
- 4.4 Basic Safety Requirements

2. Read the Summary and practise answering the questions provided on the Work Sheet. 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. Submit your answers to the Work Sheets to your Lecturer for discussion and assessment.

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 3 Summary	E137A SGB 01/2014

High Voltage Supplies

1. High voltage supplies are any electrical supply systems intended to operate at voltages above 1000 volts rms a.c. (See AS/NZS 3000:2018 Clause 1.4.128). High voltage supplies are potentially hazardous because it is not essential to actually touch a live part to receive an electric shock. Air can normally be regarded as an insulator at voltages below about 1000 volts, but at higher voltages it can become a temporary conductor.

2. The minimum permissible working distance for trained personnel* from exposed live parts under normal working conditions are:

   Up to 1000 volts: No uninsulated contact
   Up to 33 000 volts (Nominal) 700 mm
   Up to 66 000 volts (Nominal) 1000 mm
   Up to 132 000 volts (Nominal) 1200 mm
   Up to 220 000 volts (Nominal) 1800 mm
   Up to 330 000 volts (Nominal) 2800 mm

   *See paragraphs 4, 5 & 6.

3. These shall be the distances beyond the reach of any part of the body or any conducting body or unapproved object touching any part of the body.

4. Work on or in close proximity to high voltage installations must only be carried out by persons who have had appropriate training, and who have an appropriate safe working permit. An A Grade electrical worker's licence alone is not sufficient to qualify an electrical worker to work on high voltage installations.

5. Persons who intend to or are required to work on high voltage equipment after switching, isolation and earthing must be appropriately instructed and provided with a safe work permit by an authorised person (HV switching operator). These are specialised safety requirements. Refer to Energy Safety for further information if required.

6. Specific high voltage training courses are conducted by *Western Power* from time to time – usually at their Jandakot training facility.

7. The object of the requirements is to provide an environment that allows safe operation of the high voltage electrical equipment and in which protection for both authorized personnel and the public is afforded.

8. The Occupational Safety and Health Regulations 1996 also provides information about safety working distances from overhead power lines. Clause 3.64 – Overhead power lines, duties of employers etc. This regulation states that there is a danger zone surrounding overhead power lines. These danger zones extend the following distances:
   (a) 0.5 metres from insulated or 1.0 metres uninsulated live low voltage (up to 1000 volts) overhead power lines.
   (b) 3.0 metres from insulated or uninsulated live high voltage (up to 33 000 volts) overhead power lines, and
   (c) 6.0 metres from insulated or uninsulated live high voltage (exceeding 33 000 volts) overhead power lines.

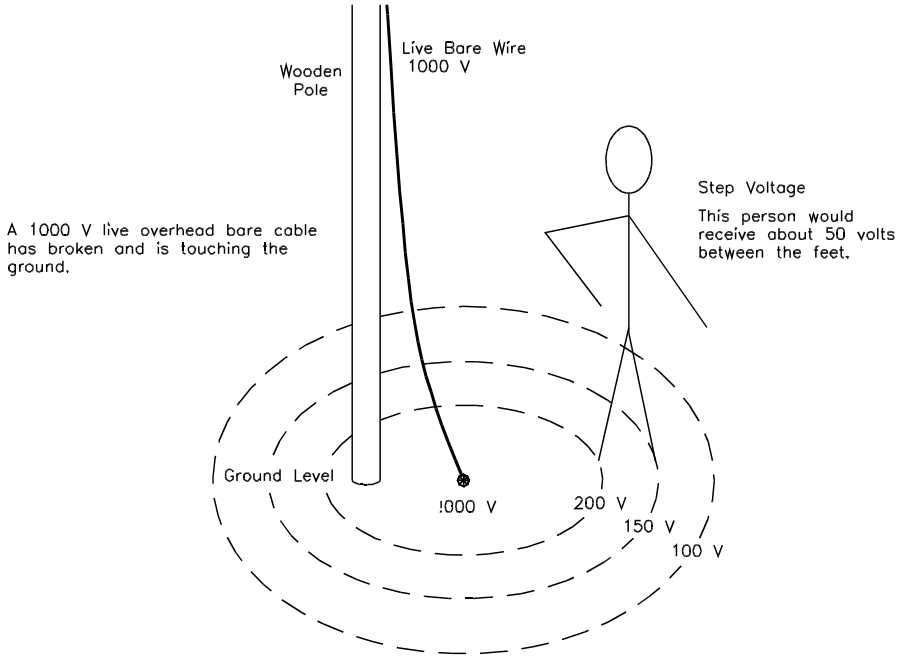
   This regulation is to protect workers on construction sites that have overhead power lines adjacent to that site. These workers would not be considered as "trained personnel" because they would not be working on these power lines.

9. Common terms associated with supply system voltages are:

a. **Touch current** - Electric current which passes through a human body or an animal body when that body touches one or more accessible parts of electrical equipment or an electrical installation, under normal conditions or fault conditions. (AS/NZS 3000:2018 Clause 1.4.124)

b. **Touch voltage** - Voltage appearing between simultaneously accessible parts. (AS/ZS 3000:2018 Clause 1.4.125).

c. **Step Voltage (U_S)** – Voltage between two points on the earth's surface that are 1m distant from each other, which is considered to be the stride length of a person (see AS 2067-2008 Clause 1.3.75).



d. **Transferred Voltage** – Voltage rise of an earthing system transferred by means of a connected conductor (for example a metallic cable sheath, PEN conductor, pipeline, rail) into areas with low or no potential rise resulting in a voltage occurring between the conductor and its surroundings.(see AS 2067-2008 Clause 1.3.82).

e. **Creepage distance** - The shortest path between two conductive parts, or between a conductive part and the bounding surface of the equipment, measured along the surface of the insulating material (see AS/NZS 3100-2009, Clause 2.1.17).

f. **Induced voltage –** A voltage which occurs in a conductive component as a result of the effects of adjacent invisible magnetic fields without a specific electrical connection to any live part.

g. **Non-flashover distance (*N*)** – the minimum phase to earth clearance that includes a margin of 10% (for clearances of 1300 mm or less) and 6% (for clearances greater

than 1300 mm) to allow for variations in construction dimensions. (see AS 2067-2008 Clause 1.3.52).

10. High voltage installations and portions of electrical installations operating at high voltage must be installed in accordance with AS 2067(See AS/NZS 3000, Clause 7.6.2.1.)

11. The specific control measures for dealing with high voltage installations include:

    a. Switching/Isolation procedures
    b. Earthing of equipment during maintenance
    c. Erection of barriers
    d. Restricting access to hazardous areas
    e. Placement of safety signs and labels
    f. Suitability of associated equipment
    g. Control and indicating equipment
    h. Circuit protection devices
    i. Busbar and switching arrangements
    j. Emergency exit facilities
    k. Fire protection arrangements
    l. Separation of HV and LV systems
    m. Size and resistance of earthing conductors
    n. Ratings and installation of HV cables
    o. HV testing to ensure suitability of equipment
    p. Use of on-site safety observers

12. Specific requirements for high voltage installations are contained in AS/NZS 3000:2018 Clause 7.6.3.

13. Guidelines for the Safe management of high voltage electrical installations published by Energy Safety/Worksafe provide information on operation and maintenance procedures of HV installations that are not controlled by the Network Operators.

14. Section 7 of the W.A. Electrical Requirements contains local requirements for consumer's high voltage installations in the range 1 kV to 66 kV.

15. Inquiries relating to high voltage supply and installations should be directed to the Network Operator's offices. For supply at voltages greater than 66 kV inquiries should be directed to the Transmission System Network Operator.

16. The *W.A. Electrical Requirements* and *Guidelines for the Safe management of high voltage electrical installations – April 2014* are available free of charge on the Internet at the address: www.energy.wa.gov.au.

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 3 Work Sheet	E137A SGB 01/2014

High Voltage Supplies

1. What is the major factor which results in high voltage installations being a potentially higher risk than lower lethal voltages such as 415/240 volts?

2. Under what conditions can air become a conductor?

3. What minimum distance should be allowed between a live 22 000 volt part and any part of a “trained” person’s body?

4. Is a current A Grade Electrical Worker’s Licence sufficient qualification to allow the holder to perform electrical work on high voltage supplies?

5. How is ‘high voltage’ defined according to AS/NZS 3000:2018 (Wiring Rules)?

6. Which W.A. government authority can be consulted for advice on safety aspects of working on or around high voltage installations?

7. Explain in your own words what is meant by the term ‘Touch Current’. State the AS/NZS 3000 Clause number (if applicable).

8. Explain in your own words what is meant by the term ‘Touch Voltage’. State the AS/NZS 3000 Clause number (if applicable).

9. Explain in your own words what is meant by the term ‘Creepage Distance’. .

10. Explain in your own words what is meant by the term ‘Induced Voltage’

11. Explain in your own words what is meant by the term ‘Non-flashover Distance’.

12. How are high voltage parts be identified in a typical electrical installation?

13. Name and describe six control measures which can be taken to reduce the risks associated with working on or around HV installations.

14. Which clause in AS/NZS 3000 describes requirements for high voltage installations?

15. Which clause in the W.A. Electrical Requirements describes general requirements for high voltage installations?

16. What Clause in the Wiring Rules specifies the Australian Standard for high voltage electrical installations?

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 4 Introduction	E137A SGB 01/2014

Test Equipment

Task:

To use electrical test equipment that is appropriate to the task in a safe manner.

Why:

The safe use of electrical test equipment is a critical aspect of maintaining a safe working environment on or near electrical equipment.

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 Assessment based on the required skills and knowledge of UEENEEE137A.

2. You must satisfactorily complete the set activities and laboratory tasks.

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

Equipment:

Typical test instruments

References:

* AS/NZS 4836:2011 Safe working on low voltage electrical installations.
* Code of Practice for Persons working on or near energised electrical installations. Energy Safety WA
* Safe working guidelines for electrical workers (March 2018) EnergySafety WA.
* AS/NZS 3000 - Wiring Rules. Standards Australia.
* WA Electrical Requirements.
* Electrical Wiring Practice (7th ed.) Pethebridge, K. & Neeson, I.
* AS/NZS 3017:2007 Electrical Installations — Testing guidelines.
* AS/NZS 3008.1.1:2017 - Electrical Installations - Selection of cables.
* Manufacturers' information sheets.

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 4 Study Guide	E137A SGB 01/2014

Test Equipment

Suggested Self-Study Guide

1. Study the following sections in the recommended references:

AS/NZS 4836:2011 Safe working on low voltage electrical installations.

Section 2 Principles of Risk Management and Assessment of Risk
Section 3 Risk Treatment

Electrical Wiring Practice (7th ed.) Pethebridge, K. & Neeson, I.

Volume 1 Chapter 9 Testing techniques and compliance verification
Section 9.1 Testing safety

2. Read the Summary and practise answering the questions provided on the Work Sheet. 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 laboratory projects in this Section.

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

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 4 Summary	E137A SGB 01/2014

Test Equipment

1. The safe use of electrical test equipment requires the user to be aware of several aspects of the testing process, including:

   a. Whether the circuit has to be energised or not.
   b. What is being tested for (voltage, current, resistance, insulation etc).
   c. The most appropriate test equipment to use for the task.
   d. The safety precautions associated with the use of a particular type of test instrument.
   e. Where the test equipment needs to be connected to measure the required value.
   f. How the test equipment is to be connected.
   g. What results are expected.
   h. The function and range on which to set the test instrument.
   i. The likely consequences on the circuit of connecting a particular test instrument at the proposed point(s).
   j. Who needs to be advised that the test is to be done.
   k. The risks associated with using a particular item of test equipment.
   l. Why the test is required.
   m. The condition of the test equipment, including when it was last calibrated.
   n. Whether the polarity of the test probes is critical.
   o. The time at which the test needs to be conducted.
   p. Who needs to be informed of the results of the test.
   q. Whether the results obtained are within acceptable limits or not.
   r. Follow the manufacturer's instructions.
   s. Selection of test equipment must take into account the possibility of transient over-voltage. Category III or category IV devices should only be used.

2. There are many different types of electrical test equipment and many variations of each type. In general, the test equipment must be suitable for the tests being performed, it must be in good condition and it must have been checked for accuracy. Test equipment used to detect an energised source must be checked on a known voltage source before and after the test.

3. The main safety procedures associated with the most common types of test equipment used in general 240/415 volt electrical installation work are shown in the following table:

1	Ammeters (clip-on)	a. Maintain a safe distance from live terminals. b. Ensure that there is adequate insulation around the conductor under test.
2	Ammeters (fixed)	a. Isolate the supply. (e.g. Identify, Isolate, Test, Tag, Lock, Bond) b. Ensure correct polarity on d.c. c. Select an appropriate range. d. Connect in series with the supply or component.
3	Voltmeters	a. Ensure correct polarity on d.c. b. Select an appropriate range. c. Check on a known source before and after the test. d. Connect in parallel with the supply or component.

4	Multimeters	a. Select an appropriate range. b. Select the appropriate function. c. Check operation before and after the test. d. Keep fingers behind the guards of test probes. e. Do not inadvertently short circuit other components with the metal of the test probes. f. Isolate the supply and disconnect parallel paths when measuring resistance. g. Switch off after each use.
5	High Voltage Insulation Testers	a. Isolate the supply b. Select an appropriate test voltage range.
6	Earth Loop Impedance Testers	a. Follow the manufacturer's instructions.
7	Volt Sticks	a. Do not rely solely on indirect voltage testers for detecting the presence of a hazardous voltage.
8	Phase Pencils	a. Should only be used in conjunction with another more reliable tester – such as a multimeter
9	415 Volt Series Test Lamp	a. Should only be used in conjunction with another more reliable tester – such as a multimeter. b. Lamps not illuminating is not a positive indication that there is no voltage – it may be too low.
10	Wiggy Testers	a. Follow the manufacturer's instructions.
11	Combi Testers	a. Follow the manufacturer's instructions. b. Select an appropriate range. c. Select the appropriate function. d. Check operation before and after the test. e. Keep fingers behind the guards of test probes. f. Do not inadvertently short circuit other components with the metal of the test probes. g. Isolate the supply and disconnect parallel paths when measuring resistance. h. Switch off after each use. When used as IR tester i. Isolate the supply j. Select an appropriate test voltage range. When used as earth fault loop impedance tester k. Follow the manufacturer's instructions. When used as RCD tester l. Follow the manufacturer's instructions.
12.	RCD Testers	a. Follow the manufacturer's instructions.

Note: The processes described above are not applicable to high voltages such as those available in the network operator's distribution system.

4. The Publications ***Safe working guidelines for electrical workers*** and ***Guidance note Working in roof spaces***, issued by the Director of Energy Safety in 2018, places restrictions on 'live work' in electrical installations.

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 4 Work Sheet	E137A SGB 01/2014

Test Equipment

1. How must voltmeters be connected in an electrical circuit?
2. How must ammeters be connected in an electrical circuit?
3. What test instrument must be used to measure the insulation resistance in an electrical device?
4. What precaution must be taken when using the test probes of any voltage detecting instrument or device?
5. What two precautions must be taken before measuring the resistance of a component in an electrical circuit?
6. What are the two settings which must be made on a typical multimeter?
7. What condition is indicated if an analogue d.c. voltmeter pointer moves down-scale when measuring a d.c. voltage?
8. What main precaution must be taken when using a clip-on ammeter in an operational circuit?
9. Is it a safe practice to rely solely on indirect voltage testers (such as ‘voltage sticks’) for detecting the presence of a hazardous voltage?
10. List six things a person must know when testing for the presence of a voltage.
11. Is a phase pencil generally considered to be a reliable instrument for testing for the presence of a lethal voltage?
12. What is the main disadvantage of using a digital multimeter to measure voltage compared to a typical analogue multimeter?
13. What check must be performed on an ohmmeter each time it is used?
14. A particular voltmeter is being used to measure the voltage between two terminals. What precaution must be taken if the voltmeter indicates zero volts?
15. Why must digital measuring instruments be switched off immediately after use?
16. How should measuring instruments be stored when they are not in use?
17. What is meant by the term ‘calibrating’ a measuring instrument?
18. Research project: Explain the limitations of using a Category II test meter.

Notes:

Government of Western Australia North Metropolitan TAFE	**Document and apply measures to control OHS risks associated with electrotechnology work**	Section 4 Activity Sheet	E137A SGB 01/2014

Use of Measuring Instruments

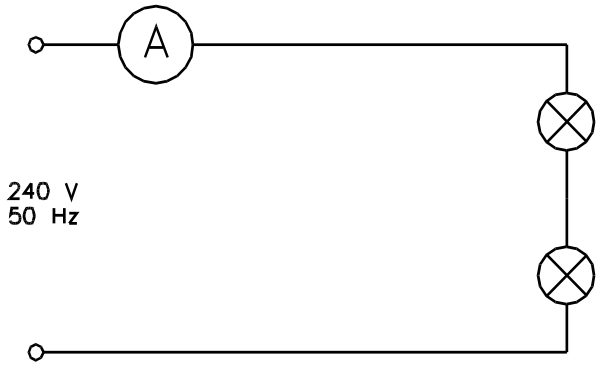
Objective:

To use various types of measuring instrument to measure electrical values.

Equipment:

Circuit project board.
Digital and analogue multimeters.
Fixed voltmeters.
Fixed and clip-on ammeters.
Phase pencil.
Indirect voltage testers (Volt Stick or similar).

Outline Circuit:



Procedure:

Danger Tag Procedure Required

1. Select a suitable fixed ammeter and connect the circuit as shown in the circuit diagram.

2. Measure the resistance of the lamps and the fixed ammeter and record the results in the Results Table.

3. Have your connections checked by your lecturer.

4. Energise the circuit. Select appropriate measuring instrument and use them to measure the other values indicated in the Results Table using all appropriate safety precautions and instrument handling techniques.

5. Isolate the supply and have your results checked by your lecturer.

6. Disconnect your wiring and return all of the equipment to its proper place.

Results Table

	Value Required	Instrument	Reading	Comment
Resistance Measurement				
	Resistance of Lamp 1.	Multimeter		
	Resistance of Lamp 2.	Multimeter		
	Resistance of the fixed ammeter.	Multimeter		
Voltage Measurement				
	Supply voltage.	Multimeter		
	Supply voltage.	Indirect tester		
	Voltage across Lamp 1.	Multimeter		
	Voltage across Lamp 2.	Multimeter		
Current Measurement				
	Line current	Fixed ammeter		
	Line current	Clip-on meter.		

Assessment (Use of Measuring Instruments)

Satisfactory:		Not Yet Satisfactory:	

Lecturer: _____ Date: _____

Notes

Notes