Demonstrate knowledge of electrical safety and safe working practices for electrical workers

US 15851 v3

Training and Assessment Resource

NCES Level 2

Electricity Supply Industry Training Organisation

www.esito.org.nz

Contents

Introduction to Training Assessment Resource

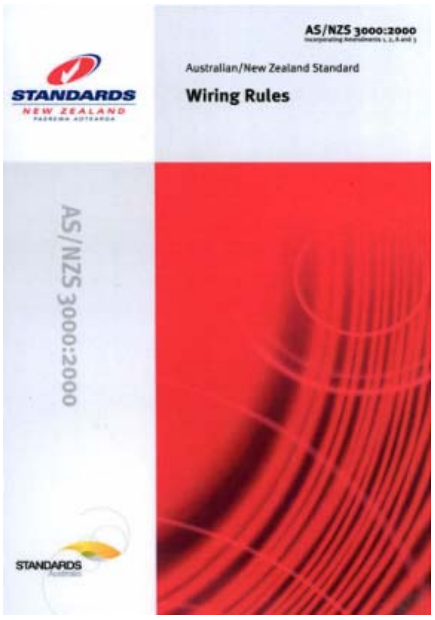
This Training Assessment Resource (TAR) contains the information that you require to complete the written assignment in the assessment pack for this unit standard.

Purpose

People who obtain credit for this unit standard are able to:

- Demonstrate knowledge of the hazardous nature of electricity
- Demonstrate knowledge of the health and safety Employment Act
- Demonstrate knowledge of the safety management of electrical hazards
- Demonstrate knowledge of the general safety practices in the workplace
- Demonstrate knowledge of special hazards
- Demonstrate knowledge of the safe use of tools and test equipment
- Analyse electrical incidents

1. Legislation, Standards, Specifications and Codes of Practice



The electricity supply industry in New Zealand is controlled through Government legislation and this determines what can be done within the industry. The relevant documents that describe these requirements are:

Electricity Act 1992

The legislation that provides for the regulation of the supply of electricity and the electricity industry in New Zealand including the regulation and control of people who work in the industry.

Electricity Regulations 1997 and subsequent Amendments

The regulations that govern the standards of installation, plant and equipment used within the electricity industry.

New Zealand Electrical Codes of Practice (NZECP)

These provide additional information to clarify the interpretation of the regulations and set standard work practices.

Joint Australian/New Zealand Standards (AS/NZ)

There is a move towards the utilisation of standards rather than regulation and to make them common to both Australia and New Zealand. At the moment this change is in transition and there is a choice as to whether an installation complies with either the standard or the regulation. The difference between standards and regulations are; standards give you the expected outcome while the regulations, with the NZECP are more concise in respect to what is required. Standards are replacing the Electrical Codes of Practice (ECP).

References for this unit standard are made to:

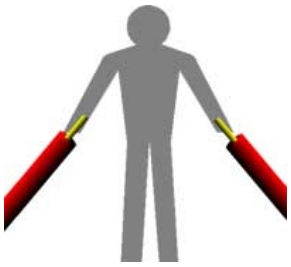
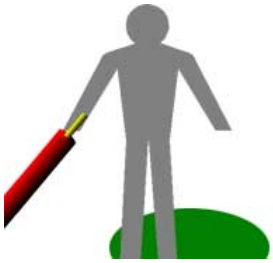
1. AS/NZS 3000:2000 Wiring Rules: The standard that is commonly used by electricians for the installation of electrical wiring.
2. AS/NZS 3760:2003 In-service Safety Inspection and Testing of Electrical Equipment: The standard that is commonly used by electrical service technicians and covers the requirements for portable electrical appliances, plant and equipment.
3. A guide to Health and Safety in Employment Act 1992 including the Health and Safety in Employment Amendment Act 2002: Published by the Occupational Safety and Health Service of the Department of Labour for safety practices in the workplace.
4. AS/NZS 4836:2001, Safe working on low-voltage electrical installations; IEC/TR2 60479-1 (1994-09), Effects of current on human beings and livestock – Part 1: General aspects;
5. Electrical Workers Registration Board, Electricity Regulations Compilation 2003. Available from Legislation Direct, PO Box 12 418, Wellington;
6. Electrical Workers Registration Board, Manual for Safety Training in the Electrical Industry, (2000) Wellington
7. Electrical Workers Registration Board and Ministry of Economic Development, Supervision Guidelines for Electrical Workers, (2003) Wellington;
8. Safety Manuals – Electricity Industry (SM-EI) Part 1, 2 and 3, (July 2004) Electricity Engineers Association of New Zealand.

Note: References include all subsequent amendments and replacements.

2. The Hazardous Nature of Electricity

2.1 How Shocks Occur

Electricity travels in closed circuits, normally through a conductor. Shock results when the body becomes part of the electrical circuit; current enters the body at one point and leaves at another. Typically, shock occurs when a person contacts:

		
Both wires of an energized circuit.	One wire of an energized circuit and the ground.	A metallic part in contact with an energized wire while the person is also in contact with the ground.

Metallic parts of electric tools and machines can become energized if there is a break in the insulation of their wiring. A low-resistance wire between the metallic case of the tool/machine and the ground – an equipment grounding conductor – provides a path for the unwanted current to pass directly to the ground. This greatly reduces the amount of current passing through the body of the person in contact with the tool or machine. Properly installed, the grounding conductor provides protection from electric shock.

2.2 Effects of current on human beings.

For a given current path through the human body, the danger to persons depends mainly on the magnitude and duration of the current flow. However, the time/current zones specified in this publication are, in many cases, not directly applicable in practice for designing measures of protection against electrical shock. The necessary criterion is the admissible limit of touch voltage (i.e. the product of the current through the body called touch current and the body impedance) as a function of time. The relationship between current and voltage is not linear because the impedance of the human body varies with the touch voltage, and data on this relationship is therefore required.

The different parts of the human body (such as the skin, blood, muscles, other tissues and joints) present to the electric current a certain impedance composed of resistive and capacitive components. The values of body impedance depend on a number of factors and, in particular, on current path, on touch voltage, duration of current flow, frequency, degree of moisture of the skin, surface area of contact, pressure exerted and temperature. The impedance values indicated in this technical specification result from a close examination of the experimental results available from measurements carried out principally on corpses and on some living persons.

What does it take to feel a shock, and at what level can you get into serious trouble. The simple answer is that low levels of electricity have the possibility to cause injury, either directly or indirectly. There is some data that indicates that under certain extreme conditions the maximum reasonable safe voltage is only 10V AC.

2.3 Physiological Effects

There are physiological effects of varying magnitude of current, as a person experiences an electrical shock.

Three primary factors affect the severity of the shock a person receives when he or she is a part of an electrical circuit:

1. Amount of current flowing through the body (measured in amperes).
2. Path of the current through the body.
3. Length of time the body is in the circuit.

Other factors that may affect the severity of the shock are:

- The voltage of the current.
- The presence of moisture in the environment.
- The phase of the heart cycle when the shock occurs.
- The general health of the person prior to the shock.

Activity

Complete the following sentence (the first one has been done for you):

Shock results when the body becomes part of the electrical circuit; current enters the body at one point and leaves at another. Typically, shock occurs when a person contacts:

Both wires of an energized circuit

Shock Physiological Effects

Electric Current	(1 second contact)	Physiological Effect	Voltage required to produce the current with assumed body resistance
		100,000 ohms	1,000 ohms
1 mA	Threshold of feeling, tingling sensation.	100 V	1 V
5 mA	Accepted as maximum harmless current	500 V	5 V
10-20 mA	Beginning of sustained muscular contraction ("Can't let go" current.)	1000 V	10 V
100-300 mA	Ventricular fibrillation, fatal if continued. Respiratory function continues.	10,000 V	100 V
6 A	Sustained ventricular contraction followed by normal heart rhythm. (defibrillation). Temporary respiratory paralysis and possibly burns.	600,000 V	6000 V

Effects can range from a barely perceptible tingle to severe burns and immediate cardiac arrest. Although it is not known the exact injuries that result from any given amperage, the following table demonstrates this general relationship for a 50-cycle, hand-to-foot shock of one second's duration:

Wet conditions are common during low-voltage electrocutions. Under dry conditions, human skin is very resistant. Wet skin dramatically drops the body's resistance.

Dry Conditions

Current = Volts/Ohms = 120/100,000 = 1mA a barely perceptible level of current.

Wet conditions

Current = Volts/Ohms = 120/1,000 = 120mA sufficient current to cause ventricular fibrillation.

If the extensor muscles are excited by the shock, the person may be thrown away from the circuit. Often, this can result in a fall from elevation that kills a victim even when electrocution does not.

When muscular contraction caused by stimulation does not allow the victim to free himself from the circuit, even relatively low voltages can be extremely dangerous, because the degree of injury increases with the length of time the body is in the circuit. LOW VOLTAGE DOES NOT IMPLY LOW HAZARD!

100mA for 3 seconds = 900mA for .03 seconds in causing fibrillation

Note that a difference of less than 100 milliamperes exists between a current that is barely perceptible and one that can kill.

High voltage electrical energy greatly reduces the body's resistance by quickly breaking down human skin. Once the skin is punctured, the lowered resistance results in massive current flow.

Ohm's law is used to demonstrate the action.

At 1,000 volts, Current = Volts/Ohms = 1,000/500 = 2 Amps which can cause cardiac standstill and serious damage to internal organs.

Activity

What is the difference (in milliamperes) between a current that is barely perceptible and one that can kill?

3. The Health and Safety Act

3.1 The Purpose of the Act

The Act is about making work activities safe and healthy for everyone connected with them.

It seeks to achieve that firstly by recognising that:

- Constructive employment relationships generate safe and healthy workplaces.
- Those involved in the work (employers, employees etc) are usually best placed to decide on the particular measures to make their own workplace safe.
- The only sure way to do that is by systematic management of all hazards.

These principles are supported by specific arrangements that:

- Reinforce the primary responsibility as being that of the employer or other person responsible for the work.
- Acknowledge that employees too have responsibilities to themselves and others.
- In bringing those two sets of responsibilities together, require good faith cooperation between employers and employees.
- Have the expectation that employee participation in health and safety issues will bring to bear readily available knowledge on the issues.

The Act does not set out to tell people how to make particular work situations safe and healthy.

Rather, it requires them to approach that systematically but flexibly, with the ability to draw on generalist information in Regulations, Codes of Practice, and Best Practice Guidelines, as well as from their workforce and specialist Department personnel.

The standard that they have to achieve is that of having taken all reasonably practicable steps to make work safe – what can reasonably be expected given the circumstances, state of knowledge, resources etc. They don't have to deal with things that they couldn't possibly have known about or control.

3.2 What the act sets out to do

The Health and Safety in Employment Act's object is to promote the prevention of harm to all persons at work and other persons in, or in the vicinity of, a place of work.

Section 5 of the Act sets out the object, and lists various means contained in the Act to achieve it, including by:

- Promoting excellence in health and safety management, in particular through being systematic
- Defining hazards and harm in a comprehensive way so that all hazards and harm are covered, including harm caused by work-related stress and hazardous behaviour caused by certain temporary conditions
- Imposing duties to ensure that people are not harmed as a result of work activities
- Setting requirements that relate to the taking of all practicable steps to ensure health and safety, and are flexible to cover different circumstances
- Encouraging the health and safety of volunteers
- Requiring employee participation in the improvement of health and safety and encouraging good faith co-operation in places of work
- Providing a range of enforcement methods in response to failure to comply with the Act. 1.4 Coverage is broad

3.3 The coverage of the act

The Act imposes duties on a wide range of working relationships in nearly all places of work.

This guide describes duties as set out in the Act and affecting different parties in the workplace:

- Employers
- Persons who control places of work
- Persons who sell or supply plant for use in places of work
- Self-employed people
- Principals to contracts
- Employees
- Volunteers
- People receiving on-the-job training or gaining work experience

Overlapping duties

Frequently a person will have duties under more than one section of the Act. For example, an employer may have duties:

- To employees (sections 6-14, 19A-19I)
- In relation to volunteers, or people receiving on-the-job training or work experience (sections 3C-3F)
- To ensure that the action or inaction of employees does not endanger the public (section 15)
- As a person who controls a place of work (section 16)
- As a principal to a contract (section 18)
- As a person who sells or supplies plant for use in a place of work (section 18A)
- In the event of accident, injury or illness (sections 25 and 26) and/or
- To comply with notices, sampling or other requirements of health and safety inspectors and/or departmental medical practitioners (sections 31, 33, 35, 37, 39-45).

Similarly, an employee has duties:

- Not to endanger themselves or others (section 19)
- Not to interfere with an accident scene (section 26) and/or
- To comply with notices, sampling or other requirements of health and safety inspectors and/or departmental medical practitioners (sections 31, 35, 37, 39-45).

Activity

What is the Health and Safety in Employment Act‘s main objective?

An employee who has management or supervisory responsibilities may be authorized to represent the interests of the employer or make statements on the employer’s behalf. They also have the duties of an employee in respect of their own conduct.

A self-employed person has similar responsibilities to an employee, and may also have duties:

- As a person who controls a place of work (section 16);
- As a principal to a contract (section 18);
- As a person who sells or supplies plant for use in a place of work (section 18A);
- In relation to volunteers, or people receiving on the job training or work experience (sections 3C-3F); or
- In the event of accident, injury or illness (sections 25 and 26).

Officers, directors or agents of a body corporate have duties. Where their actions or decisions lead to breaches of the Act by the company or other body corporate, they may be charged, whether or not the body corporate is prosecuted (section 56).

A duty may apply to more than one person at a time

Where the Act imposes a duty on one person in a particular set of circumstances, it may apply to another person at the same time, whether in the same or a different capacity. This means more than one person may be held liable for a particular breach of the Act, or the same person may be held liable under more than one section.

State employees are included

The Act applies to local and central government agencies including departments, Crown-owned entities, or state-owned enterprises. Chief executive officers of government agencies are responsible for ensuring that the state meets its obligations as an employer under the Act. There are, however, some exemptions in relation to the defence forces, and some aspects of emergency services.

Other legislation is not affected

Other legislation may impact on health and safety in the workplace, even though it is not primarily concerned with the issue — examples are the Gas Act 1992, the Building Act 1991, and the Electricity Act 1992. In these cases there may be some overlap with the Health and Safety in Employment Act.

The general principle is that, where two pieces of legislation apply to any given situation, an employer or any other person affected needs to follow both. In effect, meeting the requirements of the other legislation will usually mean that the requirements of the Health and Safety in Employment Act are being met in relation to the particular hazards covered.

Where appropriate, formal agreements have been reached between administering departments to clarify roles and responsibilities. Where the gravity of a particular offence justifies it, criminal charges under the Crimes Act may take precedence.

Object of the Act

The object of this Act is to promote the prevention of harm to all persons at work and other persons in, or in the vicinity of, a place of work by—

1. Promoting excellence in health and safety management, in particular through promoting the systematic management of health and safety; and
2. Defining hazards and harm in a comprehensive way so that all hazards and harm are covered, including harm caused by work related stress and hazardous behaviour caused by certain temporary conditions; and
3. Imposing various duties on persons who are responsible for work and those who do the work; and
4. Setting requirements that—
    a. Relate to taking all practicable steps to ensure health and safety; and
    b. Are flexible to cover different circumstances; and
5. Recognising that volunteers doing work activities for other persons should have their health and safety protected because their well being and work are as important as the well-being and work of employees; and
6. Recognising that successful management of health and safety issues is best achieved through good faith co-operation in the place of work and, in particular, through the input of the persons doing the work; and
7. Providing a range of enforcement methods, including various notices and prosecution, so as to enable an appropriate response to a failure to comply with the Act depending on its nature and gravity; and prohibiting persons from being indemnified or from indemnifying others against the cost of fines and infringement fees for failing to comply with the Act.]

Inspectors

1. The Ministerial Secretary may appoint any person who has passed the prescribed examinations or acquired the prescribed experience to be a health and safety inspector for the purposes of this Act.
2. An inspector shall perform and exercise the functions and powers of an inspector subject to the directions and conditions (if any) for the time being imposed by the Secretary.
3. Every inspector shall have a certificate of appointment, in a form approved by the Secretary.

Functions of inspectors

The functions of an inspector are:

1. To help employers, employees, and other persons to improve safety at places of work, and the safety of people at work, by providing information and education; and
2. To ascertain whether or not this Act is being and will [has been, is being, or is likely to] be complied with; and
3. To take all reasonable steps to ensure that this Act is being complied with; and
4. All other functions conferred on inspectors by this Act or any other enactment.

Powers of entry and inspection

1. For the purpose of performing any function as an inspector, any inspector may at any reasonable time enter any place of work and--
    a. Conduct examinations, tests, inquiries, and inspections, or direct the employer or any other person who or that controls the place of work, to conduct examinations, tests, inquiries, or inspections:
    b. Be accompanied and assisted by any other people and bring into the place of work any equipment necessary to carry out the inspector's functions:
    c. Take photographs and measurements and make sketches and recordings:
    d. Require the employer, or any other person who or that controls the place of work, to ensure that the place of work or any place or thing in the place of work specified by the inspector is not disturbed for a reasonable period pending any examination, test, inquiry, or inspection:
    e. Require the employer, or any other person who or that controls the place of work, to produce documents or information relating to the place of work or the employees who work there and permit the inspector to examine and make copies or extracts of the documents and information:
    f. Require the employer, or any other person who or that controls the place of work, to make or provide statements, in any form and manner the inspector specifies, about conditions, material, or equipment that affect the safety or health of employees who work there.

1A. An inspector may do any of the things referred to in subsection (1), whether or not—

a. The inspector or the person whom the inspector is dealing with is in the place of work; or

b. The place of work is still a place of work; or

c. The employer's employees work in the place of work; or

d. The person who was in control of the place of work is still in control of it; or

e. The employer's employees are still employed by the employer; or

f. In respect of a document or information, the document or information is—

g. In the place of work; or

h. In the place where the inspector is; or

i. In another place.]

2. Notwithstanding subsection (1) [or subsection (1A)] of this section, an inspector shall not enter a place of work—

a. That is, or is within, a home; or

b. Through a home,-- except with the consent of an occupier or pursuant to a warrant issued under subsection (3) of this section.

3. A District Court Judge who, on application made on oath, is satisfied that there is reasonable ground for believing that a home—

a. Is a place of work or has a place of work inside it; or

b. Is the only practicable means through which a place of work may be entered,-- may issue to an inspector named in it a warrant to enter any part of the home that is, or is the only practicable means through which the inspector may enter, the place of work.

4. Notwithstanding subsection (1) of this section, an inspector shall not enter a defence area (within the meaning of section 2(1) of the Defence Act 1990) except in accordance with a written agreement between the Secretary and the Chief of Defence Force entered into for the purposes of this section and for the time being in force.

5. Notwithstanding subsection (1)(e) of this section, if all or any part of a document, or of any information, relates to any person's health status and identifies the person, no inspector shall, without the person's consent,
    a. Require any person to produce; or
    b. Examine; or
    c. Make any copy or extract from,-- the document or information (or that part of the document or information).
6. No person is required on examination or inquiry under this section to give any answer or information tending to incriminate the person.

The Enforcement of the Act

The enforcement of the HSE Act is administered by the Department of Labour through its appointed agencies and personnel e.g., Inspectors.

The purpose of OSH's enforcement policy is to achieve compliance with the Health and Safety in Employment Act 1992.

OSH achieves this by:

- Providing information and/or advice to those who have obligations under the legislation;
- Determining whether or not the legislation is being complied with; and
- Enforcing the legislation where a breach is observed or reported.

OSH's response to any observed breach of the Act is to choose the enforcement intervention that will best:

- See hazards eliminated, isolated, or minimised quickly and effectively; and
- Influence future compliance with the legislation.

Enforcement interventions

Enforcement interventions to prevent non-compliance include:

- Written warnings by an inspector;
- Improvement notices;
- Suspension notices;
- Prohibition notices;
- Revocation of registration, certificates, exemptions and approvals;
- Application for a compliance order from the Employment Relations Authority;
- Infringement notices; or
- Prosecutions.

The chosen enforcement intervention depends on:

- The seriousness of the non-compliance;
- Continued or repeated non-compliance;
- Refusal to take remedial action; and
- The harm or potential harm to those affected by the non-compliance.

4. Risk Management

4.1 General

The Code of Practice should be used on the basis that appropriate workplace health and safety risk management processes are applied. This section examines the basics of such a process.

4.2 Hazards and risks

Hazards and risks are NOT the same thing. A hazard is something with the potential to cause harm. This can include substances, plant, work processes or other aspects of the work environment. Risk is the likelihood that death, injury or illness might result because of the hazard.

For example, the energy in electricity, that has the potential to cause an electric shock and result in a serious or even fatal injury, is a hazard. The associated risk is the likelihood that a worker might be electrocuted when they come in contact with exposed live electrical parts.

The relationship between hazard and risk is sometimes represented simply as:

Risk = Hazard X Exposure

In the above relationship, the terms:

"Exposure" would cover factors such as frequency of exposure to the hazard and probability of an incident caused by the hazard, and

"Hazard" would include the possible consequences of an incident due to such a hazard e.g. death, severe injury or property damage or both.

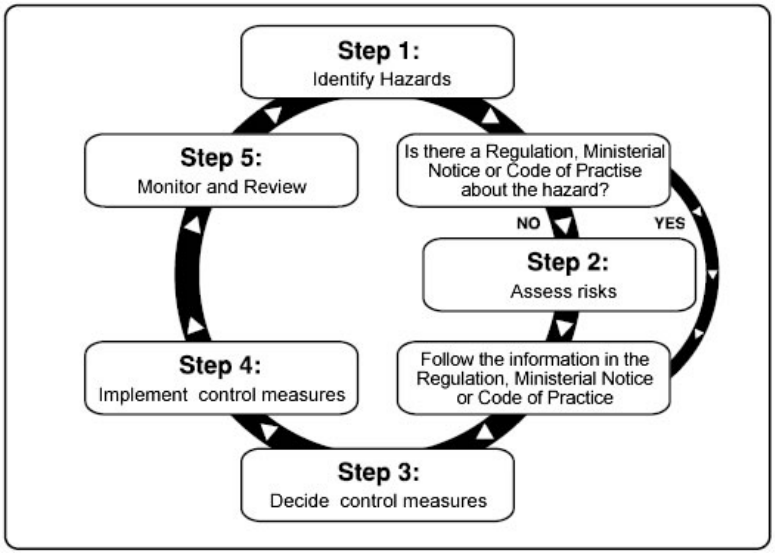
4.3 The risk management process

There are five basic steps in the risk management process, as follows:

- Identify the hazards present in a particular work situation. If there is a regulation or ministerial notice about the hazards, you must implement those requirements.
- Assess the risks of injury or property damage that may result from the hazards. This step will help to determine the level of risk associated with the identified hazards and establish a priority list based on the risk level of each hazard. The desired outcome is a priority list for control measures.

- Decide on control measures by prioritizing to eliminate the hazard or minimize the level of the risks of injury or property damage. If there is a code of practice, you must either do what the code says or adopt another way to manage the exposure to the risk. In deciding which control measures to adopt, you should start at the top of the hierarchy and work your way down.
- Implement the control measures.
- Monitor and review the effectiveness of the control measures. It may be necessary to modify the control measures or the way they were implemented if the measures were not effective or if new problems arose because of the implementation of the original control measures.

The five steps of the risk management process are illustrated below.



The risk management process

4.4 Risk Control

Where the noise levels fail to meet the legislative requirements, all practicable action must be taken to control and reduce noise emissions in that area. Methods of noise control are prioritized below according to the hierarchy of risk control options. Employees who perform the work task should be consulted with regard to control measures.

Elimination

Removing the hazard or its source from the workplace totally

Minimise

Swapping to a hazard or source with a lower risk level

Isolation

Removing the hazard from the employee or the employee from the hazard

Engineering

Physically altering the work environment

Work practices

Designing jobs to reduce employee exposures

Personal protection

Using devices for protection e.g., loud noise

If all the control measures detailed above have been exhausted and the environment still does not meet the requirements then administrative controls should be introduced to undertake the task emitting the noise at a time when it will effect as few people as possible; use job rotation to alternate noisy tasks with quiet ones and restrict access to areas of high noise levels to essential staff only.

Areas where hearing protection is required must be clearly signposted.

4.5 Control Measures

Control measures introduced must comply with the standard industry practice and must be consistent with OSH and SM-EI requirements. These include the areas of:

- Switching off all live currents before commencing work,
- Isolating supply if the whole system cannot be off-lined,
- Locking-off and tagging of isolators so that others will know of the hazard,
- Disconnecting load side of isolator,
- Proving supply is dead by testing,
- Precautions when leaving unfinished work,
- Precautions for working on live equipment,
- Safety distances from live works,
- Personnel training,
- Obey all safety rules,

- Insulating area,
- Access control for authorised personnel only,
- Inspection and testing of tools and equipment,
- Inspection of clothing, ensuring the appropriate type are used.

Activity

List the common control methods for eliminating or minimising electrical hazards in the workplace:

4.6 Evaluation of Introduced Control

Evaluation and assessment of any controls introduced must be undertaken in consultation between managers, supervisors and employees directly involved in the work area identified as possessing a noise hazard. The results of this assessment should be communicated to involved parties.

5. Supervision of Electrical Workers

Employers must ensure employees are either sufficiently experienced to do their work safely or are supervised by an experienced person (section 13 (a)).

Also, the employee must be adequately trained in the safe use of all plant, objects, substances, protective clothing and equipment that they are or may be required to use or handle (section 13 (b)).

The purpose of this section is the avoidance of harm to employees and others by ensuring that employees have the knowledge and experience that they need to safely:

- Carry out their work;
- Use plant; or
- Deal with substances;

In their place of work.

The provision applies to people receiving on-the-job training or work experience and deemed “employees” by the Act, but it doesn’t apply in relation to volunteers doing regular work.

If employees do not have sufficient knowledge or experience themselves, then they must be supervised by someone who has.

Towards ensuring that people do have adequate knowledge and experience, section 13(b) further requires that employees are adequately trained in the safe use of all plant, objects, substances, and protective clothing and equipment that they may be required to use or handle.

The standard to be met by the employer is taking "all practicable steps" to ensure these requirements are met (see 1.5, All practicable steps).

5.1 Safety tuition for electrical workers

1. This regulation applies to work to which regulation 25(1) applies.
2. No person may carry out or assist in carrying out, for the first time, work to which this regulation applies unless that person has satisfactorily completed tuition in the following subject matter:

a. Safe working practices that are appropriate to the type of work being undertaken:

b. Testing to ensure safety before commencing the work, and to ensure safety during and after the completion of the work:

c. Basic first aid:

d. Cardiopulmonary resuscitation.

3. Except where sub clause (4) applies, every person continuing to carry out or to assist in carrying out work to which this regulation applies must, at intervals not exceeding 24 months, complete refresher courses in the subject matter specified in sub clause (2).

4. Every person continuing to carry out work to which this regulation applies must, where that work involves the construction or maintenance of works,-

   a. Complete refresher courses in the subject matter specified in paragraphs (a) to (c) of sub clause (2) at intervals not exceeding 14 months; and

   b. Complete refresher courses in cardiopulmonary resuscitation at intervals not exceeding 7 months.

Supervision means the overseeing of workers, including trainees and apprentices, to ensure risks to people and property are eliminated or at least minimised. While a supervisor may perform audits, auditing should not be seen as interchangeable with supervision.

5.2 Supervision of electrical work includes:

> Health and safety matters;

> Statutory compliance e.g., what work an apprentice or restricted electrical worker is permitted to perform;

> Technical aspects e.g., compliance with AS/NZS 3000; and

> Implementation of a safe system of work.

Generally, the two distinct styles of supervision are described as:

> Direct supervision means supervision occurs at all times on a direct and constant basis; and

> General supervision means supervision where the worker does not require the constant attendance of the supervisor.

1. Only authorised electrical persons are to perform testing to prove de-energised.

2. No hand tools, other than the approved test instruments are to be used during the testing procedure.

3. Only approved test instruments, refer also to Section 5.2, that have current test and calibration status and are registered on a site electrical equipment register are to be used.

4. Prior to the commencement of testing, the test person is to remove all jewellery and metal objects that are in contact with the skin.
5. Where applicable, insulating mats are to be used for working on conductive surfaces.
6. On low voltage equipment, tests are to be conducted at the load side of the isolation point/s, by an authorised electrical person during the isolation process and at the electrical part by the electrical worker before commencing work and at the start of each new shift/day.
7. On high voltage equipment, tests are to be conducted by the switching officer at each isolation point immediately prior to applying operator earths.
8. Assess equipment to be accessed to determine if there are any live exposed parts. Exposed parts are any terminal, connection, conductor or electrical part that is able to be contacted with a standard test finger. If it is determined that there are no exposed parts, testing on energized parts can be performed with the use of an approved meter using insulating gloves only.
9. If the equipment to be worked on has live exposed parts, then apart from the minimal site specific PPE, the following PPE requirements apply:

For Low Voltage

If the person performing the testing has any part of their body within the PPE zone of an energised exposed part, they are to wear the following PPE:

- Insulating gloves rated to the highest expected voltage applicable for the task
- Face shield for electrical work
- Flame retardant clothing covering the full body, arms and legs.

For High Voltage

If the person performing testing tasks is required to work within an exclusion zone of an energised part, they are to wear the following PPE:

- Insulating gloves rated to a minimum of 1000 volts working when using the approved test instruments
- Face shield for electrical work
- Flame retardant clothing covering the full body, arms and legs.

Note: Refer to the Maintaining Electrical Tools, Protective Devices and Clothing Corporate Standard for specific information regarding flame retardant clothing, insulating gloves and face shields.

10. Verification of the test to prove de-energised task is to be recorded within plant isolation guides as per the Plant Isolation Corporate Standard.
11. A conclusive test is achieved if the voltage reading is less than 20 Volts AC for alternating current circuits and 50 Volts ripple free DC for direct current circuits.

Activity

List the minimum personal protection equipment you would require if you were testing low voltage equipment that had live exposed parts:

5.3 Procedure for Electrical Testing to Prove De-energised Requirements

1. If a testing to prove de-energised task cannot be performed as per this corporate procedure, an Electrical Engineer is to be consulted to determine an alternative test method. Where such a method is used, this process is to be documented within the Risk Assessment that relates to the work task.
2. Suitable testing devices
    a. Approved test instruments are to be inspected for damage prior to each test use.
    b. Test instruments approved for use throughout SCL

5.5 Competent Personnel

The focus of section 13 of the Act is on the ability of the individual employee to complete the task safely at any given time. This is consistent with the Act's performance-based approach, where the employer may choose how the result is best achieved. In general, employers should ensure that employees do not undertake any work unsupervised unless they are satisfied that the employee has the necessary knowledge and experience to perform it safely in that place of work. In the case of younger or inexperienced workers, it may not be enough for an employer to simply ask the employee if they are competent and receive a "yes" in answer. Where an employer is unfamiliar with an employee's competency level or an employee is unfamiliar with the work, plant, substances, or the setting where the work is being carried out, there may be an onus on the employer to have the employee demonstrate their competency.

Similarly, the fact that an employee holds a formal qualification, or experience at another place of work may not be enough — further training or supervision may be required.

5.6 Supervision of Personnel

Supervision is required where an employee or group of employees does not have appropriate knowledge or experience. The degree of supervision required is a matter to be decided in each case. Depending on the circumstances, supervision may be direct, or as a group; immediate, or remote; or it may relate only to particular aspects of the work.

Providing supervision may include a requirement to control "skylarking" in some cases where an employer is aware of behaviour that is likely to cause harm to employees or others. This requirement should be read in conjunction with that of section 15.

Supervision may also include the provision, enforcement and maintenance of safety procedures, such as a lock-out system.

Training

In addition to employees having sufficient knowledge and experience, the Act requires that employees are "adequately trained" so that they can safely perform any particular work or task.

Section 13's requirement applies equally to all categories of employee: part-time, full-time, permanent, temporary, or casual. Case law suggests that, while it is useful that a formal record of training and skills and competencies is kept, it is not essential. Instead, as stated above, the emphasis is on the ability of the individual to perform the task safely at the time.

The level of training required is "adequate", not exemplary. The emphasis of the section is on the safe use of all:

- Plant;
- Objects;
- Substances; and
- Protective clothing and equipment that employees are, or may be, required to use.

Supervisors shall ensure that, as part of their duties, the following requirements are complied with:

1. All work has been clearly identified and thoroughly planned, including arrangements for the issue of any access or test permits required for the work.
2. Any notifiable work under the HSE Regulations 1995 has been notified to the Occupational Safety and Health Service of the Dept. of Labour.
3. The potential hazards associated with the work are identified. This includes any that may arise as the work progresses.
4. All actions necessary are taken to ensure the identifiable hazards cannot cause harm to employees.
5. Employees are aware of relevant industry procedures, local instructions, operating manuals and supplier information, relating to the implementation of the requirements of this manual.

6. Employees comply with the following:
    a. They only undertake those task for which they are competent
    b. They must receive training before undertaking those task that they are not competent in
    c. The work to be done, the hazards associated with it, the procedure and the personal protective equipment and clothing and the workplace is in a safe and tidy condition.
    d. Employees new to any work are under a supervision adequate to avoid harm to themselves and others
    e. Where any supervisory work is delegated, the relevant responsibility of supervisors, as set out above, is also delegated.

Activity

Look up section 13 of the Health and Safety in Employment Act.

What does this section say about Training?

5.7 Warning and reporting procedures

Trainees should be instructed on the warning and reporting procedures used in recording and controlling of hazards in the workplace.

To assist in keeping control of the hazards we have produced some forms that will make the job easer and if kept updated regularly will provide you with the records required by the HASE Act. These are:

Material and substances register

This should be used to record all materials, chemicals and substances you use as part of your business operation.

Plant and equipment register

This should be used to list all plant, tools machinery and equipment.

Identification of hazard worksheet

This will assist you identify all types of hazards.

Material safety data sheet

This is a MSDS blank and should only be used if one cannot be provided by the product supplier.

Check lists

List all the hazards in the work environment so these can be re-assessed on a regular basis.

Hazard check schedule

A timetable to schedule your hazard inspections.

Employee hazard report

Form for all staff to report all hazards.

6. General Safety Practices in the Workplace

A preventive workplace culture is a shared set of values, beliefs, attitudes, and ways of behaving that supports the prevention of harm to people at work. It emphasizes the proactive management of hazards to eliminate them wherever practicable – and, if this is not possible, it then focuses on isolating and minimizing the hazards.

Workplaces with preventive cultures have a strong management commitment to health and safety, effective health and safety management systems, involvement of workers and their unions, communications based on good faith, and a willingness to learn from past mistakes. Preventive cultures are ones where health and safety is integrated into everyday business practice. It is not an optional 'add on'.

6.1 Workers behaviour

Employees working at a site should be displaying behaviour that promotes safety at the site. These include the following:

- Carrying out instructions properly,
- Asking if in doubt,
- Reporting unsafe conditions,
- Using correct tools and equipment,
- Keeping the workplace clean and tidy,
- Not distracting others or indulging in horseplay,
- Wearing or using protective clothing and equipment provided,
- Only using machinery if authorised to do so,
- Obeying all safety rules and signs, using only authorised tools and equipment,
- Not leaving tools on the floor or where they can fall on people below,
- Not wearing loose or torn clothing,
- Taking extra care when members of the public are present as they may not be aware of hazards.

6.2 Housekeeping

A tidy place of work is a safe place of work. It is important to plan the workplace prior to work commencing. This prevents unnecessary housekeeping problems throughout the contract.

Consideration should be given to:

- Rubbish removal and storage at intervals during the day
- Delivery of products to site should be appropriately handled
- Safe work areas
- Location of site facilities
- Storage areas for tools and equipment should be properly utilized
- Access and egress to site for staff and visitors are kept clear at all times,
- A rigid policy on de-nailing timber

There are numerous other areas that should be considered during planning to ensure good housekeeping.

Activity

Think about the last job you carried out at a site.

What did you do to promote safety?

6.3 Public access

Where construction work is being carried out consideration must be given to the public that have lawful access to, or adjacent to, the place of work.

Provisions must be in place to protect these people from any hazards created in the place of work.

This can be achieved by:

- Warning signs
- Illumination of hazard areas
- Walkway gantries with protective roofing
- Fencing, barriers

- High-visibility clothing and
- Traffic controllers, traffic lights etc

6.4 Safe Work Practices

The following practices may reduce risk of injury or fire when working with electrical equipment:

- Avoid contact with energized electrical circuits.
- Disconnect the power source before servicing or repairing electrical equipment.
- When it is necessary to handle equipment that is plugged in, be sure hands are dry and, when possible, wear nonconductive gloves and shoes with insulated soles.
- If it is not unsafe to do so, work with only one hand, keeping the other hand at your side or in your pocket, away from all conductive material. This precaution reduces the likelihood of accidents that result in current passing through the chest cavity.
- Minimize the use of electrical equipment in cold rooms or other areas where condensation is likely. If equipment must be used in such areas, mount the equipment on a wall or vertical panel.
- If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment.
- If an individual comes in contact with a live electrical conductor, do not touch the equipment, cord or person. Disconnect the power source from the circuit breaker or pull out the plug using a leather belt.

7. Electrical Safety

7.1 Workplace tools safety practices

Installation and Repair: Using Tools

Electrical employees use a variety of tools, such as nut drivers, conduit benders, electric drills, and pliers.

7.2 Hand Tools

Potential Hazards

- Poorly designed or improperly used hand tools may require excessive force and cause awkward postures resulting in tendonitis in hands, wrists and elbows.
- Short handles may press or rub against the palm and fingers causing contact stress. Small handle diameter may increase force requirements of tool leading to fatigue, discomfort and pain.
- Tools with wide handle spans require extended thumb and finger positions to activate the tool. These postures require increased finger force to provide adequate activation force increasing fatigue, discomfort and pain.
- Improper orientation of the tool handle may result in awkward position of the hand, wrist, or arm and increase force requirements of the task.

Possible Solutions

- Use power tools to do the job when repetitive or prolonged force exertion is required.
- Use a properly designed tool to promote neutral posture of the wrist and hand. Generally an inline tool is best on horizontal surfaces at about waist height, and a pistol grip is preferable for vertical surfaces at about waist height. Bent-handled tools can be designed to accommodate differing work positions and angles.
- Use tools with padded grips and handles that extend across the whole palm of the hand to minimize contact pressure.

- Ensure that tools such as screwdrivers have appropriately sized and shaped handles. Generally, handles should be about 3.5 to 8 cm in diameter. Triangular handles with rounded edges provide a better grip.
- Use tools that do not require an extended grip. The hand should be in the shape of a "C" while gripping the tool. A span of 6 to 10 cm. is best.
- Replace tools if handles are damaged.
- Take regular breaks and rotate tasks when using a hand tool for an extended period of time.
- Use fitted gloves which protect the hands from contact stress.
- Keep tools well maintained and in good repair.

7.3 Portable Power Tools

Potential Hazards

- Some portable power tools, such as pipe threaders, may be heavy or require extreme effort to counteract torque forces. Sustained use of these tools puts stress on the back, hands, arms, and shoulders.
- Tools such as jack hammers or large saws that transmit vibration may cause hand-arm vibration syndrome (HAVS). Early signs of HAVS are feelings of numbness or tingling in the fingers, hands, or arms, or numbness and whiteness in the tips of fingers when exposed to cold.
- When using tools employees may assume awkward postures including bending, stooping or extended reaching. Awkward postures maintained for long periods of time may cause fatigue, discomfort and pain, especially when heavy tools are used.
- Improper orientation of tool handles may cause awkward position of the hand, wrist, or arm and increase force requirements of the task.
- Repeatedly using a single finger to activate triggers on power tools may cause overuse of tendons and muscles leading to irritation, swelling, pain and eventually immobility.

Possible Solutions

- Use tools with a proper handle orientation that allows neutral wrist position. Generally, use tools with a pistol grip for vertical surfaces and an in-line grip for horizontal surfaces.
- Use torque bars on tools such as drills or pipe threaders to minimize the exertion required to control the tool.

- Use trigger-levers on power tools. These have a longer trigger to accommodate three fingers, rather than those with single finger trigger action.

- Maintain equipment and tools in proper working order. Unbalanced rotating parts or poorly sharpened cutting tools may create excessive vibration and increase force requirements when in use.
- Support the weight of heavy tools by using overhead or under-tool supports.
- Avoid older power tools that were not designed with ergonomics in mind and may vibrate excessively. Consider reduced-vibration tools when making new tool selection.
- Wear proper anti-vibration gloves when using power tools and use only as much finger force as necessary to provide proper control of the tool.
- Learn proper tool usage and safety practices. Employees should allow the tool or machine to do the work and should arrange the work so that they can stand upright and use the tool with the elbows close to the body.
- Keep hands warm and dry.
- Use platform ladders, regular ladder or lifts to reach higher work areas so that arms may be kept closer to the body. The arms may then safely support tools when in the power zone.
- Wear kneepads when kneeling is required.
- To reduce crouching and kneeling, sit on a stool while working on lower areas.
- Minimize the time of continuous use when operating a vibrating tool. Appropriate operating times will vary depend on the magnitude of vibration, however limiting sessions to 10 to 15 minute of continuous use with no more than 2 hours of total operating time per day is generally recognized as a prudent work/rest schedule. Other means of dampening or reducing vibration should still be observed even during shortened sessions.
- Keep cutting surfaces of tools sharp and lubricated.

Activity

Complete the table below:

When using portable power tools, list two potential hazards and possible solutions to each hazard:

Potential Hazards	Possible Solutions

7.4 Tool Belts

Potential Hazards

- Loaded tool belts may weigh over 40 kg causing an increased load and contact stress on the lower back and hips.
- Suspenders used to hold the tool belt may cause shoulder contact stress and discomfort.
- Wearing a tool belt for an extended period of time may cause fatigue, discomfort and pain.

Possible Solutions

- Use mobile tool box or bucket-style tool bag instead of a tool belt.
- Use padded belts and suspenders to evenly distribute the weight between the shoulders and the waist, thus reducing contact stress.
- Arrange tools in bags so that their weight is distributed evenly.
- When possible, reduce the weight of the tool belt by reducing the number of tools carried to those necessary for the task.

Use a backpack-style tool bag to distribute the weight of tools over the body and improve posture if tools must be carried for extended distances.

7.5 Bending and Cutting Conduit

Potential Hazards

- Manual conduit bending may require exertion of significant forces and awkward postures which may lead to overexertion of the back and shoulders.
- Bending over to cut conduit may result in overexertion to the back and shoulders.

Possible Solutions

- Use mechanical conduit benders, especially on conduit with a diameter larger than 4 cm.
- Where conditions are not optimal and power equipment may not be available, prefabricate as much conduit as possible to minimize on-site bending.
- Where manual benders are required, use longer handles thus increasing leverage and minimizes the amount of force required to bend conduit.
- Place conduit in a vice or fixture to maintain stability when cutting. Support conduit on a table or sawhorse.
- Wear gloves when manually bending conduit to reduce contact stress and avoid cuts. Ensure that conduit ends are properly reamed and good handles are maintained on manual conduit benders.
- Where code allows, use lightweight, flexible conduit, which does not require bending.

7.6 Drilling Holes

Potential Hazards

- Hole saws and drill bits may get stuck while spinning resulting in strong kickback and increasing the potential of severe injuries to the wrists, elbows and shoulders.
- Drills must be used frequently on floors, floor joists or rafters forcing employees to bend or reach for a work piece.
- Supporting heavy drills for extended periods of time may cause fatigue, discomfort and pain.
- Regular exposure to vibration when using hand-held power tools may cause hand-arm vibration syndrome (HAVS)

Possible Solutions

Use an angle drill for large holes. This provides a longer lever arm to control torque forces.

- Use a torque bar to help absorb the shock of a stuck bit.
- Use drilling tools with a built-in kick-back clutch.
- Do not force the bit. Apply even pressure and let the drill do the work.
- Use bit extensions to help minimize reaching.
- Use platform ladders, regular ladders or lifts to reach higher work areas so that arms may be kept closer to the body. The arms may then safely support tools when in the power zone.
- Ask builders to use materials that do not require drilling, such as engineered wood products with knockouts.
- Ask builders to use spacers while laying fresh concrete to minimize drilling after concrete has cured.
- Ensure that tool bits are sharp before using. Replace or sharpen bits frequently.
- Use a stool to improve access and minimize reaching.
- Wear kneepads when frequent or prolonged kneeling is required.

Electrically powered equipment, such as hot plates, stirrers, vacuum pumps, electrophoresis apparatus, lasers, heating mantles, ultrasonicators, power supplies, and microwave ovens are essential elements of many laboratories. These devices can pose a significant hazard to laboratory workers, particularly when mishandled or not maintained. Many laboratory electrical devices have high voltage or high power requirements, carrying even more risk. Large capacitors found in many laser flash lamps and other systems are capable of storing lethal amounts of electrical energy and pose a serious danger even if the power source has been disconnected.

7.7 Case Studies

Voltage: 0. Result: Electric shock. Location: Domestic

An electrician was called in to repair a damaged mains cable in a domestic installation. A test was carried out on the cable sheath using a non-contact voltage detector to see if the cable was live. However, as the cable was a neutral screen cable it meant that a voltage detector of this type would not work. The electrician then proceeded to cut through the cable with a hacksaw and he received an electric shock.

Voltage: 0. Result: Electric shock. Location: Commercial

A painter using a hand-held electric angle grinder to clean a steel column received an electric shock. He was using the grinder with the power lead draped over his shoulder in order to keep the lead away from the grinding wheel. Before it had stopped rotating he moved position and the wheel cut into the power lead, exposing the live phase conductor.

One of his hands touched the phase and neutral conductors now exposed in the damaged lead and he received an electric shock. Power was supplied through an RCD socket outlet, but current flow to earth was detected by the RCD, which was tested and found to be working correctly. The company subsequently put notices on RCD-protected equipment warning of the need to take care and that an RCD is not a substitute for basic electrical safety when using power tools.

8. Working at Heights

8.1 Personal Fall Protection

- Systems of work and equipment that secure a person to a building or structure are known as personal fall protection.
- Personal fall protection systems should be used to minimize the risk of a person falling from a height (travel restraint devices)
- Injury to a person after they have fallen from height (fall-arrest systems).
- Personal fall protection may be required to be used in conjunction with other fall protection systems.
- Personal fall protection discussed in this section includes travel restraint devices and fall arrest systems.

The use of these systems requires appropriate training to ensure the equipment is worn, attached and used in the correct way.

A travel restraint device prevents a person from reaching an unprotected edge by tethering them to an eye-bolt or other suitable anchorage point. This type of personal fall protection system is preferred over those that arrest a person after they have fallen.

Generally, the system consists of a safety belt or harness that is connected by a lanyard to a suitable anchorage point or static line. The system must be set up to prevent the wearer from reaching the edge.

Where a temporary roof anchor is used as an anchorage for a travel restraint system, it must be installed in accordance with the manufacturer's or designer's instructions. The roof or other building component to which an anchor will be attached must be checked by a competent person to verify that it is suitable for supporting the anchor. It is preferable that travel restraint systems are used in conjunction with other fall prevention methods, such as guardrails, safety nets and catch platforms. The anchorage points should be capable of taking the load.

Activity

Explain how a travel restraint device works:

A fall-arrest system is designed to arrest the fall of a person. The following points describe the different components of a fall-arrest system:

- A fall-arrest harness is an assembly of interconnected shoulder and leg straps, with or without a body belt designed to spread the load over the body and to prevent the wearer from falling out of the assembly.
- A lanyard is a line used, usually as part of a lanyard assembly, to connect a fall-arrest harness to an anchorage point or static line.
- A lanyard assembly consists of a lanyard and a personal energy absorber.
- The lanyard assembly should be as short as practicable and the working slack length not more than 2 m under a free fall condition.

Types of fall-arrest systems

- Where there is a risk of a free fall up to 2 m, a fall-arrest harness connected to a lanyard assembly and attached to a fall-arrest static line or an anchorage point
- Where there is a risk of a free fall of not more than 600 mm, a ladder belt connected to a lanyard of not more than 300 mm in length attached to a ladder fall-arrest device.

An important factor in the safe use of a fall-arrest system is to reduce the free fall distance as far as possible. Correctly installed fall-arrest equipment will only safely arrest a fall if there are no obstructions in the fall path. The longer the free fall distance, the greater the risk of the person hitting obstructions.

Before a fall-arrest system is used, the work area should be inspected to ensure there are no obstructions in the potential fall path. Any obstruction should be removed from the fall path area.

In the event of a person falling, immediate action should be taken to retrieve the person.

Fall-arrest harnesses, lanyards and static lines provide a satisfactory degree of fall protection provided the following points are taken into account:

- Persons should be properly trained and supervised in the use of the equipment.
- Persons using fall protection such as a fall-arrest harness, should not work in isolation.
- A lanyard assembly should be as short as possible and the working slack length not more than 2 m when used in conjunction with a fall-arrest system to minimize the pendulum effect (belaying).
- The fall-arrest anchorage point (fixed or travelling on static lines) should be located so that the lanyard can be attached before the user moves into a position where he or she would be at risk from a fall. Anchorage points should have a capacity of 15 kN.
- The components of a fall-arrest system should be compatible. The use of non-compatible components could lead to ineffective equipment that presents a risk of injury from falling to the person using the equipment.

A work positioning harness may be used with a short lanyard to restrict free fall to less than 600 mm.

Activity

What type of fall-arrest system would you use when there is a risk of free-fall of up to 2 metres?

Catch platform and safety nets should only be used where it is not possible to provide any more reliable means of fall protection. For example, the erection of physical barriers or personal protection systems.

A catch platform is a temporary platform located below a work area to catch a person after they have fallen. It should be of robust construction and designed for the potential impact of the load.

A safety net must be installed as close as possible to the underside of the work area, but not in contact with the surface. The safety net must cover an area extending beyond the work area.

8.2 Portable Ladders (SM-EI Part 1 & 2 Sects. 6, 10, 12 & 14; Part 3 Sect. 7)

Am I In Danger?

You risk falling if portable ladders are not safely positioned each time they are used. While you are on a ladder, it may move and slip from its supports. You can also lose your balance while getting on or off an unsteady ladder. Falls from ladders can cause injuries ranging from sprains to death.

How Do I Avoid Hazards?

- Position portable ladders so the side rails extend at least 3 feet above the landing.
- Secure side rails at the top to a rigid support and use a grab device when 1 metre extension is not possible.
- Make sure that the weight on the ladder will not cause it to slip off its support.
- Before each use inspect ladders for cracked or broken parts such as rungs, steps, side rails, feet and locking components.
- Do not apply more weight on the ladder than it is designed to support.
- Use only ladders that comply with OSH design standards

Loads

Self-supporting (foldout) and non-self-supporting (leaning) portable ladders must be able to support at least four times the maximum intended load, except extra-heavy-duty metal or plastic ladders, which must be able to sustain 3.3 times the maximum intended load.

Angle

Non-self-supporting ladders, which must lean against a wall or other support, are to be positioned at such an angle that the horizontal distance from the top support to the foot of the ladder is about 1/4 the working length of the ladder.

In the case of job-made wooden ladders, that angle should equal about 1/8 the working length. This minimizes the strain of the load on ladder joints that may not be as strong as on commercially manufactured ladders.

Rungs

- Ladder rungs, cleats, or steps must be parallel, level, and uniformly spaced when the ladder is in position for use. Rungs must be spaced between 22 to 27 cm apart.
- For extension trestle ladders, the spacing must be 20 to 60 cm. for the base, and 18 to 30 cm on the extension section. Rungs must be so shaped that an employee's foot cannot slide off, and must be skid-resistant.

Slipping

> Ladders are to be kept free of oil, grease, wet paint, and other slipping hazards. Wood ladders must not be coated with any opaque covering, except identification or warning labels on one face only of a side rail.

Other Requirements

> Foldout or stepladders must have a metal spreader or locking device to hold the front and back sections in an open position when in use.

> When two or more ladders are used to reach a work area, they must be offset with a landing or platform between the ladders.

> The area around the top and bottom of ladder must be kept clear.

> Ladders must not be tied or fastened together to provide longer sections, unless they are specifically designed for such use.

> Never use a ladder for any purpose other than the one for which it was designed.

Activity

Provide details of what you would check for when inspecting a ladder, prior to use:

Case Reports

The following Case Report was investigated by OSH illustrate how seemingly innocent workplace activities can have deadly consequences.

A Ladder Failure

An extended ladder erected according to standard practice against a pole broke under the weight of a well-built line man. The ladder was wood-type, reinforced by fibreglass rods sealed in resin-covered groove recess in each e.g., The ladder was subject to a regular inspection regime.

On investigation it appears that the resin had cracked in places and that this appears to have allowed the rod to slip along its length, reducing its ability to reinforce. It is understood that a variety of ladder brands and models incorporate this type of design.

The employer withdrew all ladders of this type from use, pending the outcome of an investigation. Any further available information will be advised in due course.

Employers are advised to check for signs of resin degradation or failure in this type of ladder and to be particularly vigilant in the inspection and withdrawal from service of defective items.

8.2 Scaffoldings (SM-EI Part 1, 2 & 3, Rules 2 & 3)

Scaffolding is used widely on both residential and commercial sites and provides a good working platform at any height. Constructing a scaffold is a complex task. It needs to be designed and erected to suit the type of work to be carried out, the site conditions, and the anticipated work load (e.g., the number of workers expected to be working on the scaffold, their materials and tools etc.)

As there are a wide variety of systems available, you need to carefully select the type to suit the intended purpose. Often safeguards to prevent workers falling from scaffolding and working platforms are inadequate or not used at all.

Before You Work on any Scaffold

Ask yourself, have you made sure all scaffolding is suitable and safe to use?

For example:

- Is the scaffold built to suit the work at hand?
- Is it erected on a firm foundation/have you considered the need for sole plates?
- Are all guardrails, midrails and toe-boards in position and at the correct height?
- Are there enough planks to form the work platform and are they secured in position?
- Are the platforms at the correct levels?
- How far is it from the closest plank to the workface, and also to the outer edge of the scaffold?

Scaffolding Solutions

Sole plates for tubular scaffold standards.

Scaffolding the perimeter of a building can provide an excellent working platform at any height.

- Is there an inside guardrail fitted if the scaffold is 200 mm or more away from the work surface/structure?
- What access is provided to and between platforms?
- Is a full safety harness needed?
- Are all scaffold ties in place?
- Will the scaffold carry the necessary loads, including workmen and any tools and materials? (make sure you provide all the details about how it is going to be used when you're having the scaffold built).

Ensured that a certified scaffolder is in direct charge of erection, alterations or dismantling of any scaffold 5 metres or more in height (and a register kept for general inspection)?

Activity

What would you need to check for if you were erecting, altering, dismantling, or using a scaffold of 5 metres or more in height?

Note: Any person who is using a scaffold 5 metres or more in height should check that the scaffold register (or similar Scaf-tag or Acu-log systems) is completed, current and up to date.

8.3 Harnesses (SM-EI Part 1, 2 & 3, Rules 2 & 3; EEA Guide for the Operation and Maintenance of Elevating Work Platforms)

Reference should be made to OSH Guidelines for the Prevention of Falls.

Fall Restraint

Fall restraint includes methods such as perimeter edge guard-railing, roof edge protection as well as fall restraint systems such as travel restraint devices. These will actually prevent a worker from falling over the edge (where a fall is taken to be a fall from the roof or unprotected edge of a building).

Any rigging of anchorages and lines for these systems is an extremely specialized area and they should only be used if you have been fully trained.

Fall Arrest

Fall arrest systems and their related safety harnesses, lines etc. are designed to catch and hold a person in the event of a fall. They are not designed to hold a person in a working position.

Fall arrest systems only provide protection for the person using the safety harness once the worker has already fallen – they don't prevent falls. This is why they should only be used when there is no other form of fall restraint available.

Use of safety harnesses, fall arrest systems and the related rigging of static lines, anchorages etc. is an extremely skilled and specialised area and should only be used as a back up, and when the user has been fully trained. In most situations there is always another means of preventing a fall (such as scaffolding the work, working from an EWP, perimeter edge protection etc.) instead of relying on a fall arrest system by itself.

Fall Protection Systems / Safety Harnesses Solutions

When guardrails are temporarily removed, a safety harness should be worn with a lanyard attached to the structure. A typical safety harness with leg and shoulder straps and lanyard – this lanyard is also fitted with a shock absorber.

Safety Harnesses Solutions

Where a fall has been arrested, the person must be rescued immediately.

Faintness and serious blood circulation problems can occur which can lead to brain damage or death in minutes.

For this reason, never use these systems unless you have been fully trained, and only where there are emergency procedures in place which enable a rescue within a few minutes.

Never work alone and always have emergency procedures in place.

8.4 Protective Clothing

Footwear that minimizes the risk of slipping should be worn when working where there is a risk of falls from heights. Consideration should be given to the surface being worked on. For example, a surface slippery from wet conditions.

A safety helmet should be attached securely to the person's head so that it remains in place should the person be arrested by fall protection equipment during a fall.

9. Electrical Incidents

9.1 Contact with Power Lines

Am I In Danger?

Overhead and buried power lines at your site are especially hazardous because they carry extremely high voltage. Fatal electrocution is the main risk, but burns and falls from elevations are also hazards. Using tools and equipment that can contact power lines increases the risk.

Examples of equipment that can contact power lines:

- Aluminium paint rollers
- Backhoes
- Concrete pumpers
- Cranes
- Long-handled cement finishing floats
- Metal building materials
- Metal ladders

9.2 A significant hazard is identified

Where a significant hazard is identified, the Act sets out the steps an employer must take:

1. Where practicable, the significant hazard must be eliminated; This may involve removing the hazard or hazardous work practice from the workplace. Elimination is the most effective control measure. It should be noted that substitution — replacing a hazard or hazardous work practice with a less hazardous one — does not necessarily result in elimination;
2. If elimination is not practicable, the significant hazard must be isolated . This may involve isolating or separating the hazard or hazardous work practice from people not involved in the work or the general work areas. It could be done by marking off hazardous areas, or installing screens or barriers;

3. If it is impracticable to eliminate or isolate the hazard completely, then the employer must minimise the likelihood that the hazard will harm employees. In addition, the employer must, where appropriate:
    a. Provide, make available to, and ensure the use of suitable clothing and equipment to protect the employees from any harm arising from the hazard
    b. Monitor employees' exposure to the hazard
    c. Seek the consent of employees to monitor their health; and
    d. With their informed consent, monitor employees' health.

This includes introducing work practices that reduce the risk. It could limit the amount of time a person is exposed to a particular hazard, or involve the use of protective equipment.

9.3 Preventing Electrical Hazards

There are various ways of protecting people from the hazards caused by electricity, including insulation, guarding, grounding, and electrical protective devices. Laboratory workers can significantly reduce electrical hazards by following some basic precautions:

- Inspect wiring of equipment before each use. Replace damaged or frayed electrical cords immediately.
- Use safe work practices every time electrical equipment is used.
- Know the location and how to operate shut-off switches and/or circuit breaker panels. Use these devices to shut off equipment in the event of a fire or electrocution.
- Limit the use of extension cords. Use only for temporary operations. In all other cases, request installation of a new electrical outlet.
- Use only multi-plug adapters equipped with circuit breakers or fuses.
- Place exposed electrical conductors (such as those sometimes used with electrophoresis devices) behind Plexiglas shields.
- Minimize the potential for water or chemical spills on or near electrical equipment.

Insulation

All electrical cords should have sufficient insulation to prevent direct contact with wires. In a laboratory, it is particularly important to check all cords before each use, since corrosive chemicals or solvent vapours may erode the insulation.

Damaged cords should be repaired or taken out of service immediately, especially in wet environments such as cold rooms and near water baths.

Guarding

Live parts of electric equipment operating at 50 volts or more (i.e., electrophoresis devices) must be guarded against accidental contact. Plexiglas shields may be used to protect against exposed live parts.

Grounding

Only equipment with three-prong plugs should be used in the laboratory. The third prong provides a path to ground that helps prevent the build-up of voltages that may result in an electrical shock or spark. This does not guarantee that no one will receive a shock, be injured, or be killed. It will, however, substantially reduce the possibility of such accidents, especially when used in combination with other safety measures.

Circuit Protection Devices

Circuit protection devices are designed to automatically limit or shut off the flow of electricity in the event of a ground-fault, overload, or short circuit in the wiring system. Fuses, circuit breakers, and ground-fault circuit interrupters are three well-known examples of such devices.

Fuses and circuit breakers prevent over-heating of wires and components that might otherwise create hazards for operators. They disconnect the circuit when it becomes overloaded. This overload protection is very useful for equipment that is left on for extended periods of time, such as stirrers, vacuum pumps, drying ovens, variacs and other electrical equipment.

Activity

What electrical equipment must be guarded against accidental contact?

10. Special Hazards

What are Special Hazards? Where are they? They exist in virtually every facility, in every business sector. From fuel storage at airfields, to oxygen storage in hospitals. From explosive, volatiles in manufacturing operations, to electrical faults which threaten the data communications networks that are today's business lifeline.

Despite their endless variety, special hazards have three things in common. First, ordinary sprinkler systems do not control or extinguish Special Hazards fires. Second, these fires grow with great speed in all directions. And third, it takes critical insight not only to identify your Special Hazards, but to apply the most appropriate solutions.

10.1 Special Hazards (Electrical)

Some special electrical hazards and causes of injury can be broken into three broad categories. These categories are:

- Electric shock causing injury or death. The electric shock may be received by direct contact, tracking through or across a medium, or by arcing;
- Arcing, explosion or fire causing burns. The injuries are often suffered because arcing or explosion or both occur when high fault currents are present; and
- Toxic gases causing illness or death. Burning and arcing associated with electrical equipment causes a range of gases and contaminants to be present. Compounds ranging from ozone to cyanide and sulphuric acids can be present as well as the hazards such as low oxygen content in the air.

The three common electrical hazards may be present individually or combined.

For example, if a fault occurred in the main switch-room of a large shopping centre all three of the electrical hazards could be present. The presence of step and touch potentials10 should be addressed as well as the potential for an explosion. Further, burning materials such as PVC and epoxy resins can cause the atmosphere to become hazardous.

Parts that are normally energized or that may become energized under fault conditions must be treated as live until the parts are proven de-energized.

The categories of common electrical hazards, listed above, are relatively clear. However, as electricity is not usually detected by sight, smell or sound, the identification (or recognition of the potential) of the hazards can be more difficult. Refer to section 4.3 of this Code for guidance regarding the identification of hazards and section B.1 for further information on electrical hazards.

Areas, outside the scope of this Code, that should also be addressed include:

- The flammable atmosphere in battery rooms or hazardous locations;
- Working in confined spaces;
- Electric field strength and magnetic field strengths. These fields, especially if the source of the field is a direct current, can cause interference with cardiac pacemakers and other medically implanted electronic devices. Precautions should also be taken to prevent other hazards such as flying metal objects.
- Preventing falls, e.g. when working at height;
- Use of explosive powered tools;
- Working on roadways;
- The use of hazardous substances such as poisons, chemicals, solvents, synthetic resins, forms of asbestos and polychlorinated biphenyls (PCB);
- The use of flammable gases such as liquid petroleum, oxygen, acetylene etc; and
- The use of explosives.

Activity

Name three types of special electrical hazards:

Case Studies

Deaths due to contact with power lines causing serious harm to cable jointer

A cable jointer narrowly missed serious injury recently when he cut through a live 11kV cable. Fortunately he was wearing full PPE, including insulating gloves, which protected him from serious injury when a flashover occurred. An 11kV cable fault was identified under a large concrete driveway. A decision was made to drill a new piece of cable under the driveway and complete the joints either side, rather than dig up a large section of the driveway.

The cables on either side were exposed and an Access Permit obtained from System Control so that cable jointer could commence the following day. The cable jointer set up the site, filled in a hazard ID sheet and then proceeded to identify the cables he was required to work on. In the first hole the cables were cleaned and identified correctly.

In the second hole the roadside cable was cleaned and found to have 11kV markings on it. An assumption was made that the second cable in the hole must be the replacement cable. It turned out that the second cable was in fact a live 11kV cable which entered from the other side of the road.

Preparations were made to cut into what the jointer had incorrectly identified as the 'new cable'. The jointer believed he had the right cable and made the unsafe decision not to spike the cable (spiking the cable ensures that no one gets hurt if the wrong cable is cut). He used a sabre saw to cut into the cable and a flashover occurred – he had mistakenly cut into a live 11kV cable. He was wearing full PPE at the time including HV gloves and this protected him from serious injury.

Crane Contact with Live 33kV Sub Station Equipment Crane

A mobile crane jib slewed uncontrolled into live 33kV sub station equipment while the crane was being levelled at the site of a heavy lift. This incident is under investigation however key facts and a related reminder have been made as promptly as possible to avoid similar events elsewhere.

A two-man crane contracting team were tasked with lifting a transformer out of a zone substation yard for transport to another substation. The work plan involved the use of a fifty ton crane for the task with a planned closest approach to live equipment of no less than 4 metres, the crane being outside the zone sub security fence. The crane jib was partially extended and raised and left slew-unlocked while a low loader was backed in beside the crane. The second of the two man team, not knowing that the crane slew had remained unlocked began to set the outriggers and level the crane. This resulted in a temporary 7 degree lean in the direction of the substation and the crane jib commenced a creeping slew towards the substation equipment. One of the team noticed the unexpected slewing motion then attempted unsuccessfully to arrest this by operating the leg level controls from the ground position.

While this attempt was being made, the crane continued to slew until it contacted live 33kV transformer equipment. The transformer differential protection caused the live equipment to trip within 70 milliseconds of contact, saving the ground operator from more serious shock and injury. The crane team members were experienced and closely related. One of the two operators did not know that the crane slew remained unsecured when he began to adjust the leg levels, causing the crane to list.

Although the work plan was for the crane to remain well outside the SM-EI 2.905 minimum approach distance, the unforeseen slewing had the serious consequence of loss of control over the actual distance. These factors highlight the importance of every team member being briefed and understanding their specific role.

Crane Boom Swung Into Power Line

A 29-year-old worker was electrocuted when he pushed a crane cable into a 33kV power line. The victim was part of a crew that was constructing a concrete wall. Before work began, the company safety director made sure that insulated line hoses were placed over sections of the power line near the jobsite and that a safety clearance zone was marked off for arriving cement trucks. After the wall was poured, one driver cleaned the loading chute of his cement truck with a water hose mounted on the truck. As he began to pull away, the crew supervisor yelled to him, asking if the crew could use his water hose to wash out their cement bucket suspended from the crane. The driver stopped the truck under the power line, and the victim, not realizing that the truck had moved, swung the boom to position the bucket behind the truck. When he grasped the handle of the bucket to pull it down, the crane cable came into contact with the overhead line. The victim provided a path to ground and was electrocuted.

Note: The case studies can be referred to at:

http://www.energysafety.govt.nz/templates/MultipageDocumentTOC____27255.aspx

10.2 Equipment Not Used in Manner Prescribed

Am I In Danger?

If electrical equipment is used in ways for which it is not designed, you can no longer depend on safety features built in by the manufacturer. This may damage your equipment and cause employee injuries.

Common Examples of Misused Equipment

- Using multi-receptacle boxes designed to be mounted by fitting them with a power cord and placing them on the floor.
- Fabricating extension cords with ROMEX® wire.
- Using equipment outdoors that is labelled for use only in dry, indoor locations.
- Attaching ungrounded, two-prong adapter plugs to three-prong cords and tools.
- Using circuit breakers or fuses with the wrong rating for over-current protection, e.g., using a 30-amp breaker in a system with 15- or 20-amp receptacles. Protection is lost because it will not trip when the system's load has been exceeded.
- Using modified cords or tools, e.g., removing ground prongs, face plates, insulation, etc.
- Using cords or tools with worn insulation or exposed wires.

How Do I Avoid Hazards?

- Use only equipment that is approved to meet OSH standards
- Use all equipment according to the manufacturer's instructions
- Do not modify cords or use them incorrectly.
- Be sure equipment that has been shop fabricated or altered is in compliance.

10.3 Improper Use of Extension and Flexible Cords

Am I In Danger?

The normal wear and tear on extension and flexible cords at your site can loosen or expose wires, creating hazardous conditions. Cords that are not 3-wire type, not designed for hard-usage, or that have been modified, increase your risk of contacting electrical current.

How Do I Avoid Hazards?

- Use factory-assembled cord sets.
- Use only extension cords that are 3-wire type.
- Use only extension cords that are marked with a designation code for hard or extra-hard usage.
- Use only cords, connection devices, and fittings that are equipped with strain relief.
- Remove cords from receptacles by pulling on the plugs, not the cords.
- Continually audit cords on-site. Any cords found not to be marked for hard or extra-hard use, or which have been modified, must be taken out of service immediately.

11. Radiation from Radiation Hazards

Electromagnetic energy generated by radio, television and microwave transmitters, etc. can be injurious to health.

11.1 Radiation hazards

Radiation hazards include infra-red, ultra violet and radio frequencies. At radio frequencies, tissue heating has been demonstrated to be the primary hazard to health. This effect is most pronounced at microwave frequencies, at high altitudes, and in certain parts of the body, the eyes in particular. Damage to the eyes is invariably permanent because the eye does not contain a self repair mechanism.

An associated hazard arises from voltages induced in conducting objects subjected to strong fields. The voltages can lead to burns, detonate electric detonators, and interfere with the operation of electronic apparatus. Persons with metal implants in the body, or who use cardiac pacemakers, especially are at risks.

11.2 Antenna Systems

Under normal circumstances it is considered that, if they do exist, unsafe radiation levels are only likely to be within a few meters of a television broadcast antenna, or close to the beam axis (boresight) of a microwave antenna, and within a few metres of the feed.

11.3 Transmitters

It is considered that there is relatively little radiation from the metal cabinets of transmitters operating at frequencies above 30MHz, but at lower frequencies radiant energy is less easily contained, and if the transmitter is capable of delivering a power output of 500 W or more, there is a possibility that dangerous voltages will be induced in nearby structures.

The following is a brief guide to the body of research undertaken worldwide.

11.4 Microwave Transmitter Testing

When testing a microwave transmitter on a bench, use a dummy load rather than an antenna. If an antenna must be used, position it in such a way that there is no chance of anybody encountering the near radiation field.

Under no circumstances make a visual examination of the feed or reflecting surfaces of an energized antenna, a s this could result in irreversible eye damage.

11.5 Ultra Violet Light

Ultra Violet should be contained and switched off while inserting or removing Eproms.

Similar precautions should be taken when exposing sensitized printed circuit boards to UV light.

11.6 Energy Radiating Devices (Radioactive Devices, Lasers, Electro-Magnetic Radiation Devices)

Excessive levels of exposure to radiation from radioactive elements can cause burns, tissue damage and long-term health problems.

The risks can be managed by:

- Only allowing authorized personnel to enter restricted areas.
- Only allowing authorized person to work on and with radioactive devices.
- Restricting entry to any area where a radioactive device has been damaged.

Laser beams can cause permanent eye damage, burns and tissue damage.

The risks can be managed by:

- Only allowing authorized personnel to enter restricted areas.
- Do not enter areas displaying laser warning signs unless authorized
- Only authorized people are to work on and with laser devices
- Ensuring that personnel do not look into laser beams or move into their path.

Activity

What shouldn't you do whilst carrying out testing on microwave transmitters?

11.7 Electrical Storms

Both electrostatic and electromagnetic fields are associated with electrical storms. Never work on structures or equipment in which voltages are likely to be induced by such fields, while electrical storms are in the vicinity. Also, keep away from any site on which there is only a small hut or enclosure while an electrical storm is in progress.

11.8 Asbestos

Asbestos dust is a health hazard. All employees carrying out asbestos related work, or working where asbestos dust may be present, shall comply with the health and Safety in Employment (Asbestos) regulations 1998.

Restricted work in terms of these regulations is notifiable.

Most work involving asbestos removal must be carried out under the direct supervision of a person holding a certificate of competence for restricted work with asbestos.

Guidance on the precautions required with asbestos is contained in OSH publication Guidelines for the Management and Removal of Asbestos 1999.

11.9 Dust and Gases

A hazardous area can be found where an explosive atmosphere is present or expected to be present in quantities that require special precautions for the construction, installation and use of potential ignition sources. The explosive atmosphere may be caused by the presence of flammable gas, vapour or combustible dust in suspension or in layers.

Some gases are toxic, some form explosive mixtures with the air and all gases can cause asphyxiation. When working in or near areas where these and other gases are present, the necessary precautions shall be taken.

Compressed gases shall be stored, transported and used in accordance with the hazardous Substances (Compressed Gas) Regulations 2004.

The safe exposure limits that shall be used for toxic gases are set out in OSH publication Workplace Exposure Standards 2002.

Where applicable, precautions set out for “Work in Confined Spaces” and “Work in Areas subject to Gas Flooding” shall be taken to avoid hazard from gases.

Suitable respirators shall be used where necessary.

Any person carrying out work in hazardous areas must be competent in terms of the requirements of AS/NZS 2381, or else work under the supervision of such a person. He or she should also be familiar with the Hazardous Substance (Classification) Regulations 2001 and other Hazardous Substance regulations that stipulate methods that must be followed to control hazards in hazardous areas.

Sparks (ignition source) from switches, portable tools and test equipment, etc can cause explosions in hazardous areas. Before carrying out any electrical work in a hazardous area, it is vital that the flammable gases, combustible dust, etc be identified and then removed by an appropriate means. After completion of any gas removal process, gas detection tests must be carried out to ensure that the area is safe before commencing work.

Since many gases are heavier than air, they are likely to collect in garage pits, sewer traps, manholes and similar laces. Before and during work in pits and manholes, etc a gas detector must be used to monitor personal safety and a “watcher” , competent to carry out any needed rescue, is normally required. Special training is generally required before attempting such work.

11.10 Chemicals

Electrical works may be carried out in an area where hazardous chemicals are found. All the precautions and regulations governing the safe practices in these areas need to be adhere to and information given on the Material safety Data Sheets to be noted.

Management of Hazardous Chemical substances

- Providing means for safe storage and disposal of a substance hazardous to health;
- Prohibiting eating, drinking and smoking in contaminated areas;
- Vacuuming in areas where dust-producing processes take place;
- Keeping lids on containers when not in use; and
- Providing and using facilities for washing and showering.

Personal protective equipment

The use of personal protective equipment should be limited to situations where other control measures are not practicable or where it is used in conjunction with other measures to increase protection. Situations where the use of suitable personal protective equipment may be necessary include:

- Where all practicable steps have been taken, but adequate control has not been achieved by other means. Suitable personal protective equipment may be necessary to secure adequate control;
- Where personal protective equipment is necessary to safeguard health until such time as adequate control is achieved by other means, for example, where urgent action is required because of plant failure; or
- During routine maintenance operations where the infrequency and small number of people involved may make other control measures impracticable. In determining the relative costs of personal protective equipment and engineering control, the ongoing costs associated with training and ensuring that personal protective equipment is maintained should be considered. Where personal protective equipment is used, employers shall ensure that it is:
- Properly selected for the individual and task;
- Readily available;
- Clean and functional;
- Checked before use;

- Correctly used when required; and
- Appropriately maintained.

Employees' ability to wear the protective equipment should also be assessed. For example, medical factors may be relevant for respirator usage.

Before personal protective equipment is provided the employer shall fully explain to employees the need for its use. Training on use, maintenance and fitting should be repeated at regular intervals. Regulations 68 and 69 of the Health and Safety in Employment Regulations 1995 require designers, manufacturers and suppliers of personal protective equipment to take all practicable steps to ensure that it will give adequate protection from the harm against which it is intended to protect.

The employer should ensure that personal protective equipment is selected and used in accordance with relevant New Zealand, Australian or equivalent overseas standards, and in particular:

1. Respiratory protection design should comply with AS/NZS 1716:1994
2. Eye protection should comply with AS/NZS 1337:1992 Eye protectors for industrial applications.
3. Clothing for protection against chemicals should comply with AS3765:1990 Clothing for protection against hazardous chemicals.

12. Electrical Hazards Checklist

12.1 Are construction switchboards properly constructed and set up?

Ensure electricity switchboards are of robust design and build, and are mounted securely. Where electricity meter and fuse assembly is fitted, make sure the switchboard has an endorsed service fuse locking device. Construction switchboards should have:

- An extension lead tie-bar to prevent strain on the plug top and socket outlet connection
- Insulated cable stands for the support of cables and extension leads off the ground
- A lockable door that cannot damage power leads when closed
- A way of keeping the door open for electrical installation work
- Weatherproofing if located outdoors or anywhere subject to water exposure
- A clear area of 1 m at the front of the board
- A lockable cover over circuit breakers and safety switches (RCDs)
- Clear access to main switch/isolating switch at all times when in use.

12.2. Are there enough switchboards for the job?

Switchboards should be spaced according to the maximum allowable lengths of the extension leads being used. The maximum lengths of the most common types of flexible leads are listed below (generally the shortest length of lead should be used when setting up switchboards):

- 25 metres for 10 A extension lead with 1.0 mm^2 flexible cables cores
- 35 metres for 10 A extension lead with 1.5 mm^2 flexible cables cores
- 5 metres for 15 A extension lead with 1.5 mm^2 flexible cables cores
- 40 metres for 15 A extension lead with 2.5 mm^2 flexible cables cores

12.3. Are RCDs fitted?

All final sub-circuits of construction wiring, including the associated socket outlets and light fittings, need to be protected by 30 mA RCDs. Where work is occurring using the existing premises power all extension leads, power tools, electrical plant and equipment must not be used unless protected by 30 mA RCDs. All RCDs should be time/current tested monthly.

12.4. Are the correct type socket outlets being used?

Check that only 240 volt socket outlets with double pole switches are used on relocatable structures and portable equipment.

12.5. Are portable outlet devices suitable?

Double adapters and other types of domestic multi-plug power boards are not suitable for use on construction sites. Only use multi-plug portable devices that comply with AS 3105 and are the industrial type fitted with over current and RCD protection.

12.6. Is construction cabling identified and protected from mechanical damage?

Make sure construction cabling is clearly identified and has protection where there is a risk of mechanical damage. If a change onsite occurs that introduces or increases the risk of damage, provide additional protection. Also ensure that there is no unauthorised work on portable buildings, such as drilling, nailing, screwing and fixing of attachments.

12.7. Are electric tools and flexible leads in a safe condition?

Ensure that electric power leads and tools brought onsite are suitable and in good condition:

- use only heavy duty type extension leads and Australian approved power tools
- have leads and tools inspected, tested and tagged by a suitable qualified person at intervals of three months, keep a register of inspections
- always visually inspect leads and tools for signs of damage before use
- make sure unserviceable tools or leads are immediately withdrawn from service

12.8. Have Certificates of Electrical Safety been issued?

Ensure the electrical contractor provides you with Certificates of Electrical Safety for all construction wiring including switchboards, each certificate should detail what work the certificate covers.

12.9. Has the electrical installation been tested?

The electrical installation including all construction wiring and switchboards need to be inspected and tested by a licensed electrician or electrical inspector before use and re-rested every 6 months for the duration of the project.

12.10. Have RCDs been tested?

Ensure that all fixed and portable RCDs are tested for tripping current and time by a licensed electrician every calendar month while used on site. The tripping function of portable RCDs should be checked before use by operating the RCD's test button.

12.11. Are portable generators suitable?

If portable generators are used on site, ensure the generator:

- Is fully serviceable and has been properly maintained where supplying a fixed installation,
- Is installed by a licensed electrician, and
- Inspected by a licensed electrical inspector before use, and
- A certificate of electrical safety is provided
- Where supplying portable tools and equipment,
- Is fitted with a 30 ma RCD, and
- Provided, if necessary, with earth electrode and bonding connections according to the manufacturer/supplier information displayed on the generator.

12.12. Are extension leads being used safely?

Check that leads are not lying in mud or water or in areas where they can be damaged or become tripping hazards. Use stable, insulated lead stands to keep them above head-height. Do not allow leads to be wrapped around scaffolds or falsework - use S-shaped off-cuts of steel reinforcing bar sheathed in cut-off lengths of garden hose instead.

12.13. Are plant and temporary structures a safe distance from power lines?

Make sure there is always a safe distance between live power lines and cranes, concrete booms, earth moving equipment, elevating work platforms, hoists, scaffolds, falsework and portable ladders by strictly observing "no go zone" safe clearances.

12.14. Is electrical installation and repair work being done safely?

Make sure that all electrical installation work and any repairs to the electrical installation are only undertaken by licensed electricians working for Registered Electrical Contractors.

Activity

An electrician received flash burns to his hands when disconnecting a 230 volt cable in a roadside pillar box supplying a residential dwelling. It was found that the cable was live and when removed the conductor came in contact with the earth connection.

What hazardous practices were used by the electrician?

What general safety measures were not taken?

What was the cause of the accident?

13. Conclusions

To meet the statutory requirements of the Electricity Act and Regulations and Standards both employers and employees have a responsibility to ensure that they are competent in:

- Demonstrating knowledge of the hazardous nature of electricity;
- Demonstrating knowledge of the health and safety Employment Act,
- Demonstrating knowledge of the safety management of electrical hazards,
- Demonstrating knowledge of the general safety practices in the workplace,
- Demonstrating knowledge of special hazards,
- Demonstrating knowledge of the safe use of tools and test equipment, and
- Analysing electrical incidents.

Next Steps

Well done! You have completed the training assessment resource for Unit standard 15851- Demonstrate knowledge of electrical safety and safe working practices for electrical workers.

When you are ready to complete your assessment tasks, please contact your assessor for instructions.

Model Answers to Activity Questions

Activity (page 10)

Complete the following sentence (the first one has been done for you):

Shock results when the body becomes part of the electrical circuit; current enters the body at one point and leaves at another. Typically, shock occurs when a person contacts:

Both wires of an energized circuit

One wire of an energized circuit and the ground.

A metallic part in contact with an energized wire while the person is also in contact with the ground.

Activity (page 12)

What is the difference (in milliamperes) between a current that is barely perceptible and one that can kill?

100 milliamperes

Activity (page 15)

What is the Health and Safety in Employment Act's main objective?

To promote the prevention of harm to all persons at work and other persons in, or in the vicinity of, a place of work.

Activity (page 25)

List the common control methods for eliminating or minimising electrical hazards in the workplace:

- switching off all live currents before commencing work,
- isolating supply if the whole system cannot be off-lined,
- locking-off and tagging of isolators so that others will know of the hazard,
- disconnecting load side of isolator,
- proving supply is dead by testing,
- precautions when leaving unfinished work,
- precautions for working on live equipment,

- safety distances from live works,
- personnel training,
- obey all safety rules,
- insulating area,
- access control for authorised personnel only,
- inspection and testing of tools and equipment,
- inspection of clothing, ensuring the appropriate type are used.

Activity (page 29)

List the minimum personal protection equipment you would require if you were testing low voltage equipment that had live exposed parts:

- Insulating gloves rated to the highest expected voltage applicable for the task
- Face shield for electrical work
- Flame retardant clothing covering the full body, arms and legs.

Activity (page 31)

Look up section 13 of the Health and Safety in Employment Act.

What does this section say about Training?

The level of training required is "adequate", not exemplary. The emphasis of the section is on the safe use of all:

- Plant;
- Objects;
- Substances; and
- Protective clothing and equipment that employees are, or may be, required to use.

Activity (page 34)

Think about the last job you carried out at a site.

What did you do to promote safety?

Use of good worker behaviour and good housekeeping practices.

Use of hazard identification and control procedures

Activity (page 39)

Complete the table below:

When using portable power tools, list two potential hazards and possible solutions to each hazard:

List any two of the following hazards and appropriate solution.

Potential Hazards

- Sustained use of tools puts stress on the back, hands, arms, and shoulders.
- Vibration may cause hand-arm vibration syndrome (HAVS).
- Awkward postures maintained for long periods of time may cause fatigue, discomfort and pain, especially when heavy tools are used.
- Improper orientation of tool handles may cause awkward position of the hand, wrist, or arm and increase force requirements of the task.
- Repeatedly using a single finger to activate triggers on power tools may cause overuse of tendons and muscles leading to irritation, swelling, pain and eventually immobility.

Possible Solutions:

- Use tools with a proper handle orientation that allows neutral wrist position.
- Use torque bars on tools such as drills or pipe threaders to minimize the exertion required to control the tool.
- Use trigger-levers on power tools.
- Maintain equipment and tools in proper working order.
- Support the weight of heavy tools by using overhead or under-tool supports.
- Avoid older power tools that were not designed with ergonomics in mind and may vibrate excessively.
- Wear proper anti-vibration gloves when using power tools and use only as much finger force as necessary to provide proper control of the tool.
- Learn proper tool usage and safety practices.
- Keep hands warm and dry.
- Use platform ladders, regular ladder or lifts to reach higher work areas so that arms may be kept closer to the body.
- Wear kneepads when kneeling is required.
- Reduce crouching and kneeling, sit on a stool while working on lower areas.
- Minimize the time of continuous use when operating a vibrating tool.
- Keep cutting surfaces of tools sharp and lubricated.

Activity (page 44)

Explain how a travel restraint device works:

A travel restraint device prevents a person from reaching an unprotected edge by tethering them to an eye-bolt or other suitable anchorage point.

Activity (page 45)

What type of fall-arrest system would you use when there is a risk of free-fall of up to 2 metres?

A fall-arrest harness connected to a lanyard assembly and attached to a fall-arrest static line or an anchorage point

Activity (page 47)

Provide details of what you would check for when inspecting a ladder, prior to use:

Inspect ladders for cracked or broken parts such as rungs, steps, side rails, feet and locking components.

Activity (page 49)

What would you need to check for if you were erecting, altering, dismantling, or using a scaffold of 5 metres or more in height?

Check that the scaffold register (or similar Scaf-tag or Acu-log systems) is completed, current and up to date.

Activity (page 53)

What electrical equipment must be guarded against accidental contact?

Live parts of electric equipment operating at 50 volts or more

Activity (page 55)

Name three types of special electrical hazards:

1. Electric shock causing injury or death. The electric shock may be received by direct contact, tracking through or across a medium, or by arcing;
2. Arcing, explosion or fire causing burns. The injuries are often suffered because arcing or explosion or both occur when high fault currents are present; and
3. Toxic gases causing illness or death. Burning and arcing associated with electrical equipment causes a range of gases and contaminants to be present. Compounds ranging from ozone to cyanide and sulphuric acids can be present as well as the hazards such as low oxygen content in the air.

Activity (page 60)

What shouldn't you do whilst carrying out testing on microwave transmitters?

Under no circumstances make a visual examination of the feed or reflecting surfaces of an energized antenna.

Activity (page 67)

An electrician received flash burns to his hands when disconnecting a 230 volt cable in a roadside pillar box supplying a residential dwelling. It was found that the cable was live and when removed the conductor came in contact with the earth connection.

What hazardous practices were used by the electrician?

Working on live equipment without appropriate safety measures

What general safety measures were not taken?

Failure to isolate the cable for the supply before working on it.

Failure to use appropriate PPE.

What was the cause of the accident?

Failure to identify that the cable was live before working on it.

Not using appropriate personal protection equipment.