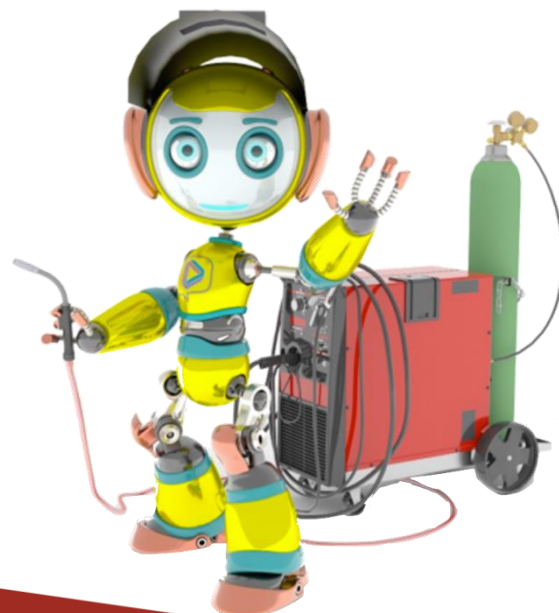




Worksafe SmartMove Certificate

Heavy Mechanical and Engineering Module Study Guide



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Contents

Learning outcomes	4
Machinery and equipment	4
Examples of dangerous machines and equipment.....	4
How do I stay safe when using mechanical equipment?	5
Quiz – Machinery and equipment	5
Forklifts.....	6
What to look out for if you have forklifts in your workplace.....	6
Quiz – Forklifts	7
Hazardous substances	7
Examples of hazardous substances	7
Common injuries and incidents from hazardous substances	8
How can you keep safe from hazardous substances?	10
Quiz – Hazardous substances	11
Welding.....	11
How do you keep safe?	12
Quiz – Welding.....	12
Noise.....	13
What can your employer do?	13
What can you do to save your hearing?	13
Quiz – Noise	14
Manual Tasks	14
How does performing a manual task result in injury?	15
What can your employer do to prevent injury from performing manual tasks?	15
Quiz – Manual tasks	16
Electricity.....	16
Lockout procedure	16
How can you keep safe around electricity?	17
Quiz – Electricity	18
Falls	18
Slips, Trips and Falls.....	18
Falls from a height	19
Being hit by falling objects	19
Quiz – Falls	20
Spot the hazards	21
Nguyen Steel	21
Hazard notebook.....	21
Heavy mechanical and engineering industry - Knowledge quiz.....	22

Heavy Mechanical and Engineering Industry

Learning outcomes

In this module you will:

1. Learn about common hazards encountered in the heavy mechanical and engineering industries
2. Understand how to prevent injuries from common workplace hazards
3. Identify existing and potential hazards at a workplace and learn how to report and record them
4. Learn how to eliminate workplace hazards and reduce risks

The heavy mechanical and engineering industries includes work activities such as:

- cutting, pressing and fabrication of steel, aluminium, etc.
- welding, grinding and casting materials
- constructing, assembling, installing, modifying, repairing and maintaining machines
- making parts, equipment, machines, instruments and tools.

Working in environments dealing with heavy equipment is dangerous. There are ways to protect yourself and be safe in this industry.

Machinery and equipment

A 15 year old, only a few days into his holiday job at a factory, had the tips of two fingers cut off in a metal press. One fingertip was reattached through microsurgery and the other finger was left permanently shortened.

Machines have moving parts and their action may cause injury to people. When working with or near machinery and equipment the mechanical hazards you may encounter include:

- moving parts that can reach, hit or crush you, such as booms or mechanical arms
- ejecting objects or material (parts, components, products or waste items) that may strike you
- being hit by mobile machinery and equipment, such as forklifts and pallet jacks.

Machine guarding can prevent or reduce access to dangerous areas of the machine. A guard can perform several functions such as protecting you from moving parts, containing ejected parts from the machine, and preventing emissions escaping.

Examples of dangerous machines and equipment

Angle grinders

Angle grinders are handheld tools with a rotating disc used for grinding and polishing work. Angle grinders are designed for grinding not cutting.

The most common angle grinder injuries are from metal particles lodging in the operator's eye. The most serious injuries are from kickback, where the disc is thrust back violently towards the operator.



Metal guillotines

Metal guillotines are used to cut sheets of metal. It is a legal requirement that metal guillotines must be guarded, operators must be trained and safe work procedures must be developed to prevent injuries.

The most common metal guillotine injuries are crushed or amputated fingers. Other injuries are from fingers jamming under the sheet of metal being cut, and strain injuries while handling large and awkward sheets of metal.



Power presses

Power presses are large machines used to stamp, cut or form metal material by using dies (tools). It is a legal requirement that all dangerous parts of power presses be securely fenced or guarded to prevent access.

When the machine is unguarded or the guarding malfunctions, it can lead to serious injury, usually amputated fingertips.



How do I stay safe when using mechanical equipment?

- Operate all machinery and equipment correctly and safely. Follow safe work procedures. Ask your supervisor to show you if safe work procedures are not available. Switch machinery and equipment off when not in use.
- Keep all machine guards in place. Any guard removed during cleaning must be replaced by an authorised person before you use the machine. It is there to protect you from moving parts.
- When first using machinery and equipment, you must be supervised until you are competent. You may be buddied up with an experienced workers as skills, knowledge and experience can be shared.
- Don't work alone with machinery unless it has an emergency stop mechanism.
- Wear PPE given to you and wear clothing that won't get caught
- Keep the area around the machinery clean.

Caution!

Never operate a machine or use a power tool:

- *that you have not be trained for*
- *while you are tired*
- *when under the influence of alcohol, drugs or medication*

Quiz – Machinery and equipment

1. Guards are fitted to machinery to:
 - a. protect you from moving parts
 - b. contain ejected parts from the machine
 - c. prevent emissions escaping
 - d. all of the above.

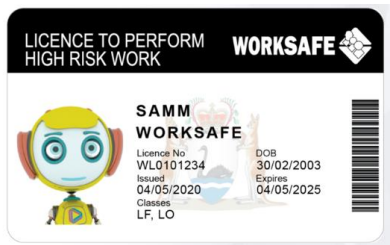
2. Which of the following statement is correct?
- The most common injuries from metal guillotines are crushed or amputated fingers
 - The most serious injuries from angle grinders are from kick-back, where the disc is thrust violently away from the object it is grinding and back towards the operator
 - All dangerous parts of power presses must be securely fenced or guarded to prevent access
 - All of the above

Forklifts

A forklift operator was killed when he reversed off a loading dock. His forklift rolled over and he received fatal head injuries. He was not wearing a seatbelt.

A forklift is a high risk load shifting machine that can lead to serious injuries or fatality if not operated properly.

In Western Australia, forklift operators must be over 18, hold a licence to perform high risk work and wear a seatbelt when operating the machine. The seatbelt is to keep the operator in the forklift in the event of a roll over.



*LO stands for *Order-picking forklift truck*

** LF stands for *Forklift truck*

The most frequently reported injuries from forklifts are:

- operators falling while getting into or out of forklifts
- operators suffering from muscular stress due to a combination of inappropriate seating, vibration and manual handling
- operators and others being hit by falling objects while in forklifts
- co-workers or pedestrians being hit by moving forklifts or moving parts of a forklift
- co-workers or pedestrians being trapped or caught between a moving forklift or moving parts of a forklift and a stationary object
- collisions between forklifts and other vehicles or stationary objects.

What to look out for if you have forklifts in your workplace

When forklifts are operated nearby, you should:

- be aware of your surroundings by looking out for other vehicles or forklifts using the area.
- understand everyone's tasks clearly
- wear a high visibility vest so that the forklifts operator can see you
- not be distracted with:
 - talking or texting on a phone
 - walking around listening to music through earphones
 - day dreaming.

Remember:

Under safety laws in Western Australia forklift drivers or operators must be at least 18 years of age and be properly trained and licensed.

Quiz – Forklifts

3. In Western Australia, it is a legal requirement that the forklift drivers or operators must be at least _____ years of age and be properly trained and licensed.
 - a. 16.
 - b. 18.
 - c. 21.
 - d. If you are capable, a forklift can be operated at any age.
 4. Who can operate the forklift?
 - a. Any worker.
 - b. Truck drivers.
 - c. Only trained and licensed workers.
 - d. All of the above.
 5. What is the purpose of a seatbelt in forklifts?
 - a. To keep you in the forklift in the event of an overturn.
 - b. It is a legal requirement.
 - c. You do not need to wear a seatbelt.
 - d. Both (a) and (b).
-

Hazardous substances

A worker used an electric arc welder to attach a bracket to a sealed metal tank. The tank had previously contained flammable liquids including methanol. When the worker commenced tack welding the bracket to the outside of the tank, the tank started to make rumbling noises and exploded.

The explosion blew the lid off the tank and pulled the tank supports out of the concrete floor. No-one was injured in this incident, but there was significant potential for serious injury or death.

A hazardous substance can be any solid substance, liquid, gas or dust that may cause you harm. Hazardous substances shouldn't be a problem most of the time, but things can go wrong if you:

- get them on your skin
- eat or drink them by mistake
- breathe them in
- mix substances so they become deadly
- mistake one substance for another.

In the heavy mechanical and engineering industries, you may work with hazardous substances such as paint, glue, solvents, cleaning products, battery acid and gases for welding.

Examples of hazardous substances

Solvents

These are used as cleaners or degreasers and as ingredients in paints, inks, glue and varnishes. Solvent droplets or vapours can irritate the eyes, nose and throat. When inhaled, solvent fumes have a narcotic effect. Symptoms include dizziness, headaches, light-headedness and nausea. At high concentrations they can cause unconsciousness and damage to the nervous system, liver and the kidneys.

Spray paints

Spray paints may contain harmful substances that can cause dermatitis, and high or frequent exposure to paints could damage your brain, reproductive system, kidneys or liver. Oil-based paints are usually flammable.

Airborne hazards

Some work activities in this industry generate airborne hazards such as welding fumes, exhaust fumes, forklift gas, glue vapours, oxyacetylene fumes, paint or spray painting fumes and smoke from furnaces and ovens.

Welding fumes

Welding fumes can be a mixture of airborne gasses such as oxides of nitrogen (NO_x), carbon monoxide (CO), carbon dioxide (CO₂), ozone (O₃) and shield gases including argon and helium.

Inhaling welding fume may cause irritation of the nose and throat, tightness in the chest, asthma, wheezing, metal fume fever, lung damage, bronchitis, cancer, pneumonia, emphysema and asphyxiation. The workplace should be fitted with a local exhaust system to help to reduce worker exposure to welding fume. Use respirators when ventilation is not enough.

Carbon monoxide (CO)

Carbon monoxide (CO) is a poisonous gas produced by operating vehicles or machinery powered by petrol or liquefied natural gas (LNG), liquefied petroleum gas (LPG) or diesel fuel motors. Because CO is colourless, tasteless and odourless, it has the potential to go undetected. Inhaling CO prevents the blood from carrying oxygen to cells, tissues and organs.

Be aware!

*Welding in a **confined space** can expose a welder to the high levels of CO causing carbon monoxide poisoning which may then cause severe headache, dizziness and disorientation, rapid or irregular heartbeat and vomiting.*

Common injuries and incidents from hazardous substances

Chemical burns

A chemical burn happens when skin or eyes come into contact with a corrosive chemical such as an acid or a base.

Some common cleaning agents include corrosive chemicals like bleach or ammonia, and these can be found in oven, sink, drain, glass or metal cleaning products.

Be aware!

Corrosive chemicals can “eat through” clothing, metal, and other materials.

You must be trained and supervised when using corrosive chemicals.

You must wear protective gear and clothing when using corrosive chemicals.

First aid should be given for chemical burns as soon as possible.

Strong acids and strong bases react very dangerously when mixed together – they can boil and splash anything nearby.

Cold burns

Cold burns can occur if skin makes contact with an object or substance that is very cold. Some chemical can cause frostbite like injuries, for example:

- liquefied petroleum gas (or LPG), which is commonly used in heating and cooking
- dry ice, which is widely used in cooling applications such as food freezing, and displays.

Be aware!

you must wear thermally resistant gloves when handling those chemicals

*It is important **not** to remove clothing which has frozen onto the skin until flushing with lukewarm water allowed it to thaw completely. Removing frozen clothing will remove the skin with it.*

Pressurised gases

A worker died when a hydraulic cylinder he was heating with a welding torch exploded. Heat from the torch overheated the residual hydraulic oil/vapours in the partially emptied cylinder. This caused pressure to build up, resulting in the piston ram being ejected through the top of the cylinder, smashing the bolted end cap, and inflicting fatal injury.

Gases are kept in cylinders under high pressure. If cylinders are damaged, for example, by being knocked over and a cylinder valve breaking, the sudden release of gas will propel the cylinder like a rocket. Examples of pressurised gases are acetylene and oxygen cylinders for welding, and aerosols.

Be aware!

Aerosol cans are kept under pressure. Aerosols can explode or turn into dangerous projectiles if overheated (left in the sun, placed next to a hot machine), ruptured, pierced, shaken, or dropped.

You must not use any heat-producing equipment such as welding torches and angle grinders on sealed hydraulic cylinders

Flammability/Fire and Explosion:

A worker died when a 205 litre metal drum he was cutting with an angle grinder exploded. The drum had previously contained methylated spirits and had both bungs in place. The worker had been instructed to cut the drum in order to make a scrap metal bin. A spark from the angle grinder ignited residual vapours in the drum, which exploded.

Fumes of flammable liquids when mixed with air in certain proportions can create an invisible “hazardous atmosphere” that can ignite. Ignition sources can be obvious like cigarettes and torches, or less obvious like static electricity (zapping), hot surfaces (stoves, lamps), electrical installations (power points, switches and switch boards).

Common flammable liquids in the workplace are petrol, solvents, methylated spirits, acetone, adhesives, paints, perfume, methanol, ethanol and degreasers.

Be aware!

You must not reuse “empty” containers that used to contain those chemicals. Even if they are properly cleaned, residual fumes inside empty containers can still create hazardous atmospheres that can explode if a spark is present.

Angle grinders produce ignition sources such as heat and sparks. Never attempt to cut or apply heat to drums that have contained flammable liquids or flammable gasses.

Areas where flammable liquids are used, mixed, or transferred from one container to another must be kept well ventilated and well separated from offices, warehouses and other places where people can gather. In the case of a spill or leak, you need to remove any ignition source if it is safe to do so.

Suffocation (asphyxia)

Asphyxia is caused by a lack of oxygen in air resulting in deficiency of oxygen in the blood.

When present in high concentrations, common gases (nitrogen, carbon dioxide, helium, and propane) can displace oxygen in the air, especially within a confined space. Inhaling too much of common gases can cause dizziness, disorientation, abnormal heart function, unconsciousness and even death.

Those gases are widely used in fire extinguisher systems and pressurised helium balloon gas.

Be aware!

Most asphyxiant gases are colourless and odourless so their presence in high concentrations may not be noticed.

Working in confined spaces is dangerous and additional measures may be required to conduct work safely (e.g. Using spotters and/or gas detectors). Confined spaces can include storage tanks, containers, cellars, utility vaults, pipes, truck or rail tank cars, boilers, bins, ditches and trenches.

Inhaling helium (from balloons or from a gas cylinder) is dangerous. It can cause your body's oxygen level to drop to dangerously low levels resulting in suffocation. The helium displaces the air, including the required oxygen, in your lungs. The inhalation of pressurised gas can also damage the lungs and can cause a stroke, seizures or death.

Toxicity

Toxicity is the degree to which a toxic substance can damage an organism.

Chlorine used for water purification is highly toxic if not used correctly.

Be aware!

Some chemicals are not toxic on their own, but can react dangerously when mixed with certain chemicals to release very toxic gases. Hypochlorite (bleach for cleaning) and oil mixture releases toxic chlorine gas.

Some chemicals can release toxic gas when in contact with liquid or moisture. Common fumigant aluminium phosphide kills insects (weevils), animals (mice and rats) and humans by releasing toxic phosphine gas.

How can you keep safe from hazardous substances?

- Read the label – look for warning labels and signs. Always follow the danger safety warnings.
- Read the safety data sheet (SDS) for more information about a product and how to use it safely. Your employer must provide (or have available) safety information documents for any substances or products that are hazardous.
- Check the hazardous substance register at your workplace. It is a legal requirement that your employer keeps a current register of each hazardous substance that may be used or stored in the workplace.
- Don't eat, drink or smoke when using or near a hazardous substance and dangerous goods.
- Don't keep food near hazardous substances or dangerous goods.
- Always use the PPE and clothing provided by your employer.
- Know what to do and where to go if you are affected by a substance. If you don't, check with your employer.
- Keep ignition sources away from any chemicals that are potentially flammable.
- Maintain good housekeeping standards – declutter and avoid build-up of combustible materials like wood pallets, cardboard boxes, dry leaves, etc. around any chemical storage.
- Don't inhale helium balloon gas. The dangers far outweigh the perceived fun.

Quiz – Hazardous substances

6. What can you do to be safe from welding fumes?
 - a. Conduct welding activities in a confined space
 - b. Hold your breath
 - c. Wear leather gloves
 - d. Use respirators when ventilation is not enough.

 7. Mike found an empty petrol drum in the workshop. He decided to make a garden bed for the outdoor area by cutting it in half. What must Mike seriously consider before he decides to use an angle grinder to complete this task?
 - a. The fuel tank may have previously contained a highly flammable liquid and may have possible chemical residue.
 - b. Angle grinders produce ignition sources such as heat and sparks.
 - c. Never attempt to cut or apply heat to drums that have contained flammable liquids or flammable gases.
 - d. All of the above.

 8. Identify **five** potential risks that can arise from using hazardous substances in the workplace.
 - a. Chemical burns
 - b. Cold and flu
 - c. Suffocation
 - d. Cold burns
 - e. Musculoskeletal injuries
 - f. Exposure to toxic or poisonous substance
 - g. Fall from a height
 - h. Flammability and explosion

 9. Select **three** correct actions you would take to keep yourself and others safe from hazardous substances.
 - a. Read the product label
 - b. Read the product SDS
 - c. Follow safe work procedures
 - d. Smell the substance
-

Welding

An apprentice welder received third degree burns to his back after his jacket caught fire. The jacket had a nylon lining and could not be removed over the welder's gloves. The welder did have access to a leather welder's jacket, but as it was cold, he preferred to use his own jacket he didn't put the leather welder's jacket on.

Welding is the process of permanently joining two or more materials together, usually metals by heat, pressure or both. Welding can be dangerous and precautions need to be taken to avoid injuries from:

- electric shock
- fire and explosion
- heat and spark to unprotected skin that can result in burns
- exposure to infrared light that can heat the lens of the eye causing eye irritation and vision damage
- exposure to intense ultraviolet radiation from a welding arc which may cause skin cancer, skin ageing and weak immune system
- exposure to toxic fumes from the material being welded or cut or from the electrodes, fluxes and gases.

When it is done in a hazardous environment, welding is extremely dangerous. These include welding in, on or near:

- confined spaces
- surfaces that have been treated or painted
- containers that have previously contained flammable materials or residues
- parts connected to wheels with pressurised tyres
- flammable dusty atmospheres.

How do you keep safe?

- Make sure you are properly trained and supervised for all welding work.
- Follow safe work procedures.
- Recognise a hazardous environment for welding. You may need to take extra precautions or avoid welding in the environment altogether.
- Check the welding equipment for damage before every use and make sure it is in good condition.
- Wear PPE and protective clothing specially made for welding provided to you at all times.

Examples of PPE and protective clothing for welders are:

- **eye and face protection** – wear a helmet with filter lens and cover plate, wear approved safety glasses with side shields (or goggles) under the helmet
- **head and ear protection** – wear a fire-resistant welder's cap or other head covering under your helmet. If loud noise is present, wear approved earplugs or muffs to protect your hearing or prevent hearing loss
- **foot protection** – wear leather, steel-toed, high-topped boots in good condition to protect your feet and ankles from injury. In heavy spark or slag areas, use fire-resistant boot protectors or leather spats strapped around your pant legs and boot tops to prevent injury and burns
- **hand protection** – wear protective flame-resistant gloves, such as leather welder's gloves
- **body protection** – wear oil-free protective clothing made of wool or heavy cotton. Do not wear synthetic (man-made) fabrics because they may burn easily, melt, stick to your skin and cause serious burns. Wear leather aprons, leggings, capes and sleeves as needed. Leather protects better than most materials.

Quiz – Welding

10. Which of the following conditions is considered to be extremely dangerous for welding activities, and may cause serious injury, fatality or long-term health damage?
- a. Confined spaces.
 - b. Surfaces that have been treated or painted.
 - c. Parts connected to wheels with pressurised tyres.
 - d. All of the above.

11. What are one of the best materials for welders' protective clothing?
- Silk.
 - Synthetic.
 - Leather.
 - All of the above.
12. What is the risk associated with welding activities?
- Electric shock.
 - Fire and explosion.
 - Sickness from inhalation of fumes from the material being welded.
 - All of the above.

Noise

Noise can be a workplace hazard. The higher the dose of noise, the greater the risk to the worker's hearing. Noisy power tools such as angle grinders, power presses, metal guillotines and cutting and buffing machines can generate noise levels that can cause permanent hearing loss. High noise levels are also produced when handling such as dumping sheared rods into racks, stacking sheet metal and dropping metal offcuts into metal recycling bins.

The noise dose is dependent on three factors:

- intensity/ loudness – measured by a noise level meter and is described in decibels (dB).
- frequency – the number of sound vibrations in one second and is measured in hertz (Hz).
- duration – the length of time the workers have been exposed to noise.

In Western Australia, the law sets a workplace exposure standard of 85 dB(A) (e.g. the typical sound levels of a front-end loader), or a peak noise level of 140 dB (e.g. the impact noise of sledge-hammering or the explosive noise of a gunshot). Any noise exposure above 140dB can create almost instant damage to hearing.

If you have raise your voice to be heard, the noise level is likely to be 85 dB(A) or more.

What can your employer do?

Where the exposure standard is exceeded, your employer must provide solutions to noise hazards such as:

- choosing quieter equipment (e.g. brooms or vacuum cleaners instead of blowers)
- keeping equipment in good working condition
- arranging the workshop layout so noisy processes are located away from employees not involved in their operation
- using portable noise barriers around static equipment like generators and concrete pumps
- scheduling the noisy work for times when as few workers as possible are present
- using job rotation to alternate noisy tasks with quiet ones
- providing you with hearing protectors (e.g. earplugs and earmuffs) to use along with all other control measures.

What can you do to save your hearing?

To safeguard your hearing, you must wear the hearing protectors that have been given to you. It might seem like there is nothing wrong with your hearing, but the damage is done without you noticing it.

Hearing protectors, like earplugs and earmuffs, should be regularly cleaned, repaired and stored near noisy areas.

Remember:

The most important factor for effectiveness of hearing protection is wearing it.

Quiz – Noise

13. To prevent hearing loss at work, the law sets a workplace exposure standard averaged over eight hours to be _____ dB(A).
 - a. 85
 - b. 95
 - c. 140
 - d. 200

 14. The most important factor for effectiveness of hearing protection devices is:
 - a. style
 - b. appearance
 - c. colour
 - d. wearing it.

 15. What controls at your workplace can reduce noise exposure?
 - a. Keeping equipment in good working order
 - b. Keeping noisy work away from other workers
 - c. Using sound absorbing material
 - d. all of the above.

 16. Noise levels are measured in:
 - a. decimals or dM
 - b. decibels or dB
 - c. millimetres per second
 - d. duration in millisecond.
-

Manual Tasks

Manual tasks are any activities or sequence of activities that require a person to use their physical body (musculoskeletal system) to perform work.

Common hazardous manual tasks in this industry include welding, deburring, grinding, lifting and transferring metal, unloading raw materials, transport of materials on the shop floor, process and assembly work at workstations, packing stillages and loading and handling finished products.

The most common injuries and health issues that can arise from performing manual tasks are musculoskeletal injuries, which affect muscles, bones and joints. In the heavy mechanical and

engineering industries, body stressing is the highest cause of serious injury as a result of performing manual tasks.

Examples of musculoskeletal injuries are:

- sprains and strains of muscles, ligaments and tendons (e.g. back strain)
- joint injuries
- disc protrusion or disc herniation of the back
- nerve injury or compression
- muscular and vascular disorders (e.g. carpal tunnel syndrome or repetitive strain injury)
- soft tissue injuries.

How does performing a manual task result in injury?

Contrary to popular belief, it's not just the weight of an object that creates the risk of musculoskeletal injuries. Workers are at risk of suffering injuries due to overexertion, awkward positions, applying pressure on one part of the body, performing the same action quickly and repeatedly and lifting heavy objects.

What can your employer do to prevent injury from performing manual tasks?

Your employer has a responsibility to provide and maintain a safe workplace. If you are about to perform hazardous manual tasks and you are unsure how to go about it, ask your employer or supervisor for assistance.

Your employer should provide you with *risk management and **task specific training where hazardous manual tasks have been identified at your workplace.

Risk management refers to the steps taken to manage workplace hazards described as **SAMM – **S**pot the hazard, **A**ssess the risk, **M**ake the changes, **M**onitor and follow-up. Task-specific training is the practising of actual tasks that will be performed.*

*** Task specific training is the practising of actual tasks that will be performed.*

Task-specific training should be provided:

- during induction to a new task
- as part of your refresher training
- when work tasks are about to be changed or new ones introduced.

After the training, you should be able to:

- recognise the risks and the sources of those risks and, in discussion with your employer or supervisor, decide the best way to minimise them
- prepare the workplace layout and surroundings to perform manual tasks safely
- prepare the load for manual handling, where applicable
- organise the task and work flow to minimise the risk of injury
- use relevant mechanical aids and handling devices provided to you
- use tools or equipment provided to you.

There are a variety of ways you can be trained to perform hazardous manual tasks. Training methods include a buddy system, demonstrations, observation, staff meetings, toolbox talks and practice sessions.

Remember:

Speak up if you think the task is too much for you. The effects of injuries from manual tasks can last a lifetime.

Quiz – Manual tasks

17. The most common health problems that can arise from hazardous manual tasks are:
- musculoskeletal injuries
 - cold and flu
 - bone cancer
 - food allergies.
18. When should you receive task specific training to perform manual tasks?
- During induction to the task.
 - As part of your refresher training.
 - When work tasks are about to be changed or introduced.
 - All of the above.
19. What types of injuries can result from performing manual tasks?
- Body stressing injuries.
 - Nerve injury or compression.
 - Muscular and vascular disorders.
 - All of the above.

Electricity

A foundry worker was electrocuted when scrap metal he was loading into a faulty electrical furnace became live.

Electric shocks happen when a person becomes part of an electrical circuit and the current flows through their body. Electricity passing through the body can cause convulsions (involuntary contractions of the muscles), the heart to stop beating, and internal and external burns. It can also cause secondary injuries resulting from falls or collisions and fire hazards resulting from an electrical fault.

Incidents with electricity are usually caused by:

- broken equipment or dangerous working conditions such as frayed or broken power cords, plugs or power points
- installation and/or repairs being undertaken by an unqualified repairer
- absence of a *residual current device (RCD) and lack of testing of RCDs
- a lack of experience, training or supervision.

A residual current device (RCD) is a safety switch or life-saving device designed to prevent you from receiving an electric shock if you touch something live, such as a bare wire. If you are using portable electrical equipment and extension leads at work, there must be an RCD installed at the switchboard, built into a fixed socket or the equipment used through a portable RCD outlet. The RCD must be regularly tested. This is a legal requirement.

Lockout procedure

When cleaning, maintaining or adjusting machinery and equipment, a lockout procedure is required to safeguard the workers who carry out the tasks.

Lockout is a safety procedure to ensure that dangerous machines and equipment are properly shut off and are not able to be started up again prior to the completion of the maintenance or repair work. The lockout procedure is used when:

- servicing or repair work places workers in danger
- a machine guard is removed for servicing.

There are three specific steps involved in locking out machines and equipment.

1. Lock

This means the electrical circuits must be shut down and locked.

This is when a lock is put on an ON switch so the machine can't be turned on. Only the person who put it on can remove it. If that person isn't available, strict rules need to be followed to ensure it is removed safely.

There is a wide range of 'locks' that can be used in this process. These can be:

- switches with a built-in lock
- chains
- jaws or hasps.

2. Tag

Tag refers to the information tag attached to a power source or piece of equipment warning others not to operate it. Tags have information about the name of the person working on the equipment, the time and date of the work and the equipment that's being isolated. Type of tags which are commonly used in the lockout procedure are danger tags and out of service tags.

3. Test

This means that all power sources need to be checked with proper test instruments to make sure everything is right before going ahead with work.

How can you keep safe around electricity?

- Understand the lockout procedure. Do not operate or use machinery and equipment that is locked and/or tagged.
- Always switch off electrical equipment at the power point before you pull out the plug.
- Use equipment properly. Regularly check and clean the equipment that you use and follow the equipment's operating instructions.
- Don't overload powerboards with lots of appliances. Only use powerboards fitted with overload protection.
- Be aware of the locations of all safety switches and what equipment they cover in case equipment needs to be switched off in an emergency. You may ask this question during your induction.
- Know emergency procedures for electrical hazards.

Remember:

Your employer must provide residual current devices (RCDs) or safety switches to reduce the risk of electric shock and electrocution.

Never use a machine that has a lock or a tag on it. This means someone is maintaining or working on it or it is unsafe.

Quiz – Electricity

20. There are three specific steps in locking out machine and equipment. These steps are:
- lock, look and tag
 - lock, tag and test
 - tag, do and test
 - lock, test and try.
21. A lockout procedure is used whenever:
- the servicing work to be done places workers in danger
 - a machine guard is removed for servicing
 - repair work to be done places workers in danger
 - all of the above.
22. Tagout refers to:
- the warning tag attached to a power source or piece of machinery telling others not to operate
 - lockout equipment for servicing
 - signing off that the machine has completed the service
 - a qualified worker is about to restart the machine
-

Falls

Slips, Trips and Falls

A 16-year-old school student undergo a traineeship program at a manufacturing workplace had three fingers severely crushed. The student was in the process of cutting a piece of wood when he slipped, lost his balance and fell forward, inadvertently placing three fingers into the operational area of the machine. At the same time, the student accidentally activated the foot control, bringing the machine's clamping device down and crushing his fingers.

Slips, trips and falls are common causes of injury in the heavy mechanical and engineering industry. They can result in serious harm and lengthy time off work. These types of injuries also mean the young worker is unable to play sport and do their normal social activities or hobbies.

A slip, trip or fall may cause injuries, including:

- broken bones when colliding with an object or hitting the ground
- cuts if it occurs near sharp objects
- sprains or strains.

What cause slips, trips and falls?

Slips, trips and falls can be caused by:

- slippery floors.
- wearing unsuitable shoes.
- objects on the floor such as boxes, bags or equipment left in walkways
- unstable, loose, or uneven surfaces like broken tiles or torn carpet
- stairs or steps especially when carrying items that obscures the view of the floor
- poor lighting
- incorrect use of steps or ladders

- being hit by falling objects.

What can your employer do to prevent slips, trips and falls?

- Allow for safe movement in the workplace, including entries and exits that are free of obstructions.
- Ensure floors and surfaces in the workplace are well-maintained and installed with task appropriate surfaces.
- Provide adequate lighting for safe movement.
- Ensure sufficient space to work.
- Maintain workplaces to keep them in a clean and tidy condition.
- Provide tools and equipment to assist you to work safely
- Ensure workers wear suitable footwear with appropriate treads that are kept clean.
- Provide information, instruction, training and supervision so that workers are not exposed to slip, trip or fall hazards.

How can you prevent slips, trips or falls at work?

- Wear suitable shoes with treads that are kept clean – incorrect footwear can cause slips and trips.
- Clean up spillages straight away and dry the floor to ensure the surface is not left wet – don't leave spills for someone else to clean up.
- Keep walkways clear of obstacles especially during busy work times.
- Carry items only at a height that you can safely see over to avoid trip hazards and bumping into things.
- Remove waste/rubbish regularly from work areas.
- Attend training on how to prevent slips, trips and falls in your workplace.

Falls from a height

Two welders suffered serious injuries when a work platform fell five metres off the raised arms of a forklift. The work platform was not secured and fell when one of the workers shifted his weight to the front of the platform.

The majority of fall injuries in the heavy mechanical and engineering industries occurred at the distance of three metres or less above the ground. Falls from ladders, forklifts and work platforms were the main cause of work-related injuries and fatalities from heights.

How can you prevent falling from a height at work?

- Follow safe systems of work.
- Using ladders and steps that are suitable for the task and well maintained.
- Use of secured elevating work platforms or other types of safe working platforms to access areas where there is risk of a fall.
- Attend height safety training which includes height safety procedures and using appropriate protective equipment to work at height safely.

Being hit by falling objects

A worker was oxy-cutting a large bucket from an excavator that stood above head height. He was not given any instruction for the task and was working alone without direct supervision. The worker was crushed when an 800 kg piece of the upper part of the bucket he was cutting broke away from the main structure and fell on him.

Objects have the potential to fall onto or hit people. Examples include:

- an object free falling from lifting machinery, a vehicle or other plant equipment, including loads being lifted that are not well secured or are unstable
- an object free falling from a main structure, such as roof scaffolding, tools, rock, soil and bricks
- an object or material ejected while using machinery or hand tools
- the collapse of an unstable structure including shelves, benches and mezzanine floors not strong enough to bear the weight of the objects kept on them.

What can your employer do to keep you safe from falling objects?

- Conduct risk assessments (known as SAMM) associated with an object falling on a person prior to commencing the tasks.
- Have safe work procedures in place.
- Use toe boards or guardrails on scaffolds to prevent objects from falling. Alternately, use debris nets or catch platforms to grab falling objects.
- Instruct and train workers on tasks associated with the risk of falling objects and ensure competency.
- Limit access to an area where there is a risk of an object falling.

How can you prevent being hit by falling objects at work?

- Follow safe work procedures.
 - Report any hazards of objects falling to your employer promptly so risks can be managed before an incident occurs.
 - Never place yourself or allow anyone else in the drop zone of an unrestrained load.
 - Use suitable personal protective equipment (PPE) provided such as a hard hat when work is being performed overhead or when other work conditions call for it.
 - When working with machines or power tools that can produce flying particles, wear safety glasses, goggles or face shields.
 - Stack materials securely to prevent them from sliding, falling or collapsing.
 - Secure all tools and materials to prevent them from falling on people below.
-

Quiz – Falls

23. What can your employer do to prevent slips, trips and falls at work?

- a. Provide adequate lighting for safe movement
- b. Maintain workplaces to keep them in a clean and tidy condition
- c. Ensure workers wear suitable footwear with appropriate treads that are keep clean.
- d. All of the above.

24. What is an example of a falling object that could cause workplace injuries?

- a. An object free falling from lifting, including loads being lifted that are not well secured or are unstable.
- b. An object free falling from a main structure.
- c. An object or material ejected while using machinery or hand tools.
- d. All of the above.

25. Which of the following statements will prevent you from being hit by falling objects? (Select three that apply)

- a. Never place yourself in the drop zone of an unrestrained load.
 - b. Wear a bucket hat for sun protection when work is being performed overhead.
 - c. When working with machines or power tools that can produce flying particles, wear safety glasses, goggles or face shields.
 - d. Stack materials securely to prevent them from sliding, falling or collapsing.
-

Spot the hazards

Nguyen Steel

There are 6 hazards in this area. Try and find them all.



Hazard notebook

Fill in the hazard notebook

#	Spot the hazard	Assess the risk	Make the change	Monitor and follow-up
1	Overloaded forklift. The forklift operator is not wearing a seatbelt	High	Ask the person to take more manageable loads that are safer to move. Indicate that the forklift operator must wear a seatbelt while driving a forklift	Check in later. If there are still o changes, report the incident to the supervisor
2				
3				
4				
5				
6				

Heavy mechanical and engineering industry - Knowledge quiz

1. Guards are fitted to machinery to:
 - a. protect you from moving parts
 - b. contain ejected parts from the machine
 - c. prevent emissions escaping
 - d. all of the above.

2. Which of the following statement is correct?
 - a. The most common injuries from metal guillotines are crushed or amputated fingers
 - b. The most serious injuries from angle grinders are from kick-back, where the disc is thrust violently away from the object it is grinding and back towards the operator
 - c. All dangerous parts of power presses must be securely fenced or guarded to prevent access
 - d. All of the above

3. In Western Australia, it is a legal requirement that the forklift drivers or operators must be at least _____ years of age and be properly trained and licensed.
 - a. 16.
 - b. 18.
 - c. 21.
 - d. If you are capable, a forklift can be operated at any age.

4. Who can operate the forklift?
 - a. Any worker.
 - b. Truck drivers.
 - c. Only trained and licensed workers.
 - d. All of the above.

5. What is the purpose of a seatbelt in forklifts?
 - a. To keep you in the forklift in the event of an overturn.
 - b. It is a legal requirement.
 - c. You do not need to wear a seatbelt.
 - d. Both (a) and (b).

6. What can you do to be safe from welding fumes?
 - a. Conduct welding activities in a confined space
 - b. Hold your breath
 - c. Wear leather gloves
 - d. Use respirators when ventilation is not enough.

7. Mike found an empty petrol drum in the workshop. He decided to make a garden bed for the outdoor area by cutting it in half. What must Mike seriously consider before he decides to use an angle grinder to complete this task?
 - a. The fuel tank may have previously contained a highly flammable liquid and may have possible chemical residue.
 - b. Angle grinders produce ignition sources such as heat and sparks.
 - c. Never attempt to cut or apply heat to drums that have contained flammable liquids or flammable gases.
 - d. All of the above.
8. Identify **five** potential risks that can arise from using hazardous substances in the workplace.
 - a. Chemical burns
 - b. Cold and flu
 - c. Suffocation
 - d. Cold burns
 - e. Musculoskeletal injuries
 - f. Exposure to toxic or poisonous substance
 - g. Fall from a height
 - h. Flammability and explosion
9. Select **three** correct actions you would take to keep yourself and others safe from hazardous substances.
 - a. Read the product label
 - b. Read the product SDS
 - c. Follow safe work procedures
 - d. Smell the substance
10. Which of the following conditions is considered to be extremely dangerous for welding activities, and may cause serious injury, fatality or long-term health damage?
 - a. Confined spaces.
 - b. Surfaces that have been treated or painted.
 - c. Parts connected to wheels with pressurised tyres.
 - d. All of the above.
11. What are one of the best materials for welders' protective clothing?
 - a. Silk.
 - b. Synthetic.
 - c. Leather.
 - d. All of the above.

12. What is the risk associated with welding activities?
- a. Electric shock.
 - b. Fire and explosion.
 - c. Sickness from inhalation of fumes from the material being welded.
 - d. All of the above.
13. To prevent hearing loss at work, the law sets a workplace exposure standard averaged over eight hours to be _____ dB(A).
- a. 85
 - b. 95
 - c. 140
 - d. 200
14. The most important factor for effectiveness of hearing protection devices is:
- a. style
 - b. appearance
 - c. colour
 - d. wearing it.
15. What controls at your workplace can reduce noise exposure?
- a. Keeping equipment in good working order
 - b. Keeping noisy work away from other workers
 - c. Using sound absorbing material
 - d. all of the above.
16. Noise levels are measured in:
- a. decimals or dM
 - b. decibels or dB
 - c. millimetres per second
 - d. duration in millisecond.
17. The most common health problems that can arise from hazardous manual tasks are:
- a. musculoskeletal injuries
 - b. cold and flu
 - c. bone cancer
 - d. food allergies.

18. When should you receive task specific training to perform manual tasks?
- During induction to the task.
 - As part of your refresher training.
 - When work tasks are about to be changed or introduced.
 - All of the above.
19. What types of injuries can result from performing manual tasks?
- Body stressing injuries.
 - Nerve injury or compression.
 - Muscular and vascular disorders.
 - All of the above.
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