Form 98

Indemnity receipt

V34.4.17

Office	Event #	Exhibit #

Statement

I, _____

(Surname field - ALL CAPS) (First names field)

of, _____

(Address in full)

acknowledge receipt of the property described below.

I undertake to indemnify every officer of the public service from and against any action that may be taken for the recovery of that property and I further declare that I am entitled by law to the possession of the said property and that no other person has acquired any title to this property.

Conditions of receipt of the property (if none, write 'nil')

Property description

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Signatures

Recipient

Name _____ _____

Signature

Inspector

Name _____ _____

Signature

Classification _____ Date _____

Construction Safety Focus

December 2016



Hire Yards

This document provides suppliers, employers and employees with information about WorkSafe's current safety focus in the hire yard industry and directs them to detailed guidance about plant and equipment.

The equipment hire industry supplies a substantial portion of plant and equipment used on construction sites in Victoria

WorkSafe inspectors are currently visiting hire yards to ensure that suppliers, in particular hire yard operators, are complying with their duties under Victoria's health and safety legislation.

Safe plant and equipment are essential for achieving safe construction work, however, these items can become damaged during use.

Common equipment damage

Common faults or damage that may require an item of plant to be isolated from the hire fleet may include, but is not limited to:

- Parts are missing, damaged or worn out (eg faulty brakes, jammed or worn wheels or missing plant guarding)
- Electrical equipment water damaged, clogged with dust/dirt/debris, etc
- Safety locks or mechanisms are difficult to open and close and/or are corroded.
- Emergency stop systems are not operating correctly
- Electrical leads and connections are damaged (eg exposed, unsecured and/or unearthed wiring)
- Sling lifting points are bent or worn out
- Safe working limits labels or decals are missing or illegible
- Missing maintenance and inspection labels/tags/ reports

Duties of suppliers

Suppliers who hire or lease plant intended for use at a workplace must:

- ensure, so far as is reasonably practicable, that the plant is safe and without risks to health if it is used for a purpose for which it was designed, manufactured or supplied
- give adequate information about the plant (including the purpose for which the plant was designed and any conditions necessary to ensure that the plant is safe and without risks to health)
- ensure plant is inspected and maintained between each hiring or leasing; and
- the details of inspection or maintenance carried out are recorded and retained.

Note: Additional obligations apply to hirers of plant. See "Further Information" for detailed guidance.

Inspector Focus

Inspectors are looking to ensure that a safe working environment is provided and maintained; and processes are in place to ensure plant is safe. This includes, but is not limited to the points set out below.

Hire yard safety

- Employees (including contractors) performing the inspection/repair are competent
- Employees providing instruction on safe operation of plant are competent and appropriately trained
- Hazardous manual handling tasks are identified and associated risks are controlled so far as is reasonably practicable
- Segregation between equipment storage areas, loading areas and pedestrian walkways is clearly defined
- Storage and racking systems are appropriate (eg load limits are clearly labelled and are not being exceeded)
- Appropriate amenities and first aid facilities are provided for employees
- Appropriate spill containment is provided for fuels, oils and other hazardous substances that are stored on site;
- Employees (including contractors) are competent to load and unload hired mobile plant
- Vehicles used to transport hired plant are appropriate for the task

Inspection/maintenance between hiring

- Returned plant and equipment is inspected, maintained and repaired (if required) by a competent person, and the details are recorded
- Damaged equipment is isolated from hire fleet
- Electrical equipment, including generators, residual current devices are appropriately inspected, tested and tagged
- Height access equipment is supplied with appropriate fall prevention controls, eg trestles above 2m have appropriate guard railing

Hire processes

- Persons hiring plant should be advised of any applicable High Risk Work (HRW) licence requirements.
  eg operating a boom type elevating work platform with a boom length 11m or more, requires a HRW licence.
- Plant is being provided with safe use instructions/ manuals.

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Construction Safety Focus

Further Information

Visit www.worksafe.vic.gov.au to download the following publications:

Checklist - Health and safety in construction plant and equipment hire yards

Safety Alert - Workers crushed in EWPs

Safe loading of elevated work platforms on tilt tray trucks

Dangerous machines safety checklist

Certification, licensing & qualifications checklist

Hiring out construction plant & equipment checklist

A health and safety solution – Pressure Vessels – Air Receivers

Construction Safety Focus – Musculoskeletal injury prevention

Contact WorkSafe's Advisory Service on (03) 9641 1444 or free call 1800 136 089.

Note: This guidance material has been prepared using the best information available to WorkSafe, and should be used for general use only. Any information about legislative obligations or responsibilities included in this material is only applicable to the circumstances described in the material. You should always check the legislation referred to in this material and make your own judgement about what action you may need to take to ensure you have complied with the law. Accordingly, WorkSafe cannot be held responsible and extends no warranties as to the suitability of the information.

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Inspector

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Classification _____ Date _____

GUIDE FOR MANAGING RISKS FROM HIGH PRESSURE WATER JETTING

DECEMBER 2013

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Office of Industrial Relations - 200339

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safe work australia

Safe Work Australia is an Australian Government statutory agency established in 2009. Safe Work Australia consists of representatives of the Commonwealth, state and territory governments, the Australian Council of Trade Unions, the Australian Chamber of Commerce and Industry and the Australian Industry Group.

Safe Work Australia works with the Commonwealth, state and territory governments to improve work health and safety and workers' compensation arrangements. Safe Work Australia is a national policy body, not a regulator of work health and safety. The Commonwealth, states and territories have responsibility for regulating and enforcing work health and safety laws in their jurisdiction.

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Contact information
Safe Work Australia
Phone: 1300 551 832
Email: info@swa.gov.au
Website: www.swa.gov.au

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1. INTRODUCTION

This guide provides practical guidance for persons conducting a business or undertaking on how to manage health and safety risks associated with high pressure water jetting operations. It aims to provide users of water jetting systems with guidance on safe operating practices to protect workers and other people who are near water jetting operations.

1.1 What is high pressure water jetting?

High pressure water jetting is a process using a stream of pressurised water to remove material, coatings or contamination and debris from the surface of a work piece or material substrate including:

- high pressure water jetting systems pressurised by positive displacement pumps with an output capability greater than 800 bar litres per minute, and
- water jetting systems operating below 800 bar litres per minute where there is a foreseeable risk of injury to operators or other people.

High pressure water jetting systems consist of an energy source like an electric motor or internal combustion engine, a pump, control mechanism, hoses, pipes, nozzles and various other components necessary for the equipment to function as a system.

Common hazards and risks include the water jet piercing the skin, being hit by flying debris and exposure to noise. Other hazards associated with high pressure water jetting include working in confined spaces, fall hazards, respiratory and eye hazards, electric shock and potential exposure to hazardous chemicals.

Key terms used in this guide are defined in Appendix A.

1.2 Who has health and safety duties in relation to water jetting?

Table 1 Duties in relation to water jetting

Who	Duties	Provisions
A person who conducts a business or undertaking	Ensure, so far as is reasonably practicable, workers and other people are not exposed to health and safety risks arising from the business or undertaking. This duty requires the person to manage risks by eliminating health and safety risks so far as is reasonably practicable, and if this is not reasonably practicable, by minimising those risks so far as is reasonably practicable.	WHS Act s 19
	There are more specific requirements to manage risks under the Work Health and Safety (WHS) Regulations, including those associated with hazardous chemicals, airborne contaminants and plant, as well as other hazards associated with water jetting activities like noise and manual tasks.	WHS Regulations

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Who	Duties	Provisions
Designers, manufactures, importers, suppliers or installers of plant, substances or structures	Ensure, so far as is reasonably practicable, the plant, substance or structure they design, manufacture, import or supply is without risks to health and safety. This duty includes carrying out testing and analysis as well as providing specific information about the plant, substance or structure.	WHS Act ss 22-26
Officers such as company directors	Exercise due diligence to ensure the business or undertaking complies with the WHS Act and Regulations. This includes taking reasonable steps to ensure the business or undertaking has and uses appropriate resources and processes to eliminate or minimise risks from high pressure water jetting operations.	WHS Act s 27
Workers	Take reasonable care for their own health and safety and to not adversely affect other people's health and safety. Workers must co-operate with reasonable policies or procedures relating to health and safety at the workplace and comply, so far as they are reasonably able, with reasonable instructions. If personal protective equipment (PPE) is provided by the business or undertaking, the worker must so far as they are reasonably able, use or wear it in accordance with the information, instruction and training provided.	WHS Act s 28
Other persons at the workplace, like visitors	Take reasonable care for their own health and safety and must take reasonable care not to adversely affect other people's health and safety. They must comply, so far as they are reasonably able, with reasonable instructions given by the person conducting the business or undertaking to allow that person to comply with the WHS Act.	WHS Act s 29

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1.3 What is involved in managing risks associated with high pressure water jetting?

Chapter 2 of this Guide provides guidance on how to manage the risks associated with high pressure water jetting following a systematic process which involves:

- identifing hazards – find out what could cause harm in high pressure water jetting operations
- assessing risks if necessary – understand the nature of the harm that could be caused by the hazard, how serious the harm could be and the likelihood of it happening

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- controlling risks – implement the most effective control measures that are reasonably practicable in the circumstances, and
- reviewing control measures to ensure they are working as planned.

Further guidance on the risk management process generally is available in the Code of Practice: *How to manage work health and safety risks*.

CONSULTING YOUR WORKERS

Section **47**

The person conducting a business or undertaking must, so far as is reasonably practicable, consult with workers who carry out work for the business or undertaking who are, or are likely to be, directly affected by a matter relating to work health or safety.

Section **48**

If the workers are represented by a health and safety representative, the consultation must involve that representative.

Consultation involves sharing information, giving workers a reasonable opportunity to express views and taking those views into account before making decisions on health and safety matters.

Consultation with workers and their health and safety representatives is required at each step of the risk management process. By drawing on the experience, knowledge and ideas of your workers you are more likely to identify hazards and choose effective control measures.

You should encourage your workers to report hazards and health and safety problems immediately so the risks can be managed before an incident occurs.

CONSULTING, CO-OPERATING AND CO-ORDINATING ACTIVITIES WITH OTHER DUTY HOLDERS

Section **46**

If more than one person has a duty in relation to the same matter under this Act, each person with the duty must, so far as is reasonably practicable, consult, co-operate and co-ordinate activities with all other persons who have a duty in relation to the same matter.

There is often more than one business or undertaking involved in high pressure water jetting operations. Each has responsibility for health and safety to the extent they influence and control aspects of the high pressure water jetting activities. In these situations you should share information to find out who is doing what and work together in a co-operative and co-ordinated way so risks are eliminated or minimised so far as is reasonably practicable.

For example, if you engage a contractor to carry out water jetting operations at your workplace you should find out what work processes are being used, identify associated hazards and how the risks will be controlled. This may include jointly conducting a risk assessment for the work and determining the control measures to implement. You should provide contractors with relevant information to help them assess the risks including from hazardous chemicals which may be present in waste generated by the process. After the risk assessment has been conducted it is important for duty holders to co-operate and co-ordinate activities with each other to implement the control measures.

Further guidance on consultation is available in the Code of Practice: *Work health and safety consultation, co-operation and co-ordination.*

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1.4 Information, training, instruction and supervision

Section **19**

A person conducting a business or undertaking must ensure, so far as is reasonably practicable, the provision of any information, training, instruction or supervision that is necessary to protect all persons from risks to their health and safety arising from work carried out as part of the conduct of the business or undertaking.

Regulation **39**

A person conducting a business or undertaking must ensure that information, training and instruction provided to a worker is suitable and adequate having regard to:

- the nature of the work carried out by the worker
- the nature of the risks associated with the work at the time of the information, training and instruction, and
- the control measures implemented.

The person must ensure, so far as is reasonably practicable, that the information, training and instruction provided under this regulation is provided in a way that is readily understandable by any person to whom it is provided.

Workers must be trained and have the appropriate skills to carry out a particular task safely.

Training should be provided to workers by a competent person.

Table 2 Training topics

Topics	Issues to cover
System operation	Explain how to safely operate all components of the high pressure water jetting system including the potential dangers, problems and emergency actions to be taken if the equipment fails or malfunctions.
Cutting action	Demonstrate the cutting action of a pressurised jet of water and the potential hazard it poses by using audio-visual aids or using the equipment.
Control devices	Explain how to safely operate all relevant control devices.
Part compatibility	Explain how important it is to check all component parts, fittings and hoses are compatible and are the correct size and rated equal to or greater than the maximum operational pressure of the high pressure pump unit. Using the correct parts reduces the possibility of equipment failures and resulting injuries.
Hoses	Explain the correct method of inspection before use as well as connecting hoses including laying them out without kinks, protection from wear and the correct tools to use on couplings and fittings.
Nozzles	Explain how to choose the correct nozzle use and size to check the maximum reaction force of 250 N or 25.5 kg is not exceeded during manual gun operations. The manufacturer's nozzle charts should be used for this.

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Topics	Issues to cover
Personal protective equipment	Give instructions about when and how specific PPE should be worn.
Maintaining equipment	Explain that water jetting components like valves and seating surfaces in pressure-regulating devices experience high rates of wear during operation and that the equipment should be inspected often and maintained to ensure it can be used safely.

Workers who operate high pressure water jetting equipment should maintain their competency. This can be assessed and revised by providing refresher training or by evaluating and documenting an assessment of the high pressure water jetting operation.

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2. THE RISK MANAGEMENT PROCESS

2.1 Identifying the hazards

The first step in managing risks associated with high pressure water jetting operations is to identify all hazards that could potentially cause harm to people. These may be identified by:

- conducting a walk through assessment of the workplace
- observing the work and talking to workers about how water jetting is carried out
- inspecting plant and equipment used during high pressure water jetting operations
- reading product labels, safety data sheets and manufacturer's instruction manuals
- talking to manufacturers, suppliers, industry associations and health and safety specialists, and
- reviewing incident reports.

Some examples of high pressure water jetting hazards include:

- cutting and reaction forces from high pressure water jets
- flying debris
- hazardous chemicals and biological materials
- noise, and
- water jetting plant and equipment.

2.2 Assessing the risks

A risk assessment is not mandatory for high pressure water jetting operations. However it is required in some situations, for example when working in a confined space. A risk assessment can help:

- identify which workers are at risk
- determine what sources and processes are causing the risks
- identify what kind of control measures should be implemented, and
- assess check the effectiveness of existing control measures.

The likelihood of each hazard actually causing harm in a specific situation should be assessed. The following questions may help with the assessent:

- How often and for how long will exposure to the hazard occur?
- If exposed to the hazard will the outcome be severe, moderate or mild?
- What is the substrate being blasted?
- What are the surface coatings of the items being blasted? For example do they contain lead or other toxic metals?
- What are the conditions under which high pressure water jetting operations are being carried out? For example are they carried out in a confined space?
- What are the skills, competence and experience of the operators?

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2.3 Controlling the risks

Some control measures are more effective than others. Control measures can be ranked from the highest level of protection and reliability to the lowest. This ranking is known as the *hierarchy of control*.

ELIMINATING THE RISK

This means removing the hazard or hazardous work practice from the workplace. This is the most effective control measure and must always be considered before anything else.

If eliminating the risk is not reasonably practicable, you must consider using substitution, isolation or engineering controls, or a combination of these control measures to minimise the risk.

MINIMISING THE RISK

Substitution

Minimise the risk by substituting or replacing a hazard or hazardous work practice with a safer one.

Isolation

Minimise the risk by isolating or separating the hazard or hazardous work practice from people, for example by installing screens or barriers around the water jetting operations.

Engineering controls

Engineering controls are physical control measures to minimise risk, for example controlling the jet of water mechanically.

If a risk remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable by using:

Administrative controls

Administrative controls should only be considered when other higher order control measures are not reasonably practicable, or to increase protection from the hazard. These are work methods or procedures designed to minimise the exposure to a hazard, for example job rotation and varying tasks to reduce the risks associated with prolonged periods of jetting gun operation and other repetitive manual handling tasks.

Any remaining risk must be minimised, so far as is reasonably practicable, by providing and ensuring the use of:

Personal protective equipment

PPE is the lowest order control measure in the hierarchy of controls. PPE should also only be considered when other higher order control measures are not reasonably practicable or to increase protection from the hazard. Examples of PPE include using safety eyewear, hearing protection, safety helmets, cut-resistant leg protection or reflective, high-visibility clothing.

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COMBINING CONTROL MEASURES

In most cases a combination of the control measures will provide the best solution to minimise the risk to the lowest level reasonably practicable. You should check your chosen control measures do not introduce new hazards.

2.4 Maintaining and reviewing control measures

The control measures implemented to protect health and safety should be regularly reviewed to make sure they are effective including when there is a change at the workplace. If a control measure is not working effectively it must be revised to ensure it is effective to control the risk.

For example, control measures should be reviewed:

- when an injury or illness occurs because of a hazard the risk assessment addressed, or failed to consider
- before making changes to the nature of the water jetting operations
- before introducing new plant or jetting techniques
- if new information becomes available to indicate a control measure may no longer be the most effective way to control the risk, and
- when there are changes to who carries out the work.

Control measures should be reviewed in consultation with workers and their health and safety representatives. Workers are often able to quickly identify and propose solutions to problems when they occur.

Control measures should be checked by using the same methods as the initial hazard identification and risk assessment. If a hazard is not eliminated or minimised by the chosen control measure, go back through the risk management steps, review the information and make further decisions about risk control.

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3. GENERAL SAFETY RECOMMENDATIONS

The following safety recommendations should be considered when managing the risks to workers from the hazards associated with high pressure water jetting operations.

3.1 Water jetting plant and equipment

Section **21(2)**

Persons conducting a business or undertaking who have management or control of plant at a workplace must ensure, so far as is reasonably practicable, the plant is without risks to the health and safety of any person.

Section **22(2)**

Designers of plant must ensure, so far as is reasonably practicable, the plant is designed to be without risks to the health and safety of persons.

When buying water jetting plant and equipment you should check safety features have been incorporated into the design. The following information must be passed on from the designer to the manufacturer and supplier to the end user:

- The purpose the plant was designed or manufactured.
- The results of calculations, analysis, testing or examination necessary to ensure the plant is without risks to health and safety.
- Any conditions necessary for the safe use of the plant.

A supplier must give this information to each person who receives the plant which may be in the form of a manufacturer's manual.

Suppliers of new and second-hand high pressure water jetting equipment must ensure, so far as is reasonably practicable, it is without risks to health and safety. For example, it is in safe working order. A supplier must also provide the manufacturer's safe operating procedures.

A supplier of second-hand high pressure water jetting equipment must ensure, so far as is reasonably practicable, any associated risks are identified. Before the equipment is supplied, ensure the person to whom the equipment is supplied is given written notice of:

- the condition of the plant
- any faults identified, and
- if required, that the plant should not be used until the faults are rectified.

The manufacturer's safe operating procedures should be followed by anyone carrying out water jetting operations.

GENERAL

Water jetting plant, equipment and attachments should only be used in accordance with the manufacturer's recommendations.

No rigid lance attachment should be used unless it is fitted with a handle and a hold-to-activate device. It should only be used in accordance with the manufacturer's instructions.

Jetting equipment and attachments should not be modified without the manufacturer's approval.

Modifications to Class B equipment and developing new systems incorporating Class B equipment should only be carried out by a competent person with relevant engineering skills. Such modifications or developments should be consistent with relevant safety recommendations.

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LIMITS AND USE

A high pressure water jetting system should not be used unless it:

- has been inspected or serviced in accordance with the manufacturer's recommendations, and
- is free from any fault identified at the last inspection or service which may adversely affect the performance and safe operation of the equipment.

Note: Chapter 4 provides guidance on the inspection, care and maintenance of high pressure water jetting systems.

SAFEGUARDS

Anyone using high pressure water jetting equipment should follow these safety recommendations:

- Where necessary all equipment near jetting operations should be shielded or protected from debris and the ingress of water from operating the jetting equipment.
- Any essential electrical installation should meet the required protection levels against the ingress of water vapour or overspray.
- People other than the operating team should be kept out of barricaded work areas.
- Work activities should be planned to provide safe access to the equipment and item or surface being jetted.
- Overhead work should be avoided where possible, as this may cause unstable worker positioning and increase the risk of musculoskeletal disorders.
- Operators using manually operated jetting systems should be in a safe and well-balanced position before starting jetting operations.
- Jetting operations should not be performed from ladders or other surfaces not intended for use by workers, as this can lead to loss of control of the jetting equipment.
- Operators should check there is no interruption or interference to the release mechanism of any hand or foot controls that could stop the equipment operating safely and consistent with the manufacturer's specifications.
- Jetting operations should stop when:
  - conditions change or new hazards are introduced
  - unauthorised people enter the barricaded area
  - recommended safe work practices are not being followed, or
  - a malfunction occurs.
- Jetting systems should be depressurised and secured when:
  - not in use and left unattended, and
  - components are being replaced or repairs are being made to the system.

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3.2 Medical alert card

Water jetting operators should carry an immediately accessible, waterproof medical alert card issued by the person conducting a business or undertaking (PCBU).

The card should:

- outline the possible nature of injuries and post-incident infections that can be caused by high pressure water jetting, and
- provide details of immediate first-aid treatment until medical treatment can be arranged.

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4. EQUIPMENT CARE AND MAINTENANCE

High pressure water jetting systems should be maintained by a competent person in accordance with the manufacturer's recommendations. Records should be kept of service, repairs and maintenance.

4.1 Pump unit

The pump unit should be maintained in accordance with the manufacturer's instructions. This should include daily pre-operational checks on the following items as applicable:

- Engine and drive unit – lubricating oil, water, hydraulic fluid and fuel levels.
- Pump unit – lubricating oil, water filters, drive belts, gauges and gearbox oil levels.
- Hydraulic hose reel – lubricating oil and fluid levels.
- Condition of guards, shields and safety interlocks.
- Electric leads and connectors.

4.2 Filters and strainers

Water filters should be checked regularly, depending on the water supply conditions and in accordance with the pump manufacturer's recommendations.

Water should be cleaned through filters that meet the pump manufacturer's recommendations. Otherwise this may cause the control mechanisms to malfunction and destroy the equipment, exposing workers to the serious risk of injury.

4.3 Hose assemblies

Hose, couplings, connectors and hose end fittings selected before assembly should be suitable for use with the maximum working pressure of the high pressure water jetting unit to be used.

Before each use, hose assemblies should be visually inspected by a competent person to ensure:

- the correct pressure rating and size is selected
- there is no apparent structural damage e.g. corroded or broken wires, bulging, kinking or cuts
- end fittings are in good condition and of the correct pressure rating for the unit operating pressure, and
- hose connections to equipment or other hoses are restrained with braided stockings or are restricted in some other suitable way to stop their movement if the hose end fails.

Hoses with broken wires, deep abrasions, kinking, blisters or bubbles in the outer covering should be identified as 'defective' and taken out of service.

End fittings and crimping with cracks, corrosion, damaged threads or other evidence they may not be safe to use should be identified as 'defective' and taken out of service.

TESTING AND VERIFICATION

Hose assemblies used with Class A water jetting systems should be tested in accordance with the requirements of AS 3791-1991: *Hydraulic hose*.

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Hose assemblies used with Class B water jetting systems should be tested in accordance with AS/NZS 4233 Part 1-1999: *High pressure water jetting systems – safe operation and maintenance.*

Records should be kept of all tests. Only those hoses identified as meeting the safe operating performance recommendations should be returned to service.

Hoses should be tested when they:

- are new
- have been damaged
- have been re-ended or repaired, and
- have been exposed to adverse operational conditions which may have affected their structural integrity.

CARING FOR AND STORING HOSES

The service life of a hose assembly is affected by many factors like storage, pressure cycles, temperature, environment, chemical exposure and longitudinal stress.

Table 3 Maximising the service life of hose assemblies

Cause of wear	Steps to extend life of hose assemblies
Pressure cycles	Hose assemblies should not be unnecessarily subjected to frequent and prolonged periods of high pressure.
Temperature exposure	Exposure of hoses to temperatures in excess of the stated rating should be avoided.
Chemical exposure	Hose assemblies should not unnecessarily be exposed to chemicals or corrosive substances. Where hose assemblies are exposed to these such substances, steps should be taken as soon as possible to neutralise their effect.
Longitudinal stress	Repetitive and prolonged use of hose assemblies in long-line drain cleaning functions and long vertical drops should be avoided.
Environment exposure	Unnecessary exposure to sharp, protruding and abrasive surfaces should be avoided. Where this is not practical, steps should be taken to minimise the damage to hose assemblies.
Storage	Where possible, hose assemblies should be stored lying flat in a cool dry area.

Defective hoses should be removed from service and clearly marked and tagged to prevent unintentional use.

4.4 Nozzles

Water jetting nozzles are designed to control the direction, velocity, flow rate, pressure, shape and distribution of fluid flow as it exits the nozzle carrier.

Jetting nozzles come in two categories: rear facing nozzles which are used in drain and tube cleaning and forward facing nozzles which are used for general cleaning duties.

Jetting equipment including nozzles should be kept clean and stored safely when not in use.

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Nozzles should be inspected before each use for blocked or damaged orifices, damage to threads, cracks or any other structural damage that could adversely affect their safe operation.

Nozzles identified as being defective should be removed from service and repaired or destroyed.

As well as a pre-start measure, inspecting nozzles regularly during jetting operations can identify wear and damage before this causes an injury.

GUN NOZZLES

Pin nozzles reduce the jet of water to a solid parallel stream of water and are used for cutting or penetrating. They can be either a screw in or step design (see Figure 1).

FIGURE 1 Pin nozzles



Fan nozzles change the jet of water to a designated flat angle and are used as surface cleaners (see Figure 2).

FIGURE 2 Fan nozzles



Rotating nozzles are either motorised or driven by the flow of water and are designed to clean surfaces (see Figure 3).

FIGURE 3 Rotating nozzle



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Nozzle manufacturer supply charts are used to calculate nozzle orifice size and reaction force. The reaction force should be calculated using the high pressure water jetting pump's maximum pressure rating. A sample nozzle chart is at Appendix D.

When a higher reaction force is needed to achieve acceptable results mechanical devices to control the nozzle should be used. This can be in the form of mechanised equipment or engineered structures designed to hold the excess reaction force in all planes.

Pipe cleaning nozzles are designed to clean the internal surfaces of a pipe or tube and can be either spinning or fixed.

Fixed nozzles have a longer dwell time because of the time the jet of water impacts on a point. They are used for harder products (see Figure 4).

FIGURE 4 Fixed nozzles



Spinning nozzles have a much shorter dwell time and are used for softer products (see Figure 5).

FIGURE 5 Spinning nozzle



Spinning nozzles can have a combination of forward facing, side facing and rear facing jets of water. The calculation for nozzle sizes should take into account the thrust needed to pull the nozzle up the pipe or tube.

Nozzle manufacturers supply information to assist in these calculations.

4.5 High pressure jetting guns

High pressure jetting guns or lances should be fitted with at least one fast acting hold-to-activate device that when deactivated, will stop the flow of high pressure water. This device should be under the direct control of the jetting operator.

There are three types of guns currently being used within the high pressure water jetting industry. They have different operating systems. Each gun type should only be used with the correct operating system.

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These are:

- *Dry shut-off gun* – incorporates a trigger-operated mechanical valve shutting off the flow of water from the pump. These can only be used on systems with an unloader valve. The pressure in the hose from the pump to the gun remains constant at all times (see Figure 6).

FIGURE 6 Dry shut-off gun



- *Wet dump gun* – incorporates a trigger-operated mechanical valve diverting water flow to a large orifice (either a hose or second barrel) outlet thus depressurising the system (see Figure 7).

FIGURE 7 Wet dump gun



- *Dry dump gun* – incorporates a trigger-operated mechanical valve with either an electric or pneumatic control connected to the pump control system. This system diverts the flow of water at the pump and reduces the pump speed to idle (see Figure 8).

FIGURE 8 Dry dump gun



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Jetting guns should be fitted with double-action safety trigger mechanisms to prevent inadvertent operation.

High pressure jetting guns or lances should be maintained by a competent person in accordance with the manufacturer's recommendations.

Guns or lances should be inspected and tested before each use with particular attention being given to checking:

- the correct operation of the trigger mechanism and guard
- the hose connections and threads
- the nozzle holders and seals
- the hose is secured to the gun by a braided stocking
- an impervious over hose shroud is fitted, and
- the handle or shoulder stock is fitted as required by manufacturer's instructions.

The gun and shut off mechanism should also be tested under low pressure to ensure correct operation.

4.6 Foot control devices

Foot control devices on guns are designed to shut off or divert the water flow from the pump unit. They should be a 'hold-to-activate' type and can be dry shut off, wet dump and dry dump mechanisms.

Foot control devices should be fitted with a guard or cover as well as a double-action trigger mechanism to stop them being operated accidentally.

On mechanical foot control devices the pressure hose should be secured to the device using a braided stocking with an impervious hose shroud covering the pressure hose. This will protect the operator if the hose fails.

Foot control devices should be maintained by a competent person in accordance with the manufacturer's recommendations.

4.7 Hose connection and layout

The point where the hose attaches to a hand or foot controlled device should be protected by an over-sheath shroud manufactured from materials capable of withstanding the direct force of the water jet. This also protects the operator if the hose separates or the end fails.

The point where the hose attaches to a hand or foot controlled device should also be protected by a braided stocking that can stop the hose from whipping around and causing injury or damage if the hose separates or the end fails.

Water supply and high pressure jetting hoses should not be laid across thoroughfares, walkways or roads where they are likely to be damaged. Where hoses are to be hung vertically, each hose should be supported by a wire stocking. Where multiple lengths of hose are used in this way they should be supported at points below each coupling so there is no weight on the coupling.

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4.8 Electrical equipment

Electrical pump control equipment should be of an extra low voltage type not exceeding 50 volts AC and should comply with local electrical design and use requirements. Electrical connectors should be waterproof, suitable and rated for the environment they are to be used in. They should be protected from unintended closed and open circuit failures.

Where water jetting operations are carried out in work environments where the pump and control equipment are located within potentially explosive atmospheres, for example in the petrochemical industry, electrical pump control equipment should meet the requirements of AS 2380.1-1989:*Electrical equipment for explosive atmospheres – Explosion-protection techniques – General requirements.*

Due to the harsh nature of most high pressure water jetting work sites, electrical equipment can fail. Care should be taken to check that cables, plugs, connectors and control devices are in good condition before each use.

4.9 General maintenance, repairs and documentation

Major servicing operations and repairs requiring specialist knowledge should only be carried out by competent workers with thorough knowledge of the equipment. Such equipment includes:

- pressure relief valves
- bursting discs if used
- pressure control devices
- pump control valves or dry shut-off control valves, and
- electrical controls and equipment.

Operators of high pressure water jetting systems should not carry out repairs other than simple adjustments to or replacement of parts which are specifically listed in the manufacturer's instructions for use and periodic service. Other repairs or maintenance should be carried out by the manufacturer or other suitably qualified people.

When maintaining or assembling jetting systems the correct sized tools should always be used. Tools of the incorrect size can damage equipment and should not be used.

Maintenance records should be kept for each major piece of equipment. After each inspection or service recommended by the manufacturer the person carrying out the work should record:

- the condition of the equipment and hoses
- repairs performed
- adjustments performed, and
- the date when the inspection or work was carried out and the name of the person carrying out the task.

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4.10 Marking equipment

Parts or assemblies which need to be identified for service, maintenance or application should be permanently marked with enough information to identify the part, its use and performance and in a way which is easy to read.

PUMPS

High pressure water jetting systems should be fitted with a permanently mounted name plate which provides the following information:

- manufacturer's name or mark
- model designation, serial number and year of manufacture
- maximum volume and pressure performance
- maximum input speed, and
- maximum operating pressure.

HOSES

Hoses should be marked with the following information:

- manufacturers identification
- date of manufacture, and
- maximum operating pressure.

ADAPTORS AND END FITTINGS

Adaptors and end fittings should be marked so the manufacturer's identification and maximum operating pressure can be identified.

HOSE ASSEMBLIES

Hose assemblies should be marked so the following information can be clearly identified:

- The assembler.
- Date of assembly.
- Date of testing.
- Maximum operating pressure.

RE-ENDED AND RETESTED HOSES

Hose assemblies which have been re-ended or retested should be marked so the following information can be identified:

- The organisation performing the work.
- The organisation performing the retesting.
- Date of testing.
- Reference to the test reports.

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5. PERSONAL PROTECTIVE EQUIPMENT

Regulation **44**

If personal protective equipment is to be used to minimise a risk to health and safety in relation to work at a workplace in accordance with regulation 36, the person conducting a business or undertaking who directs the carrying out of work must provide the personal protective equipment to workers at the workplace, unless the personal protective equipment has been provided by another person conducting a business or undertaking.

The person conducting the business or undertaking who directs the carrying out of work must ensure the equipment is:

- selected to minimise risk to health and safety
- suitable having regard to the nature of the work and any hazard associated with the work
- a suitable size and fit and reasonably comfortable for the worker who is to use or wear it
- maintained, repaired or replaced so that it continues to minimise risk to the worker who uses it
- clean, hygienic and in good working order, and
- used or worn by the worker, so far as is reasonably practicable.

Regulation **45**

The person conducting a business or undertaking who directs the carrying out of work must ensure, so far as is reasonably practicable, that personal protective equipment to be used or worn by any person other than a worker at the workplace is capable of minimising risk to the person's health and safety and the person uses or wears the equipment.

Regulation **46**

The worker must, so far as the worker is reasonably able, use or wear the equipment in accordance with any information, training or reasonable instruction given by the person conducting the business or undertaking.

The worker must not intentionally misuse or damage the equipment.

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As high pressure water jetting is very hazardous, suitable PPE should always be worn regardless of other control measures in place.

5.1 Head protection

Where required, head protection complying with AS/NZS 1801: 1997: *Occupational protective helmets* should be worn.

5.2 Eye protection

Eye protection suitable for the task, of good fit on the worker and complying with AS/NZS 1337: 2010 (Series): *Personal eye protection* should always be worn when the worker is near jetting operations. The worker in direct control of the flow of water should as a minimum, wear safety glasses and a face shield complying with AS/NZS 1337.

Where liquids which can cause eye damage are being used at the workplace it may be necessary to use a combination of a face shield visor and goggles or a full hood with shield.

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5.3 Leg and body protection

Workers should wear waterproof protective clothing complying with AS 3765.1-1990: *Clothing for protection against hazardous chemicals — Protection against general or specific chemicals* or AS 3765.2-1990: *Clothing for protection against hazardous chemicals – Limited protection against specific chemicals.*

Leg and body armour manufactured from materials capable of withstanding the direct force of the water jet should be used by water jetting operators where there is risk of injury.

Liquid or chemical-resistant suits should be worn where a risk assessment indicates these are required.

5.4 Hand protection

Hand protection complying with the recommendations of AS/NZS 2161.2:2005: *Occupational protective gloves - General requirements*, AS/NZS 2161.3:2005: *Occupational protective gloves - Protection against mechanical risks* or AS/NZS 2161.5:1998: *Occupational protective gloves - Protection against cold*, should be worn where a risk assessment indicates this is required.

5.5 Foot and lower leg protection

Workers should wear protective footwear complying with AS/NZS 2210.3:2009: *Occupational protective footwear - Specification for safety footwear*. A foot and lower leg guard or shield made from material capable of withstanding the direct force of the water jet should be used where there is a risk of foot or leg injury.

Further guidance on the selection of footwear is in AS/NZS 2210.1: 2010: *Safety, protective and occupational footwear - Guide to selection, care and use.*

5.6 Personal hearing protectors

Where noise cannot be eliminated or minimised so far as is reasonably practicable personal hearing protectors as well as instruction and training in their use should be provided.

Hearing protectors should be selected in accordance with AS/NZS 1269.3:2005: *Occupational noise management – hearing protector program* and tested in accordance with AS/NZS 1270:2002: *Acoustics - hearing protectors*.

5.7 Respiratory protection

Workers involved in high pressure water jetting operations should wear respiratory protection where there is an assessed risk of injury that can be prevented by such equipment. Respiratory protection should only be worn by workers who have been trained in its correct use.

A respiratory protection program should be implemented where there is evidence it could prevent injury or disease.

AS/NZS 1715:2009: *Selection, use and maintenance of respiratory protective equipment* provides guidance on the implementation of respiratory protection programs.

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6. PLANNING AND PRE-OPERATIONAL PROCEDURES

6.1 General

Assessing and planning each job is important. This ensures high pressure water jetting is carried out in a way that is without risks to health and safety.

Planning usually starts with initial customer liaison and a job or site inspection. People planning the work and people familiar with the work environment and the item or material to be jetted, should meet with the workers who will be carrying out the work to identify and discuss:

- potential hazards of the work area
- control measures to be implemented
- potential environmental problems
- safety standards, and
- emergency procedures.

Based on this information, the job can then be planned.

Further information on consulting, co-operating and co-ordinating activities with other duty holders is in section 1.3.

As a minimum the planning process should include:

- the number of workers and any special skills, qualifications or training required over - and above the safe use of high pressure water jetting e.g. such as an elevated work platform licence
- isolation procedures including locking and tagging
- equipment required including PPE
- barricading and signage requirements
- notifing other workers nearby
- providing safe work instructions for workers
- calculations to ensure when manual gun operations take place the reaction force is equal to or below the maximum reaction force of 250 N or 25.5 kg, and
- the crew completing a pre-start hazard assessment before starting jetting operations.

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6.2 Asbestos

High pressure water jetting must not be carried out on asbestos or asbestos containing material.

Regulation **446**

A person conducting a business or undertaking must not use, or direct or allow a worker to use, high-pressure water spray on asbestos or asbestos containing material.

Asbestos can release airborne fibres whenever it is disturbed. Inhaling these fibres is a significant health risk. Asbestos has been used in products including:

- certain textured coatings and paints
- roofing materials
- vinyl or thermoplastic floor tiles, profiled sheets used on roofs and walls and flat sheets in flashings

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- imitation brick cladding, and
- plaster patching compounds.

The WHS Regulations contain specific requirements on asbestos and asbestos-containing material.

It can be difficult to identify whether asbestos is used in a product just by looking at it. Having a sample of the suspected material analysed will confirm whether asbestos is present or not. Sampling can be hazardous and must only be done by a competent person. Samples must only be analysed by a National Association of Testing Authorities accredited laboratory or a laboratory approved by the regulator or operated by the regulator.

Further information on asbestos is available in the Code of Practice: *How to safely remove asbestos* and the Code of Practice: *How to manage and control asbestos in the workplace*.

6.3 Training and operator competency

People who use high pressure water jets and equipment should be competent to carry out the task they are requested to complete. This means they should be trained or instructed using a structured competency-based process.

Operators should also undergo competency-based training on a specific task or equipment they work on. See also section 1.4.

6.4 Safe work instructions

Safe work instructions should be developed for using high pressure water jetting units and should be used with a pre-start hazard identification system.

6.5 Pre-start checks and hazard assessment

Pre-start checks should be done before every operation. These can be in the form of a checklists which should be completed in consultation with all operators involved in the job. A basic checklist should cover:

- the type of job
- high pressure pump checks including mechanical and safety devices
- isolation procedures including locking and tagging
- hose checks including where required the currency of hose tags or certificates
- barricades and signs
- workers required
- special equipment used, and
- special work permits.

A pre-start hazard identification and assessment should also be carried out on each job. Safe work instructions manage the repetitive elements of a task but they are not effective when there are changes in the work environment.

An example of a pre-service and operational checklist is at Appendix C.

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6.6 Work areas, barricades and signs

A safe area should be established around the planned jetting operations. The limits of this area should be clearly defined by using a physical barrier. This area is known as the safety zone.

Where jetting operations are not shielded by physical barriers, for example inside a vessel, the perimeter of the defined area should be outside the effective range of the jet of high pressure water. Barriers should also stop people coming into contact with other hazards associated with the jetting operation like flying scale or debris falling from above.

Where work is carried out on public roads, work areas should also comply with AS 1742.3-2009: *Manual of uniform traffic control devices - Traffic control for works on roads*.

All high pressure water jetting equipment including the jetting unit should be located within the safety zone. Entry into the safety zone should be restricted to authorised people through a designated safe entry point.

The safe entry point should be established by the work crew as part of the pre-start hazard identification process and should be identified by a sign with the words "ENTRY BY AUTHORISED PERSONS ONLY". The safe entry point should be located where it can be monitored by a safety observer while they also carry out their primary role of observing the work area and jetting operator without distraction.

Where it is not possible to locate a safe entry point that is monitored by a safety observer, the work area should be treated as a total exclusion zone and access restricted to only those workers actually carrying out the work. This may be necessary for situations where the observer does not have a clear view of people approaching the work area.

When high pressure water jetting equipment is being operated, signs indicating "DANGER – HIGH PRESSURE WATER JETTING EQUIPMENT IN USE" should be displayed where they are clearly visible to people approaching the area and those near the area where the equipment is being used.

Signs should also be used to warn people they are approaching a hazardous area.

Further guidance on signs is in AS 1319-1994: *Safety signs for the occupational environment*.

6.7 Equipment placement

The correct placement or positioning of high pressure water jetting plant and equipment in the workplace is important for health and safety and efficient operations. The pump unit should be placed as close as possible to the work site to reduce the amount of hose used and to reduce the area covered by the operation.

Check that plant and equipment placement does not become a hazard and critical access ways are left unobstructed. Hoses should be arranged to effectively minimise potential tripping hazards. The pump unit should not be placed where it can be contaminated by debris from the jetting operation.

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7. OPERATIONAL PROCEDURES

7.1 Shutoff devices

Every high pressure water jetting operation should include at least two ways of stopping the flow of high pressure water. One of these shutoffs should be controlled by the nozzle operator and should be a fast acting self-actuating hold-to-activate shutoff device. The other shutoff should be an emergency stop device controlled by the safety observer.

7.2 System compatibility

Equipment used including guns, foot control devices, hoses and nozzles during water jetting operations should be suitable for use with greater than or equal to the maximum operating pressure of the high pressure pump.

The safety relief device, for example the safety valve or burst disc should be set at a minimum of 10 per cent over the maximum operating pressure of the high pressure pump and in accordance with the manufacturer's recommendations.

7.3 Operational roles and communication

Each worker within the work team should have a defined role, for example the nozzle operator or safety observer. Where possible, workers should swap roles throughout the course of the jetting operations to avoid fatigue and to keep alert.

Effective communication between members of the work team during jetting operations is very important. A mechanism, for example radio headphones which allow the nozzle operator to convey their requirements to the pump operator or observer will make the jetting operations safer and more efficient.

The most common way of communicating is by using hand signals. If hand signals are used, workers should agree on a set of signals before starting jetting operations. Every worker should understand and be alert to the signals at all times.

Hand signals should not be used as the communication method where the nozzle operator requires two hands to safely hold the device. In these circumstances alternative communication methods should be provided.

Further information on hand signals for high pressure water jetting operations are in Appendix E.

7.4 Gun work

Using a hand held gun for jetting operations increases the risk of the high pressure water jet coming into contact with and injuring the operator. Where eliminating the use of a hand held gun for jetting operations is not possible, using one or a combination of the following control measures may minimise the risk, so far as reasonably practicable:

- a gun with a barrel or lance length* that ensures the nozzle strikes the ground before the operator can inadvertently direct it onto their feet or legs
- dual hold-to-activate devices on the gun
- foot and lower leg guards or shields manufactured from material capable of withstanding the direct force of the jet, and
- a body harness that prevents the gun being aimed at the operator.

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Note: In some circumstances, for example industrial rope access work or working in confined spaces, it may be necessary to use a much shorter barrel on the gun. Extreme caution should be exercised by the gun operator and the other team members to ensure risks likely to affect the safety of workers operating the equipment or working nearby are minimised, so far as is reasonably practicable.

Where possible the operator should be allowed to experience the reaction force of the high pressure water jet progressively until the required operating pressure is reached. The operator should be able to stand comfortably and unsupported without straining while operating the gun.

The reaction force along the axis of the gun barrel should be calculated for an average operator to retain control of the gun safely and comfortably. The lowest pressure suitable for the work should be used. A maximum reaction force of 250 N or 25.5 kg is recommended.

When a higher reaction force is needed to achieve acceptable results mechanical devices to control the nozzle should be used, for example gimbals and remote controlled machinery.

FIGURE 9 Nozzle clamp (gimbal)



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Critical elements to consider when carrying out gun work include ensuring:

- a dedicated safety observer in control of an emergency shut off device is part of the work team, whose primary concern is the welfare of the worker operating the gun
- the work area is free of trip or fall hazards
- the gun is tested at low pressure and at working pressure before each use
- operating pressure is gradually increased so the operator becomes accustomed to the reaction force, and
- people not actively involved in the jetting operation remain outside the safety zone.

7.5 Pipe cleaning

Pipe cleaning is another common use for high pressure water jetting. However the process is inherently hazardous because the high pressure nozzle is attached to a flexible hose which reduces the operator's control of it.

Operators should check pipe cleaning jobs are set up so the nozzle cannot physically come out of the pipe when it is under pressure. An anti-withdrawal device that is mechanically held to the end of the pipe should be used. This device has an opening in it through which the hose is fed and will stop the hose or nozzle being ejected inadvertently or by hydraulic force.

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Hoses should be clearly marked at a suitable distance from the nozzle to indicate the location of the nozzle as it is withdrawn from the pipe or tube.

A foot control hold-to-activate device e.g. a foot pedal—should be used on every pipe cleaning job. This eliminates relying on the operator to physically shut down the high pressure pump in the event of an incident.

During manual pipe cleaning or lancing operations, the entrance to the line or pipe should not be cleaned with a lance fitted with a retro (back) jet. Where a retro jet is used for pipe cleaning or lancing, the nozzle operator should be provided with suitable guards and PPE to shield them from the water and debris.

The clearance between the outside diameter of each of the hose, lance or nozzle assembly and the inside wall of the item being cleaned should be sufficient to allow the washout of water and debris. Where the diameter of the nozzle and hose assembly exceeds two-thirds of the pipe being cleaned, extra care is required to minimise the risk of the nozzle and debris forming a hydraulic piston which may be forced out under pressure towards the operator.

Where the length of the nozzle and rigid hose coupling and bend radius of the hose is less than the internal diameter of the pipe, a length of rigid pipe (a starter bar) should be used to extend that distance to a length of at least the pipe internal diameter.

If the use of a starter bar is not feasible, a suitable safety shield (able to withstand a direct and sustained blast of the jet) should be provided to protect the operator should the nozzle turn through 180 degrees or double back towards the operator.

When cleaning vertical pipelines that are blocked, it is almost always necessary to clean the pipe from the bottom to allow the scale to fall out and stop the hose from becoming jammed. This process introduces the hazard of the hose falling out of the pipe either under pressure or as pressure is applied.

One method of controlling this risk is to use an anti-withdrawal device attached to the end of the pipe with an opening in it through which the hose is fed. The nozzle is attached after the hose is passed through the opening, with the diameter of the opening being smaller than the diameter of the nozzle. This prevents the nozzle from falling any further than the end of the pipe.

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7.6 Heat exchanger cleaning

Heat exchangers can be de-scaled manually or by using automated or semi-automated equipment. Where deposits are soft, for example oil deposits, manual cleaning techniques are usually used.

Manual cleaning is usually carried out by at least two operators. One worker operates the hose or flexible lance and controls the water flow via a foot control device, while the other worker acts as an observer and controls an emergency shutdown mechanism and other shut off devices where applicable.

The most significant risks from cleaning a heat exchanger are:

- the nozzle exiting the tube being cleaned while still under pressure
- the tube becoming pressurised and forcing the nozzle out at the operator end
- the tube becoming pressurised and ejecting a plug of scale or steel blocking a faulty tube, and
- the nozzle and hose assembly being damaged when exiting the tube.

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Possible control measures for these hazards include:

- using chemicals to clean tubes
- using mechanical or automated lance handling equipment
- installing mechanical shields over the end of the tube bundle opposite to the end being worked on
- limiting the distance the hose can enter a tube
- using nozzle extensions preventing it and hose crimps from fouling on the tube face when being pulled back into the tube, and
- using anti-withdrawal devices to prevent inadvertent or hydraulic force ejection of the flexible lance and nozzle.

This work requires specialised skills. Each person who carries out this task should have received specific training and instruction in how to operate the equipment used and how to perform the task safely by a person who is competent in this field.

7.7 Surface preparation

Surface preparation work generally uses ultra-high pressure water jetting equipment. This means very high pressures in excess of 2,500 bar and low water flows are used. As a result the effective range of the water jets is comparatively lower than those used for other general cleaning and de-scaling activities. However, the cutting efficiency of the jets at close range is significantly higher and increases the potential for injury.

Where handguns are used for surface preparation work the control measures listed in the section on 'gun work' should be considered.

Cleanliness and care of ultra-high pressure water jetting equipment is essential. Water filters should be regularly checked and cleaned or replaced. Hoses and high pressure fittings should be taped or covered when not in use to stop the ingress of dirt and other foreign material. Systems should be thoroughly flushed before each use to ensure nozzles are not damaged or blocked by foreign particles.

7.8 Vessel cleaning

An operator working inside a vessel while cleaning it using high pressure water jetting is a very high risk activity. The need for an operator to enter a vessel during cleaning should be eliminated so far as is reasonable practicable.

Tank cleaning heads can be used instead. These can be mounted in a variety of ways, for example by being hung from cables or mounted on a rigid fixture. The most important aspect of their operation is to check the arms are not bent and the nozzles are balanced and in good condition. If there are problems in either of these areas, the reaction forces on the head will be unbalanced and injury or damage to the equipment could result. This will be obvious if only the hose or cable supports the tank cleaning head, as it is likely to swing about uncontrolled inside the vessel.

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7.9 Drain cleaning

Although drain cleaning operations usually operate at considerably lower pressures than needed for most high pressure water cleaning jobs, they share many of the same hazards and operational aspects of high pressure water. Although pressures used may be lower, the power available at the nozzle is comparable with high pressure pumps so is just as hazardous.

Most drain cleaning is carried out using a truck mounted pressure pump with or without a suction unit to remove the debris. Drain cleaners operate at pressures of around 150 to 210 bar and flow rates of 250 to 300 litres per minute.

Most drain cleaners are controlled by a remote control pendant that allows the operator to move about the rear of the truck and have total control of the operation at all times.

The risks created by other hazards should be assessed when choosing a suitable number of workers to safely carry out the operations-(see section 1.1). Drain cleaning units use positive displacement pumps similar to high pressure units. The majority of other equipment used in this application is the same as the equipment used for high pressure applications and should be subject to the same maintenance and safety procedures.

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8. HAZARDOUS WASTE MATERIAL

8.1 Hazardous waste

Water jetting produces debris which may contain hazardous materials, including chemicals like heavy metals and biological waste, which create risks to health and safety.

Note: This material should not contain asbestos as the WHS Regulations prohibit the use of high pressure water jetting on asbestos or asbestos containing material.

A product safety data sheet should be obtained before starting water jetting operations to identify if hazardous materials are present in the substrate or coating being jetted.

The risks arising from potential exposure to hazardous waste material should be identified, assessed and controlled in accordance with the requirements of the WHS Regulations.

Regulation **49**

A person conducting a business or undertaking at a workplace must ensure that no person at the workplace is exposed to a substance or mixture in an airborne concentration that exceeds the exposure standard for the substance or mixture.

Safe working procedures should consider how to eliminate or minimise exposure to this material during water jetting operations. PPE and facilities suitable for the hazardous materials known or suspected to be present in waste generated from water jetting operations should be provided.

Further guidance on hazardous chemicals can be found in the Code of Practice: *Managing risks of hazardous chemicals in the workplace.*

8.2 Hazardous waste disposal

The risk of exposure to hazardous waste material may also arise when loading, transporting and unloading debris for disposal.

The person conducting the business or undertaking should manage the risk to health and safety arising from the disposal of waste material and ensure the material is handled and disposed of in accordance with work health and safety and environmental protection requirements.

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APPENDIX A – DEFINITIONS

Anti-withdrawal device means a device designed to stop a flexible lance from ejecting or being pulled from a tube or pipe during the lancing operation.

Bar litres per minute is a commonly used measure of the energy produced by a high pressure water jetting system expressed as a pressure, volume value per unit of time. See Appendix B – *Pressure flow diagram.*

Bursting disc means a safety device designed to rupture and discharge the fluid to stop a safe pre-determined pressure being exceeded.

Class A system means a high pressure water jetting system producing a maximum energy, measured in pressure volume units per minute—for example bar litres per minute—between 800 bar litres per minute and 5600 bar litres per minute. See Appendix B – *Pressure flow diagram*.

Class B system means a high pressure water jetting system producing a maximum energy, measured in pressure volume units per minute—for example bar litres per minute—exceeding 5600 bar litres per minute. See Appendix B – *Pressure flow diagram*.

Competent person means a person who has acquired through training, qualification or experience the knowledge and skills to carry out the task.

Dump valve system means an operator controlled system that opens a free flow path for the water (either to ground or recycled), reducing the system pressure to a safe level without shutting off the flow to the nozzle.

Extra low voltage means 50 volts AC as defined in AS/NZS 3000:2007: *Electrical installations*.

Foot control device means a control device arranged for actuation by an operator's foot either in place of or in addition to another form of control.

High pressure water jetting system means a water delivery system consisting of an energy source, for example electric motor or internal combustion engine, pump, control mechanism, hoses and pipes, nozzles and various other attachments and components necessary for the equipment to function as a system. The function of the system is to increase the velocity of the liquids at the point of application. Solid particles or extra chemicals may also be introduced but the exit in all cases will be a free stream.

Hose assembly means a hose with couplings or end fittings attached in accordance with the hose manufacturer's recommendations.

Jetting gun means a portable combination of the operator's control valve, lance and nozzle, normally resembling a gun in arrangement.

Lances

Flexible lance means a flexible hose used to feed a nozzle through pipes or tubes.

Rigid lance means a rigid tube used to extend the nozzle from the end of the hose or flexible lance.

Lancing (rigid or flexible) means an application where a lance and nozzle combination is inserted into and retracted from the interior of a pipe or tubular product.

Mechanical device means a device engineered and manufactured to restrain a nozzle carrier, or lance where reaction forces exceed 250 N or 25.5 kg. These devices can either be manual or automated.

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Nozzle means a device with one or more openings where the fluid discharges from the system. The nozzle restricts the area of flow of the fluid accelerating the water to the required velocity and shaping it to the required flow pattern and distribution for a particular use. Combinations of forward and backward nozzles are often used to balance the thrust.

Operator means a person who has been trained and has demonstrated competence to perform a water jetting task without supervision.

Reaction force means the force created by water moving as it leaves the nozzle. The force acts in the opposite direction to moving water.

Relief valve means a valve which automatically opens to discharge fluid to relieve pressure.

Safety observer means a member of the work team assigned with the following tasks:

- observing the jetting operations and barricaded area
- shutting down the system in an emergency or if the system malfunctions
- controlling or communicating to the controlling operator the system pressure as requested by the jetting operator, and
- controlling access of people into the safety zone.

Starter bar means a rigid piece of pipe fixed to a nozzle that prevents reversing of the nozzle in the line.

Water jet means a jet stream of water produced from the individual nozzle orifice. The shape of the jet is determined by the form of the orifice while the speed at which it travels is determined by the orifice design, orifice area and pressure.

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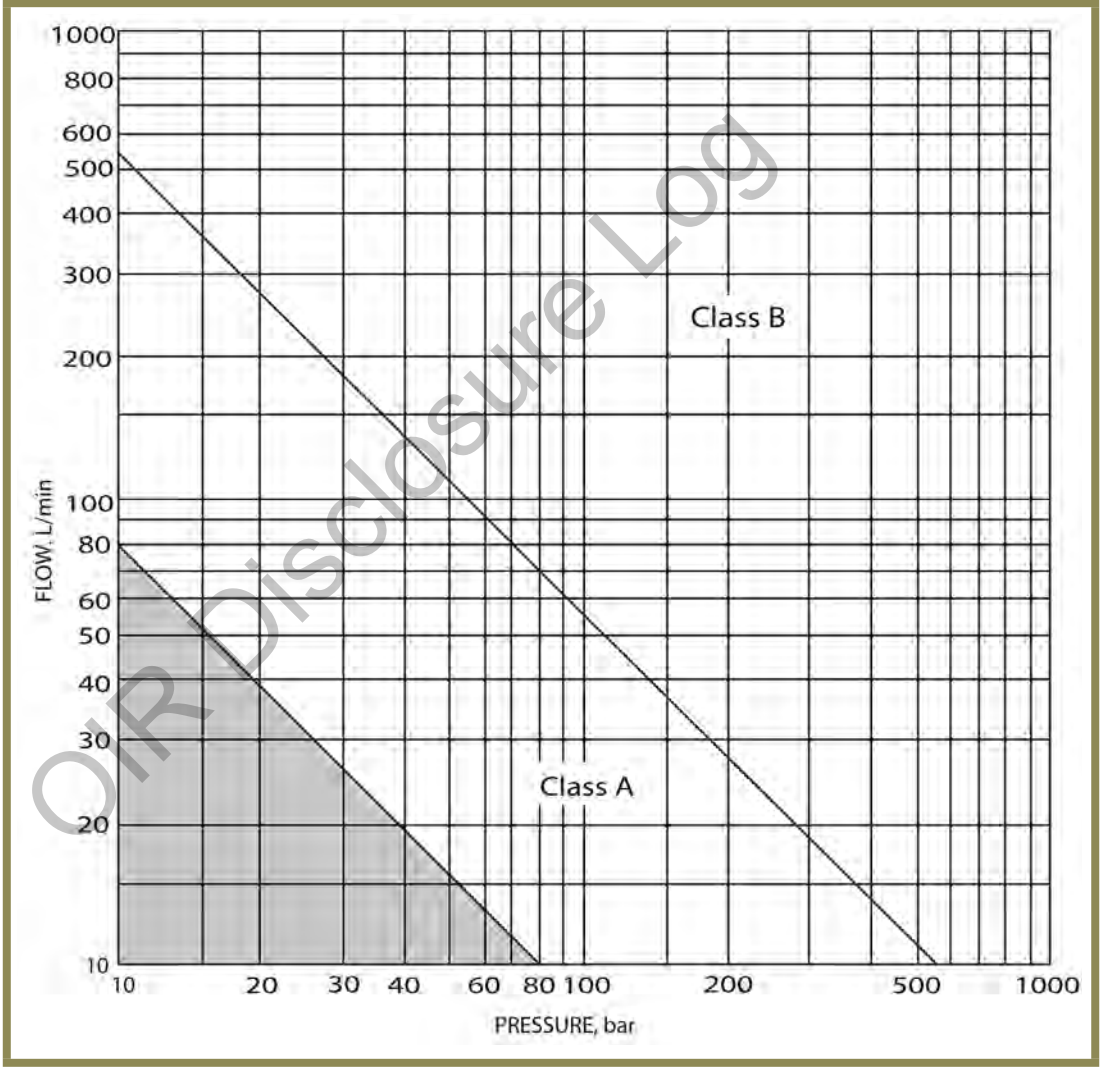
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APPENDIX B – PRESSURE FLOW DIAGRAM

Figure 10 shows a way to calculate and compare the output capability (pressure volume combination) and classify high pressure water jetting systems.

The output of jetting systems is normally measured in bar litres per minute.

FIGURE 10 Pressure flow chart



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APPENDIX C – EXAMPLE OF A PRE-SERVICE AND OPERATIONAL CHECKLIST

Date:.....

Location:.....

Equipment/Item being cleaned:

1. Is the work area including the other end of the unit being cleaned clearly defined?
2. Are warning signs posted?
3. Have precautions been taken to protect electrical equipment?
4. Is there a risk to workers or possible damage to equipment from things like the release of chemicals, hot or flammable liquids, gases, drifting mist or other materials?
5. Have workers nearby been told about the intention to carry out water jetting operations?
6. Are components, for example fittings, hoses, guns and foot pedals of the correct pressure rating?
7. Are the hoses of the correct pressure rating?
8. Are hoses in safe operating condition?
9. Are fittings in safe operating condition?
10. Are hoses and lines protected from accidental damage?
11. Are nozzles free from blockages and in safe operating condition?
12. Have steps been taken to prevent inadvertent nozzle reversal or ejecting accidentally?
13. Is the filter on the pump water supply suction clean and in safe operating condition?
14. Is there a suitable cool and clean water supply?
15. Have workers been provided with PPE appropriate for this job?
16. Have workers received the correct level of training for the job?
17. Are workers competent to carry out this work?
18. Has the complete hose run been flushed and air removed from the system?
19. Has the hook-up including pipes, hoses and connections been pressure tested with water at the maximum operating pressure?
20. Are control systems operating correctly?
21. Is the location of emergency medical aid known by workers?
22. Has an effective communication system been put in place for the job?
23. Have the emergency stops been tested?
24. Has the reaction force been calculated to ensure that it is under 250N (25.5kgs) for hand held gun work?

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APPENDIX D – EXAMPLE OF A NOZZLE CHART USED TO CALCULATE REACTION FORCE

A nozzle chart lets operators calculate reaction force. Reaction force should be calculated using the high pressure water jetting pump's maximum pressure rating.

When using the chart, operators must first determine the maximum operating pressure of the pump. This is listed across the top of the chart. The required flow rate is then selected. By matching the pressure and flow, the chart then gives you a reaction force in Newtons that is appropriate to the selected nozzle size.

Nozzle Ø mm	Operating pressure - bar														
	200	300	400	500	600	700	750	800	900	1000	1100	1200	1300	1400	1500
Part-No.	Flow rate – L/min Recoil force in jetting direction /(N)*														
0,15	0,2 *1*	0,2 *1*	0,3 *1*	0,3 *2*	0,3 *2*	0,4 *2*	0,4 *2*	0,4 *3*	0,4 *3*	0,4 *3*	0,5 *4*	0,5 *4*	0,5 *4*	0,5 *5*	0,5 *5*
0,20	0,3 *1*	0,4 *2*	0,5 *2*	0,5 *3*	0,6 *3*	0,6 *4*	0,7 *4*	0,7 *5*	0,7 *5*	0,8 *6*	0,8 *6*	0,8 *7*	0,9 *7*	0,9 *8*	0,9 *9*
0,25	0,5 *2*	0,7 *3*	0,8 *4*	0,9 *4*	0,9 *5*	1,0 *6*	1,0 *7*	1,1 *7*	1,1 *8*	1,2 *9*	1,3 *10*	1,3 *11*	1,4 *12*	1,4 *13*	1,5 *13*
0,30	0,8 *3*	1,0 *4*	1,1 *5*	1,2 *6*	1,4 *8*	1,5 *9*	1,5 *10*	1,6 *10*	1,7 *12*	1,7 *13*	1,8 *14*	1,9 *15*	2,0 *17*	2,1 *18*	2,1 *19*
0,35	1,1 *4*	1,3 *5*	1,5 *7*	1,7 *9*	1,8 *11*	2,0 *12*	2,1 *13*	2,1 *14*	2,3 *16*	2,4 *18*	2,5 *19*	2,6 *21*	2,7 *23*	2,8 *25*	2,9 *26*
0,40	1,4 *5*	1,7 *7*	2,0 *9*	2,2 *11*	2,4 *14*	2,6 *16*	2,7 *17*	2,8 *18*	2,9 *21*	3,1 *23*	3,3 *25*	3,4 *27*	3,5 *30*	3,7 *32*	3,8 *34*
0,45	1,8 *6*	2,2 *9*	2,5 *12*	2,8 *14*	3,0 *17*	3,3 *20*	3,4 *22*	3,5 *23*	3,7 *26*	3,9 *29*	4,1 *32*	4,3 *35*	4,5 *38*	4,6 *41*	4,8 *43*
0,50	2,2 *7*	2,7 *11*	3,1 *14*	3,4 *18*	3,8 *21*	4,1 *25*	4,2 *27*	4,3 *29*	4,6 *32*	4,8 *36*	5,1 *39*	5,3 *43*	5,5 *47*	5,7 *50*	5,9 *54*
0,55	2,6 *9*	3,2 *13*	3,7 *17*	4,1 *22*	4,5 *26*	4,9 *30*	5,1 *32*	5,2 *35*	5,6 *39*	5,9 *43*	6,2 *48*	6,4 *52*	6,7 *56*	6,9 *61*	7,2 *65*
0,60	3,1 *10*	3,8 *15*	4,4 *21*	4,9 *26*	5,4 *31*	5,8 *36*	6,0 *39*	6,2 *41*	6,6 *46*	7,0 *52*	7,3 *57*	7,6 *62*	8,0 *67*	8,3 *72*	8,5 *77*
0,65	3,7 *12*	4,5 *18*	5,2 *24*	5,8 *30*	6,3 *36*	6,9 *42*	7,1 *45*	7,3 *48*	7,8 *54*	8,2 *60*	8,6 *67*	9,0 *73*	9,3 *79*	9,7 *85*	10,0 *91*

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Nozzle Ø mm	Operating pressure - bar														
	200	300	400	500	600	700	750	800	900	1000	1100	1200	1300	1400	1500
Part-No.	Flow rate – L/min Recoil force in jetting direction /(N)*														
0,70	4,2 *14*	5,2 *21*	6,0 *28*	6,7 *35*	7,4 *42*	7,9 *49*	8,2 *53*	8,5 *56*	9,0 *63*	9,5 *70*	10,0 *77*	10,4 *84*	10,8 *91*	11,2 *98*	11,6 105
0,75	4,9 *16*	6,0 *24*	6,9 *32*	7,7 *40*	8,4 *48*	9,1 *56*	9,4 *60*	9,8 *64*	10,3 *72*	10,9 *81*	11,4 *89*	11,9 *97*	12,4 *105*	12,9 *113*	13,4 *121*
0,80	5,5 *18*	6,8 *27*	7,8 *37*	8,8 *46*	9,6 *55*	10,4 *64*	10,7 *69*	11,1 *73*	11,8 *82*	12,4 *92*	13,0 *101*	13,6 *110*	14,1 *119*	14,7 *128*	15,2 *137*
0,85	6,3 *21*	7,7 *31*	8,9 *41*	9,9 *52*	10,9 *62*	11,7 *72*	12,1 *78*	12,5 *83*	13,3 *93*	14,0 *103*	14,7 *114*	15,3 *124*	16,0 *134*	16,6 *145*	17,2 *155*
0,90	7,0 *23*	8,6 *35*	9,9 *46*	11,1 *58*	12,2 *70*	13,1 *81*	13,6 *87*	14,0 *93*	14,9 *104*	15,7 *116*	16,5 *128*	17,2 *139*	17,9 *151*	18,6 *162*	19,2 *174*
0,95	7,8 *26*	9,6 *39*	11,1 *52*	12,4 *65*	13,6 *78*	14,6 *90*	15,2 *97*	15,7 *103*	16,6 *116*	17,5 *129*	18,4 *142*	19,2 *155*	20,0 *168*	20,7 *181*	21,4 *194*
1,00	8,7 *29*	10,6 *43*	12,3 *57*	13,7 *72*	15,0 *86*	16,2 *100*	16,8 *107*	17,3 *115*	18,4 *129*	19,4 *143*	20,3 *157*	21,2 *172*	22,1 *186*	22,9 *200*	23,7 *215*
1,05	9,6 *32*	11,7 *47*	13,5 *63*	15,1 *79*	16,6 *95*	17,9 *110*	18,5 *118*	19,1 *126*	20,3 *142*	21,4 *158*	22,4 *174*	23,4 *189*	24,4 *205*	25,3 *221*	26,2 *237*
1,10	10,5 *35*	12,9 *52*	14,8 *69*	16,6 *87*	18,2 *104*	19,6 *121*	20,3 *130*	21,0 *139*	22,3 *156*	23,5 *173*	24,6 *191*	25,7 *208*	26,7 *225*	27,8 *242*	28,7 *260*
1,15	11,5 *38*	14,0 *57*	16,2 *76*	18,1 *95*	19,9 *114*	21,5 *133*	22,2 *142*	22,9 *151*	24,3 *170*	25,6 *189*	26,9 *208*	28,1 *227*	29,2 *246*	30,3 *265*	31,4 *284*
1,20	12,5 *41*	15,3 *62*	17,7 *82*	19,7 *103*	21,6 *124*	23,4 *144*	24,2 *155*	25,0 *165*	26,5 *186*	27,9 *206*	29,3 *227*	30,6 *247*	31,8 *268*	33,0 *289*	34,2 *309*

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Nozzle Ø mm	Operating pressure - bar														
	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
Part-No.	Flow rate – L/min Recoil force in jetting direction /(N)*														
0,15	0,6 *5*	0,6 *5*	0,6 *6*	0,6 *6*	0,6 *6*	0,6 *7*	0,6 *7*	0,7 *7*	0,7 *8*	0,7 *8*	0,7 *8*	0,7 *9*	0,7 *9*	0,7 *9*	0,8 *10*
0,20	1,0 *9*	1,0 *10*	1,0 *10*	1,1 *11*	1,1 *11*	1,1 *12*	1,2 *13*	1,2 *13*	1,2 *14*	1,2 *14*	1,3 *15*	1,3 *15*	1,3 *16*	1,3 *17*	1,3 *17*
0,25	1,5 *14*	1,6 *15*	1,6 *16*	1,7 *17*	1,7 *18*	1,8 *19*	1,8 *20*	1,8 *21*	1,9 *21*	1,9 *22*	2,0 *23*	2,0 *25*	2,0 *25*	2,1 *26*	2,1 *27*
0,30	2,2 *21*	2,3 *22*	2,3 *23*	2,4 *24*	2,5 *26*	2,5 *27*	2,6 *28*	2,6 *30*	2,7 *31*	2,8 *32*	2,8 *33*	2,9 *35*	2,9 *36*	3,0 *37*	3,0 *39*
0,35	3,0 *28*	3,1 *30*	3,2 *32*	3,3 *33*	3,4 *35*	3,4 *37*	3,5 *39*	3,6 *40*	3,7 *42*	3,8 *44*	3,8 *46*	3,9 *47*	4,0 *49*	4,0 *51*	4,1 *53*
0,40	3,9 *37*	4,0 *39*	4,2 *41*	4,3 *44*	4,4 *46*	4,5 *48*	4,6 *50*	4,7 *53*	4,8 *55*	4,9 *57*	5,0 *60*	5,1 *62*	5,2 *64*	5,3 *66*	5,4 *69*
0,45	5,0 *46*	5,1 *49*	5,3 *52*	5,4 *55*	5,6 *58*	5,7 *61*	5,8 *64*	6,0 *67*	6,1 *70*	6,2 *72*	6,3 *75*	6,5 *78*	6,6 *81*	6,7 *84*	6,8 *87*
0,50	6,1 *57*	6,3 *61*	6,5 *64*	6,7 *68*	6,9 *72*	7,0 *75*	7,2 *79*	7,4 *82*	7,5 *86*	7,7 *89*	7,8 *93*	8,0 *97*	8,1 *100*	8,3 *104*	8,4 *107*
0,55	7,4 *69*	7,6 *74*	7,9 *78*	8,1 *82*	8,3 *87*	8,5 *91*	8,7 *95*	8,9 *100*	9,1 *104*	9,3 *108*	9,5 *113*	9,6 *117*	9,8 *121*	10,0 *126*	10,2 *130*
0,60	8,8 *82*	9,1 *88*	9,4 *93*	9,6 *98*	9,9 *103*	10,1 *108*	10,4 *113*	10,6 *119*	10,8 *124*	11,0 *129*	11,3 *134*	11,5 *139*	11,7 *144*	11,9 *149*	12,1 *155*
0,65	10,4 *97*	10,7 *103*	11,0 *109*	11,3 *115*	11,6 *121*	11,9 *127*	12,2 *133*	12,4 *139*	12,7 *145*	13,0 *151*	13,2 *157*	13,5 *163*	13,7 *169*	14,0 *175*	14,2 *181*

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Nozzle Ø mm	Operating pressure - bar														
	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
Part-No.	Flow rate – L/min Recoil force in jetting direction /(N)*														
0,70	12,0 *112*	12,4 119	12,7 *126*	13,1 *133*	13,4 *140*	13,8 *147*	14,1 *154*	14,4 *161*	14,7 168	15,0 *175*	15,3 *182*	15,6 *189*	15,9 *196*	16,2 *203*	16,5 210
0,75	13,8 *129*	14,2 *137*	14,6 145	15,0 *153*	15,4 *161*	15,8 *169*	16,2 *177*	16,5 *185*	16,9 *193*	17,2 *201*	17,6 *209*	17,9 *217*	18,2 *225*	18,6 *233*	18,9 *242*
0,80	15,7 *147*	16,2 *156*	16,6 *165*	17,1 *174*	17,5 *183*	18,0 *192*	18,4 *202*	18,8 *211*	19,2 *220*	19,6 *229*	20,0 *238*	20,4 *247*	20,8 *257*	21,1 *266*	21,5 *275*
0,85	17,7 *165*	18,3 *176*	18,8 *186*	19,3 *196*	19,8 *207*	20,2 *217*	20,8 *228*	21,2 *238*	21,7 *248*	22,1 *259*	22,6 *269*	23,0 *279*	23,4 *290*	23,9 *300*	24,3 *310*
0,90	19,9 *186*	20,5 197	21,1 *209*	21,6 *220*	22,2 *232*	22,8 *243*	23,3 *255*	23,8 *267*	24,3 *278*	24,8 *290*	25,3 *301*	25,8 *313*	26,3 *325*	26,7 *336*	27,2 *348*
0,95	22,1 *207*	22,8 *220*	23,5 *233*	24,1 *245*	24,7 *258*	25,4 *271*	26,0 *284*	26,5 *297*	27,1 *310*	27,7 *323*	28,2 *336*	28,8 *349*	29,3 *362*	29,8 *375*	30,3 *388*
1,00	24,5 *229*	25,3 *243*	26,0 *258*	26,7 *272*	27,4 *286*	28,1 *301*	28,8 *315*	29,4 *329*	30,0 *344*	30,7 *358*	31,3 *372*	31,9 *386*	32,4 *401*	33,0 *415*	33,6 *429*
1,05	27,0 *252*	27,9 *268*	28,7 *284*	29,5 *300*	30,2 *316*	31,0 *331*	31,7 *347*	32,4 *363*	33,1 *379*	33,8 *395*	34,5 *410*	35,1 *426*	35,8 *442*	36,4 *458*	37,0 *473*
1,10	29,7 *277*	30,6 *294*	31,5 *312*	32,3 *329*	33,2 *346*	34,0 *364*	34,8 *381*	35,6 *398*	36,3 *416*	37,1 *433*	37,8 *450*	38,6 *468*	39,3 *485*	40,0 *502*	40,6 *520*
1,15	32,4 *303*	33,4 *322*	34,4 *341*	35,3 *360*	36,3 *379*	37,2 *398*	38,0 *416*	38,9 *435*	39,7 *454*	40,5 *473*	41,3 *492*	42,1 *511*	42,9 *530*	43,7 *549*	44,4 *568*
1,20	35,3 *330*	36,4 *350*	37,5 *371*	38,5 *392*	39,5 *421*	40,5 *433*	41,4 *453*	42,3 *474*	43,3 *495*	44,1 *515*	45,0 *536*	45,9 *557*	46,7 *577*	47,5 *598*	48,4 *618*

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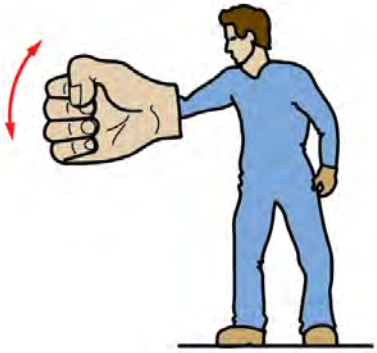
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APPENDIX E – HAND SIGNALS

The following set of hand signals may be used for communicating when carrying out high pressure water jetting operations.

FIGURE 11 Hand Signals

1 Pressurise system Thumb pointing upwards, the rest of the hand closed. From shoulder height, the arm moves up and down.	**2 Raise pressure** First finger pointing up, the rest of the hand closed. The hand is moved in a circular motion.
	
3 Lower pressure Finger pointing down, the rest of the hand is closed. Moves the hand in a circular motion.	**4 Depressurise system** Form a fist. Move the arm back and forth at shoulder height.
	

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APPENDIX F – OTHER REFERENCE MATERIAL

The following list of published technical standards provide guidance only. Compliance with them does not guarantee compliance with the WHS Act and Regulations in all instances. This list is not exhaustive.

AS/NZS 1269.3: 2005	*Occupational noise management, Part 3 Hearing protector program*
AS/NZS 1270: 2002	*Acoustics, hearing protectors*
AS 1319-1994	*Safety signs for the occupational environment*
AS/NZS: 1337 (Series) 2010, Amdt 1-2012, 2012	*Personal eye protection*
AS/NZS: 1715 2009	*Selection, use and maintenance of respiratory protective equipment*
AS 1742.3-2009	*Manual of uniform traffic control devices, Part 3 Traffic control for works on roads*
AS/NZS 1801: 1997, Amdt 1-1999	*Occupational protective helmets*
AS/NZS 2210.1: 2010	*Safety, protective and occupational footwear, Part 1 Guide to selection, care and use*
AS/NZS 2210.2: 2009	*Occupational protective footwear, Part 2 Test methods*
AS/NZS 2161.2: 2005	*Occupational protective gloves, Part 2 General requirements*
AS/NZS 2161.3: 2005	*Occupational protective gloves, Part 3 Protection against mechanical risks*
AS/NZS 2161.5: 1998	*Occupational protective gloves, Part 5 Protection against cold*
AS/NZS 3000: 2007, Amdt 1-2009, Amdt 2-2012	*Electrical installations*
AS 3765.1- 1990,	*Clothing for protection against hazardous chemicals, Part 1 Protection against general or specific chemicals*
AS 3765.2- 1990,	*Clothing for protection against hazardous chemicals, Part 2 Limited protection against specific chemicals*
AS 3791- 1991, Amdt 1-1991, Amdt 2-1995	*Hydraulic hose*
AS/NZS 4233.1- 1999	*High pressure water jetting systems, Part 1 Safe operation and maintenance*
AS/NZS 4233.2- 1999	*High pressure water (hydro) jetting systems, Part 2 Construction and performance*
AS/NZS 4233.2-1999	*High pressure water jetting systems, Part 2 Construction and performance*

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THIS GUIDE PROVIDES PRACTICAL GUIDANCE ON HOW TO MANAGE HEALTH AND SAFETY RISKS ASSOCIATED WITH HIGH PRESSURE WATER JETTING OPERATIONS.

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RTI Document No. 58

Department of Justice and Attorney-General

Workplace Health and Safety Queensland

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Managing risks of plant in the workplace

Code of Practice 2013

Great state. Great opportunity.

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RTI Document No. 1[illegible]

Queensland Government

This Queensland code of practice has been approved by the Attorney-General and Minister for Justice and commences on 1 December 2013.

This code is based on a national model code of practice developed by Safe Work Australia and approved by the Select Council on Workplace Relations on 13 July 2012 as part of the harmonisation of work health and safety laws.

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FOREWORD

This Code of Practice on managing health and safety risks of plant in the workplace is an approved code of practice under section 274 of the *Work Health and Safety Act 2011* (the WHS Act).

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the WHS Act and the Work Health and Safety Regulation (the WHS Regulation).

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the WHS Act, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks that may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the WHS Act and Regulation. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Compliance with the WHS Act and Regulation may be achieved by following another method, such as a technical or an industry standard, if it provides an equivalent or higher standard of work health and safety than the code.

An inspector may refer to an approved code of practice when issuing an improvement or prohibition notice.

This code of practice has been developed by Safe Work Australia as a model code of practice under the Council of Australian Governments' *Inter-Governmental Agreement for Regulatory and Operational Reform in Occupational Health and Safety* for adoption by the Commonwealth, state and territory governments.

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SCOPE AND APPLICATION

This Code provides practical guidance on how to manage health and safety risks of plant once it is in the workplace, from plant installation, commissioning and use through to decommissioning and dismantling.

This Code provides practical guidance to persons who conduct a business or undertaking and have management or control of plant in the workplace, as well as to persons who install and commission plant. It includes information about specific control measures required under the WHS Regulation for plant generally. Other approved codes of practice on various types of plant may also be referenced.

The Code of Practice: *Safe design, manufacture, import and supply of plant* provides further guidance for persons conducting a business or undertaking involved in these activities.

How to use this Code of Practice

In providing guidance, the word 'should' is used in this Code to indicate a recommended course of action, while 'may' is used to indicate an optional course of action.

This Code also includes various references to provisions of the WHS Act and Regulation which set out the legal requirements. These references are not exhaustive. The words 'must', 'requires' or 'mandatory' indicate that a legal requirement exists and must be complied with.

1 INTRODUCTION

Plant is a major cause of workplace death and injury in Australian workplaces. There are significant risks associated with using plant and severe injuries can result from the unsafe use of plant including:

- limbs amputated by unguarded moving parts of machines
- being crushed by mobile plant
- sustaining fractures from falls while accessing, operating or maintaining plant
- electric shock from plant that is not adequately protected or isolated
- burns or scalds due to contact with hot surfaces, or exposure to flames or hot fluids.

Other risks include hearing loss due to noisy plant and musculoskeletal disorders caused by manually handling or operating plant that is poorly designed.

1.1 The meaning of key terms

Plant includes any machinery, equipment, appliance, container, implement and tool, and includes any component or anything fitted or connected to any of those things. Plant includes items as diverse as lifts, cranes, computers, machinery, conveyors, forklifts, vehicles, power tools and amusement devices.

Plant that relies exclusively on manual power for its operation and is designed to be primarily supported by hand (e.g. a screw driver) is not covered by the WHS Regulation. The general duty of care under the WHS Act applies to this type of plant.

Certain kinds of plant, such as forklifts, cranes and some pressure equipment, require a licence from the WHS regulator to operate and some high-risk plant must also be registered with the WHS regulator.

Competent person means a person who has acquired through training, qualification or experience the knowledge and skills to carry out the task.

A competent person has a more specific meaning in the following circumstances:

- For design verification, the person must have the skills, qualifications, competence and experience to design the plant or verify the design.
- For inspection of plant for registration purposes the person must have
    - educational or vocational qualifications in an engineering discipline relevant to the plant being inspected, or
    - knowledge of the technical standards relevant to the plant being inspected.
- For inspection of mobile cranes, tower cranes and amusement devices the person must:
    - have the skills, qualifications, competence and experience to inspect the plant, and be registered under a law that provides for the registration of professional engineers (in jurisdictions where such a law exists), or
    - be determined by the WHS regulator to be a competent person.

Fail safe means a state or condition where, if any component or function of the plant fails, a system exists to prevent any increase in the risks. For example, if the primary hoist brake fails on a crane lifting a person in a workbox, the secondary hoist brake will prevent uncontrolled dropping of the workbox. However, once the secondary brake is engaged, a lower level of safety has been reached. The situation must be made safe and the fault rectified so that the fail safe capability is re-established.

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1.2 Who has health and safety duties in relation to plant at the workplace?

A person conducting a business or undertaking has the primary duty under the WHS Act to ensure, so far as is reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking. This duty includes ensuring, so far as is reasonably practicable:

- the provision and maintenance of safe plant
- the safe use, handling, storage and transport of plant.

Persons who conduct a business or undertaking involving the management or control of fixtures, fittings or plant at a workplace also have a duty to ensure, so far as is reasonably practicable, that the fixtures, fittings and plant are without risks to the health and safety of any person.

The WHS Regulation include specific duties for persons who conduct a business or undertaking involving the management or control of plant (persons with management or control of plant) including requirements to:

- manage the health and safety risks associated with plant
- prevent unauthorised alterations to or interference with plant
- use plant only for the purpose for which it was designed unless the proposed use does not increase the risk to health or safety.

As there are generally a number of people involved with plant during its lifecycle (e.g. from its design through to its use and eventual disposal), a person can have more than one duty and more than one person can have the same duty at the same time.

For example, if you own and operate plant in your workplace and you decide to modify it yourself, you will have the duties of a designer and manufacturer as well as a person with management or control of plant at the workplace.

If you own the plant, you will be the person with management or control of that plant. If you hire or lease an item of plant, you have management or control of that plant for the period that you have hired it for and will have responsibility for ensuring health and safety together with the person you have hired or leased it from.

If you conduct a business or undertaking that installs, commissions, maintains, operates, tests, repairs or carries out any other activity associated with plant in workplaces, even if you do not own the plant, you will be a person with management or control of the plant. This is because you have a degree of control over the plant during the period of the activity. In these situations you will have responsibility for managing risks associated with the plant together with other duty holders, such as the owner of the plant.

Officers, for example company directors, have a duty to exercise due diligence to ensure that the business or undertaking complies with the WHS Act and Regulation. This includes taking reasonable steps to ensure that the business or undertaking has and uses appropriate resources and processes to eliminate or minimise risks that arise from plant used in the workplace.

Workers have a duty to take reasonable care for their own health and safety and must not adversely affect the health and safety of other persons. Workers must comply with any reasonable instruction and cooperate with any reasonable policy or procedure relating to health and safety at the workplace.

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1.3 Other persons with duties related to plant

Designers, manufacturers, suppliers, importers and installers of plant must also ensure, so far as is reasonably practicable, that the plant is without risks to health and safety.

Designers

The safe design of plant plays a critical role in eliminating hazards and risks before plant is introduced in the workplace.

A designer is a person who conducts a business or undertaking that designs, redesigns or alters the design of plant or any part of the plant that is to be used or could reasonably be expected to be used at a workplace.

Designers have a duty to ensure, so far as is reasonably practicable, that the plant is without risks to health and safety to workers throughout the life of the plant. Among other things, designers must also provide specific information to the manufacturer. If the manufacturer advises the designer that there are safety issues with the design, the designer must revise the information to take account of these concerns, or tell the manufacturer in writing the reasons why such revision is not necessary. Designers must also carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary to ensure the plant is safe and without risks to health and safety.

Manufacturers

Manufacturers have a duty to ensure, so far as is reasonably practicable, that the plant is manufactured to be without risks to workers throughout the lifecycle of the plant. Manufacturers must advise the designer of any hazards they identify during manufacture and ensure that hazards are not incorporated into the manufacture of the plant.

Manufacturers must also arrange for any calculations, analysis, testing or examination that may be necessary to ensure that the plant is without risks to health and safety. If design registration is required, the manufacturer must give the design registration number to the person with management or control of the plant, who must ensure the number is kept readily accessible.

A reliable way to achieve this is for the manufacturer to permanently mark the design registration number on the plant.

Importers and suppliers

Importers of plant from outside Australia must take all reasonable steps to obtain information from the manufacturer and then pass this information on when supplying the plant. If this is not available importers must carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary to ensure, so far as is reasonably practicable, that the plant is without risks to the health and safety of any person. If design registration is required, the importer will also have duties to ensure that the design of plant is registered.

Any imported plant must be inspected, having regard to information provided by the manufacturer. If this information requires the plant to be tested then the importer must undertake this testing.

If an importer identifies any hazards, the importer must not supply the plant until the risks have been eliminated, or minimised, so far as is reasonably practicable, or if that is not possible, advise the person receiving the plant of those risks.

If the item of plant requires any alteration as a result of testing or hazard identification, then the importer must take all reasonable steps to advise the designer and manufacturer of this.

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Suppliers of second-hand plant must ensure, so far as is reasonably practicable, that any faults in the plant are identified. A written notice outlining the condition of the plant, any faults identified and, if appropriate, that the plant should not be used until the fault is rectified must be provided to the person to whom the plant is supplied.

If second-hand plant is to be used for scrap or spare parts, the supplier must inform the person they are supplying the second-hand plant to that the plant is being supplied as scrap or spare parts and that the plant in its current form is not to be used as plant. This must be done in writing or by marking the item of plant.

Further information is available in the *Safe design, manufacture, import and supply of plant Code of Practice.*

Installers

An installer is a person who conducts a business or undertaking who sets up, assembles, places in position and connects or otherwise makes plant ready for use. Installers have certain duties under the WHS Regulation (see Section 3.2 of this Code).

1.4 What is required to manage the risks associated with plant?

WHS Regulation section 203: A person with management or control of plant at a workplace must manage risks to health and safety associated with the plant.

WHS Regulation sections 34-38: In order to manage risk under the WHS Regulation, a duty holder must:

- identify reasonably foreseeable hazards that could give rise to the risk
- eliminate the risk so far as is reasonably practicable
- if it is not reasonably practicable to eliminate the risk, minimise the risk so far as is reasonably practicable by implementing control measures in accordance with the hierarchy of control
- maintain the implemented control measure so that it remains effective, and
- review, and if necessary revise, risk control measures so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health and safety.

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This Code provides guidance on how to manage the risks associated with plant in the workplace by following a systematic process that involves:

- identifying hazards
- if necessary, assessing the risks associated with these hazards
- implementing and maintaining risk control measures
- reviewing risk control measures.

Guidance on the general risk management process is available in the *How to Manage Work Health and Safety Risks Code of Practice.*

Providing and obtaining information

Designers, manufacturers, importers and suppliers all have duties to provide information about the plant to enable other duty holders to fulfil the responsibilities they have in managing the risks associated with it. This information must be given to each person to whom the plant (or its design) is provided. Information must be passed on from the designer through to the manufacturer and supplier to the end user. This information includes:

- the purpose for which plant was designed or manufactured
- the results of any calculations, analysis, testing or examination
- any conditions necessary for the safe use of the plant.

Consulting workers

Consultation involves sharing of information, giving workers a reasonable opportunity to express views and taking those views into account before making decisions on health and safety matters.

WHS Act section 47: The WHS Act requires that you consult, so far as is reasonably practicable, with workers who carry out work for you who are (or are likely to be) directly affected by a work health and safety matter.

WHS Act section 48: If the workers are represented by a health and safety representative, the consultation must involve that representative.

Consultation with workers and their health and safety representatives is required at each step of the risk management process.

Your workers usually know the hazards and risk associated with the plant they use. By drawing on the experience, knowledge and ideas of your workers you are more likely to identify all hazards and develop effective risk controls.

It is important to consult your workers as early as possible when planning to introduce new plant or change the way plant is used.

Consulting, co-operating and co-ordinating activities with other duty holders

There may be other businesses involved with plant at your workplace (e.g. who carry out installation or repair, or who share the workplace with you).

WHS Act section 46: The WHS Act requires that you consult, co-operate and co-ordinate activities with all other persons who have a work health or safety duty in relation to the same matter, so far as is reasonably practicable.

For example, if you own or manage an on-hire business and your workers undertake work at other workplaces then you should exchange information with the host business to determine:

- if your workers could be exposed to hazardous plant
- what each of you will do to control any associated risks.

If you use plant (e.g. mobile plant such as a forklift) at a workplace that is shared with other businesses you should talk to those businesses about the risks your plant could cause them and work together in a co-operative and co-ordinated way to manage the risks.

Further guidance on consultation requirements is available in the *Work Health and Safety Consultation, Co-operation and Co-ordination Code of Practice.*

1.5 Registering plant

Certain items of plant and types of plant designs must be registered. A list of registrable plant is provided at Appendix A.

Registrable plant must be:

- design registered before it is supplied
- item registered before it is used.

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Design registration

Design registration is the registering of a completed design, from which any number of individual items can be manufactured. The person applying for design registration may be either the original designer or a person with management or control of the item of plant.

Item registration

Plant item registration applies to a specific item of plant and each item requires registration. The purpose of registering an item of plant is to ensure that it is inspected by a competent person and is safe to operate. It is the responsibility of the person with management or control of plant to ensure that all registrable plant items are registered.

Further information on registering plant is provided in Chapter 5 of this Code.

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2 THE RISK MANAGEMENT PROCESS

2.1 Identifying hazards

Identifying hazards involves finding all of the things and situations that could potentially cause harm to people. Hazards associated with plant generally arise from:

- the plant itself, for example hazards associated with a forklift would include hazards relating to its mobility, its electrical, hydraulic and mechanical power sources, moving parts, load-carrying capacity and operator protection
- how and where the plant is used. The forklift, for example may have hazards arising from the kind of loads it is used to lift, the size of the area in which it is used and the slope or evenness of the ground.

Inspect the plant

Inspect each item of plant in your workplace and observe how it is used. Talk to your workers and their health and safety representatives to find out what their experience is with the plant they operate, inspect or maintain.

If you have hired or leased plant, you should also consult the person who owns the plant about potential hazards, because you both have responsibility for ensuring that the plant is safe and without risk to health and safety.

When identifying hazards you should think about all the activities that may be carried out during the life of the plant at your workplace, such as: installation, commissioning, operation, inspection, maintenance, repair, transport, storage and dismantling. For each of these activities, you should consider whether the plant could:

- cause injury due to entanglement, falling, crushing, trapping, cutting, puncturing, shearing, abrasion or tearing
- create hazardous conditions due to harmful emissions, fluids or gas under pressure, electricity, noise, radiation, friction, vibration, fire, explosion, moisture, dust, ice, hot or cold parts
- cause injury due to poor ergonomic design, for example if operator controls are difficult to reach or require high force to operate.

Other factors to consider include:

- the condition of the plant, for example its age, its maintenance history and how frequently the plant is used.
- the suitability of the plant, for example is it actually being used for its intended purpose?
- the location of the plant, for example what is its impact on the design and layout of the workplace and are workers able to access the plant without risk of slips, trips or falls?
- abnormal situations, for example, what abnormal situations, misuse or fluctuation in operating conditions can you foresee?

A checklist to assist in identifying hazards associated with plant is at Appendix B.

Review safety information

Information about hazards, risks and control measures relating to plant in your workplace can be obtained from:

- manufacturers, importers or suppliers of the plant
- maintenance technicians or specialists such as engineers
- your workers
- WHS regulators, unions and other organisations
- businesses or undertakings similar to your own
- technical standards.

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Review incident records and data

Check your records of workplace injuries and illness, dangerous incidents, plant inspection reports and maintenance logs, workers' compensation records and the results of any investigations to collect information about plant hazards.

2.2 Assessing the risks

A risk assessment involves considering what could happen if someone is exposed to a hazard combined with the likelihood of it happening. A risk assessment can help you determine:

- how severe a risk is
- whether existing control measures are effective
- what action you should take to control the risk
- how urgently the action needs to be taken.

A risk assessment is unnecessary if you already know the risk and how to control it.

To assess the risk associated with plant hazards you have identified, you should consider the following:

What is the potential impact of the hazard?

- How severe could an injury or illness be? For example, lacerations, amputation, serious or fatal crushing injury, burns or loss of hearing.
- What is the worst possible harm the plant hazard could cause?

How likely is the hazard to cause harm?

- Is it highly likely or unlikely to happen?
- How frequently are workers exposed to the hazard? For example, if plant is used constantly with five operators per shift and three 8-hour shifts and there is a lack of high level control measures, the risk will increase compared to the occasional use by a single operator.

Other factors to consider when undertaking a risk assessment include:

- In what type of conditions is the plant used in (e.g. in a confined space, muddy or dusty environment)?
- What is the condition of the plant? For example, is it old and missing safety features found on new plant? Is it reliable or often needing emergency maintenance?
- If there are other people or items of plant in the vicinity, what effect do they have on the likelihood or consequence?
- Where and when is access required during the installation, operation or maintenance of plant and in an emergency?
- What work practices and procedures exist in relation to plant safety (for example, isolation to carry out maintenance, emergency shut-down)?
- What kind of training, information, instruction and supervision is provided to workers and other persons who may be exposed to plant?
- Does the plant's safety depend on the competency of its operators?
- How is work organised? For example:
  - the speed of the process line
  - pedestrian and vehicular traffic around the plant
  - time spent on repetitive tasks
  - shift work arrangements
  - any production incentives that may affect health and safety.

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2.3 Controlling risks

The ways of controlling risks associated with plant are ranked from the highest level of protection and reliability to the lowest. This ranking is known as the *hierarchy of risk control.* The WHS Regulation require duty holders to work through this hierarchy to choose the control that most effectively eliminates or, where that is not reasonably practicable, minimises the risk in the circumstances. Specific controls are required under the WHS Regulation for certain types of plant, such as:

- powered mobile plant
- plant that lifts or suspends loads
- industrial robots
- lasers
- pressure equipment
- scaffolds.

The hierarchy of control measures

Elimination – The most effective control measure is to remove the hazard or hazardous work practice associated with the plant (e.g. buy pre-sawn timber instead of using a power saw.

Many hazards can be addressed before introducing plant into your workplace, that is, in the) planning and purchasing stages. For example, purchasing machinery that is designed and built to produce low noise levels is more effective than providing workers with personal hearing protectors. This also avoids costly modifications to plant after it is purchased.

If elimination is not reasonably practicable, you must minimise the risk by:

Substitution – Substitute the plant (or hazardous parts of it) with plant that is safer. For example:

- using a cordless drill instead of an electric drill if the power cord is in danger of being cut
- isolation – separate the hazardous plant from people, either by distance or physical barrier. For example:
  - constructing a booth from which the plant can be operated remotely
  - using concrete barriers to separate mobile plant from workers.

Engineering controls – Include modifications to tools or equipment (e.g. installing guards to prevent contact with moving parts of machinery or installing a roll over protective structure on a tractor).

Administrative controls – If risk remains, it must be minimised by implementing administrative controls, so far as is reasonably practicable, for example installing a tag-out system to ensure that workers are aware that the plant is isolated from its power source and must not be operated while maintenance or cleaning work is being done. Providing training and supervision, using warning signs or arranging work to minimise the time spent near noisy machinery are all examples of administrative controls.

Personal protective equipment (PPE) – Any remaining risk must be minimised with suitable PPE, such as providing workers with breathing protection, hard hats, gloves, aprons and protective eyewear.

Administrative control measures and PPE rely on human behaviour and supervision, and used on their own, tend to be least effective in minimising risks.

Combining control measures

In many cases, a combination of control measures will provide the best solution. For example, protecting workers from flying debris when using a concrete cutting saw may involve guarding the blade, isolating the work area and using PPE such as a face shield.

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2.4 Maintaining and reviewing risk control measures

WHS Regulation section 37: Control measures must be maintained so that they continue to protect workers and other people from the hazards associated with plant. The control measures must be:

- fit for purpose
- suitable for the nature and duration of the work, and
- installed, set up and used correctly.

WHS Regulation section 38: A person conducting a business or undertaking must review and as necessary revise control measures:

- when the control measure is not effective in controlling the risk
- before a change at the workplace that is likely to give rise to a new or different health and safety risk that the control measure may not effectively control
- if a new hazard or risk is identified
- if the results of consultation indicate that a review is necessary
- if a health and safety representative requests a review.

The control measures that are implemented must be reviewed and, if necessary, revised to make sure they work as planned and that no new hazards have been introduced by the control measures.

You should consult your workers to obtain feedback on the plant and work processes being used and consider the following questions:

- Are the relevant workers aware of the control measures and do they understand them?
- Are the control measures, for example guards, working effectively in both their design and operation?
- Have all hazards associated with the plant been identified?
- Has the purchase of a new item of plant made the job safer?
- Are safety procedures being followed?
- Has an incident occurred in relation to the plant?
- If new legislation or new information becomes available, does it indicate current controls may no longer be the most effective?

When deciding how frequently to carry out a review, you should consider the level of risk (high risk plant may need more frequent review) and the type of plant involved (there may be particular stages in the life of the plant where a more frequent review is needed).

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3 CONTROLLING RISKS: FROM PURCHASE TO DISPOSAL

3.1 Purchasing and hiring plant

Many injuries and illnesses associated with plant occur due to a failure to select the right equipment for the job. Before you purchase plant, check that it is suitable for the intended use including the environment it will be used in and the workers using it. Discuss your needs with the plant supplier, who must provide you with information about:

- the purpose for which the plant was designed or manufactured
- the results of any calculations, analysis, testing or examination
- any conditions necessary for the safe use of the plant
- any alterations or modifications made to the plant.

Before purchasing, hiring or leasing plant you should also determine:

- the hazards and risks associated with installation, commissioning, operation, inspection, maintenance, repair, transport, storage and dismantling of the plant
- control measures needed to minimise these hazards and risks
- the manufacturer's recommendations in relation to the frequency and type of inspection and maintenance needed
- any special skills required for people who operate the plant or carry out inspection and maintenance
- any special conditions or equipment required to protect the health and safety of people carrying out activities such as installation, operation and maintenance
- any alterations or modifications to be made to the plant.

You should check whether the plant includes some or all of the following characteristics:

- contact with or access to dangerous parts is prevented, for example by using guards and protective structures
- it is of sturdy construction and has tamper-proof design
- there are no obstructions to the plant operator
- it has fail safe operation
- it is easy to inspect and maintain
- it does not introduce other hazards (for example manual handling problems or excessive noise) into your workplace
- it incorporates measures to minimise risks during use (for example low noise).

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Purchasing second-hand plant

WHS Regulation section 198: A supplier of plant must:

- take all reasonable steps to obtain the information required to be provided to the manufacturer under section 23(4)(a) and (c) of the Act and these Regulations, and
- when the plant is supplied, ensure the person to whom the plant is supplied is given the information obtained by the supplier.

WHS Regulation section 199: A supplier of second-hand plant must ensure, so far as is reasonably practicable, that any faults in the plant are identified.
Before plant is supplied, the supplier of second-hand plant must ensure that the person to whom the plant is supplied is given written notice of:

- the conditions of the plant
- any faults identified, and
- if appropriate, that the plant should not be used until the faults are rectified.

WHS Regulation 8: A supply of a thing does not include the supply of a thing by a person who does not control the supply and has no authority to make decisions about the supply, for example an auctioneer without possession of the thing or a real estate agent acting in their capacity as a real estate agent.

Suppliers' duties apply whether the plant is new, second-hand or hired out.

Some examples of suppliers include a person conducting a business or undertaking who:
- sells second-hand plant at a retail outlet or directly sells their own second-hand plant
- imports second hand plant for on-sale, and
- auctions second-hand plant, excepting certain clearing sales (see below).

Suppliers' duties apply to suppliers that know, or should know, the plant is to be used in a workplace.

Suppliers' duties apply to a person conducting a business or undertaking whether the sale is a one-off sale or forms part of the business' day-to-day operations.

Duty to supply safe plant

Suppliers of second-hand plant must ensure, so far as is reasonably practicable, that the plant it without risks to the health and safety of persons who use it or may be exposed to it.

This includes, so far as is reasonably practicable, identifying any faults in the plant.

Suppliers of second-hand plant, other than scrap or spare parts, must give written notice to a prospective buyer of:
- the condition of the plant, including identified faults, if any, and
- if appropriate, that the plant should not be used until the faults are rectified.

Suppliers of second-hand plant must also take all reasonable steps to obtain information about how to use the plant correctly and safely from the manufacturer or original supplier.

Suppliers of second-hand plant must give the buyer:
- this information, and
- all available records of the plant that were kept by the previous owner.

The information may include data sheets, test certificates, operations and service manuals, reports and a safety manual.

Out-dated or non-existent safety features of second-hand plant

Second-hand plant is more likely to have out-dated or missing safety features.

In these circumstances suppliers of second-hand plant must do what is reasonably practicable to supply equipment that is safe for use at work.

The degree of risk posed by the plant must be weighed up against the cost of implementing measures to minimise it. Suppliers of second-hand plant should consider:
- if it is reasonably practicable to retrofit or modify the plant to improve its safety having regard to improvements to that type of plant since its manufacture, and
- if not reasonably practicable—whether information needs to be given to the buyer about any relevant matters including the purpose for which the plant was designed or manufactured and any conditions necessary to ensure the plant is without risks to health and safety when properly used.

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Buyers also have a duty to ensure the plant is safe and has all the required safety features before bringing it into service.

Adequate information to be provided about the condition of second-hand plant

Adequate information must be given to the buyer about the purpose for which the plant was designed or manufactured and any conditions necessary to ensure its safe use.

Apart from the manufacturer or original supplier—information about using second-hand plant safely, including its condition, may be obtained from:

- the previous owner of the plant, or
- a 'competent person' engaged to assess the plant and develop this information.

Without this kind of information, suppliers of second-hand plant have no way of knowing whether they have met their suppliers' duties under the Act.

Suppliers' duties and agents or auctioneers selling used agricultural plant at clearing sales

Supplies' duties apply to sellers' agents like auctioneers, unless the agent does not take control of the supply and has no authority to make decisions about the supply.

Agents selling used agricultural plant at clearing sales do not take possession of the plant, have little or no control of the supply and are not considered to be suppliers.

In these limited circumstances the suppliers' duties will only apply to the seller—not their agent.

Supplying scrap and spare parts

Plant sold for scrap or spare parts are not intended to be used at a workplace so does not need to be made safe or supplied with instructions for use.

However the supplier must tell prospective buyers that the plant is being supplied for scrap or spare parts only and that it cannot be used safely in its current form for any other purpose.

This should be done in writing or by marking the item of plant.

Hiring plant

When you hire plant, both you and the person you have hired it from must ensure, so far as is reasonably practicable, that the plant is safe to use. During the time that the plant is in your possession you will have control over the way the plant is used in the workplace.

Before you hire the plant you should assess whether the plant is suitable for its intended use. You should also check that the plant has been inspected and maintained by the supplier according to the manufacturer's specifications. This may involve checking the log book or maintenance manual. You should also ensure that the supplier provides you with the manufacturer's information about the purpose of the plant and its proper use.

Any person who hires or leases plant to others will have duties as a supplier of plant and as a person with management or control of plant. This means that they must ensure, so far as is reasonably practicable, that the plant is safe to use and properly maintained. They must also provide specific information with the plant about how to operate it safely.

In most cases the supplier will be responsible for inspecting and maintaining the plant. However, if the plant is to be hired for an extended period of time, you and the supplier may develop arrangements to ensure that the plant is adequately inspected and maintained throughout the lease. This may involve the supplier coming to your workplace to maintain the plant, or you maintaining the plant while it is at your workplace.

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The arrangements you make will depend on your ability to inspect and maintain the plant in accordance with the manufacturer's specifications. If you choose to maintain the plant yourself during the lease, you should provide all information and records about the maintenance to the hirer at the end of the lease.

3.2 Installation and commissioning of plant

WHS Regulation 204: A person with management or control of plant at a workplace must ensure that:

- plant is not commissioned unless the person has established that the plant is, so far as reasonably practicable, without risks to the health and safety of any person;
- the person installing or commissioning the plant is a competent person, and is provided with all the information necessary to minimise risks to health and safety; and
- the processes for the installation, construction and commissioning of plant include inspections that ensure, so far as is reasonably practicable, the risks are monitored.

Installing plant

An installer should ensure:

- plant is erected or installed in having regard to the manufacturer's instructions including ensuring that specialised tools, jigs and appliances necessary to minimise any risk of injury during installation are used
- access to and egress from plant complies with relevant standards
- plant is stable during installation
- the interaction of plant with people, work processes and other plant is considered
- environmental factors affecting installation and use (e.g. wet conditions) are considered
- all electrical installations associated with plant comply with AS 3000 (also known as the Australian/New Zealand Wiring Rules) as far as it is relevant.

The installer should notify the designer, manufacturer, supplier and/or the person with management or control of plant of any new risks identified during the installation of the plant.

Positioning plant in the workplace

Plant should be positioned so that:

- risks from hot plant (such as friction, molten material, hot gases) are controlled through restricted access, guarding or insulation
- there is sufficient space (suggested 600 mm, the minimum width of a walkway) for safe access to the plant for operation, cleaning, maintenance, inspection and emergency evacuation
- the plant does not obstruct doorways and emergency exits
- the proximity to other plant does not have a negative effect on the operation of the plant or work processes
- the plant rests on a suitable foundation where required (e.g. on a floor or other support that ensures the plant is stable and secure)
- ventilation is adequate to deal with the nature and volume of any emissions from the plant
- workers and others are not exposed to noise levels greater than those stated in the exposure standard for noise under the WHS Regulation.

Commissioning plant

Commissioning plant involves performing the necessary adjustments, tests and inspections to ensure plant is in full working order to specified requirements before the plant is used. Commissioning includes recommissioning.

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The person who commissions plant should ensure that:
- the commissioning sequence is in accordance with the design specifications
- tests, such as dummy runs, are carried out to check that the plant will perform within the design specifications.

3.3 Instruction, training and supervision

Before plant is used in your workplace, you must provide your workers and other persons who are to use the plant with information, training, instruction or supervision that is necessary to protect them from risks arising from the use of the plant.

You must also provide the necessary safety information to persons who are involved in installing, commissioning, testing, maintaining or repairing plant, as well as decommissioning, dismantling or disposing of plant. This should include information on the types of hazards and risks the plant may pose to the person when they are carrying out these activities.

This information may be supported with safe work procedures that include instructions on:
- the correct use of guarding and other control measures
- how to safely access and operate the plant
- who may use an item of plant, for example only authorised or licensed operators
- how to carry out inspections, shut-down, cleaning, repair and maintenance
- traffic rules, rights of way, clearances and no-go areas for mobile plant
- emergency procedures.

Any emergency instructions relating to an item of plant should be clearly displayed on or near it.

Training programs should be practical and 'hands on' and take into account the particular needs of workers, for example literacy levels, work experience and specific skills required for safe use of the plant.

Supervisors should take action to correct any unsafe work practices associated with plant as soon as possible, otherwise workers may think that unsafe work practices are acceptable.

3.4 Using plant in the workplace

WHS Regulation sections 205-206: A person with management or control of plant at a workplace must:
- so far as is reasonably practicable, prevent unauthorised alterations to or interference with the plant
- take all reasonable steps to ensure the plant is only used for the purpose for which it is designed, unless a competent person has assessed that the proposed use does not increase the risk to health and safety
- ensure all safety features, warning devices, guarding, operational controls, emergency stops are used in accordance with instructions and information provided.

Workers who operate plant should be competent, or suitably supervised during training, so that they do not put themselves or others at risk. It is important to retain all operating manuals and instructional material provided by the manufacturer in order to correctly operate and maintain the plant once it is in the workplace. You should also consider and address the risks that may arise from:
- operator fitness for work, for example fatigue
- carrying out routine or repetitive tasks
- local conditions and working procedures.

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High risk work licences

Certain types of plant, such as industrial lift trucks and some types of cranes, require the operator to have a high risk work licence before they can operate the plant. Schedule 3 of the WHS Regulation sets out the classes of high risk work licences and the types of plant involved.

3.5 Making changes

If you intend to alter the design of the plant, change the way the plant is used or change a system of work associated with the plant, you should carry out the risk management process again.

If you intend to use plant in a different way or for a purpose that it was not designed for, you must ensure that the risks associated with the new use are assessed by a competent person. For example, if an item of plant that is designed to cut wood is intended to be used to cut metal, all hazards associated with that use must be identified and the appropriate controls implemented. This may mean the provision of a lubricating and/or cooling fluid system to ensure that the cutting process does not generate excess friction or heat.

The competent person's assessment should:

- include all aspects of the proposed task
- outline the reasons a purpose-designed item of plant cannot be used for the proposed task, such as the impracticability of using it or additional risks that using purpose-designed plant would generate
- take into account the recommendations of the designer, manufacturer or supplier of the plant and ensure the proposed use is not outside its capabilities
- identify differences between the item of plant and one that is purpose-designed for the task, and describe measures used to control the risks that such plant is designed to control
- amend any relevant documentation, for example, operator and maintenance manuals and signage.

If a competent person decides that the plant is not suitable for the proposed task, it must not be used for that task.

Making alterations to plant

Prior to making any alterations to plant you should consult with the designer and manufacturer to ensure all relevant safety issues have been considered. Any alterations you make to the plant will result in you assuming the obligations of a designer or manufacturer.

If the original designer or manufacturer cannot be contacted (for older plant or imported plant) the alterations should be carried out by a competent person in accordance with the relevant technical standards. See Appendix C for examples of published technical standards.

In the case of plant that requires design registration, the altered design must be registered if the alteration to the design may affect health and safety.

Plant should be isolated from power sources and be unable to be switched on or activated accidentally before alterations begin or while alterations are being carried out.

Before returning altered plant to service you should:

- have control measures in place to eliminate or, where that is not reasonably practicable, minimise any risks created by the alteration including providing information and training for users and supervisors about the changes
- inspect and test the plant, having regard to the altered design specifications and relevant technical standards.

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3.6 Inspecting plant

WHS Regulation section 213: A person with management or control of plant at a workplace must ensure that maintenance, inspection, and if necessary testing, of plant is carried out by a competent person in accordance with manufacturer's recommendations, or if those aren't available, in accordance with recommendations of a competent person. If it is not reasonably practicable to comply with the manufacturer's recommendations or the recommendations of a competent person, the inspection and testing must occur annually.

The inspection of plant should be conducted in accordance with a regular maintenance system to identify any:

- potential problems that were not anticipated during plant design or task analysis
- deficiencies in plant or the equipment associated with use of plant (e.g. wear and tear, corrosion and damaged plant parts)
- adverse effects of changes in processes or materials associated with plant
- inadequacies in control measures that have been previously implemented.

Inspection of associated work processes should be conducted regularly to identify any:

- unsafe work practices associated with the use of plant
- negative effects of changes in processes or materials associated with plant
- inadequacies in control measures that have been previously implemented.

Regularly inspect hand-held powered plant and repair or replace them when necessary, and replace damaged or worn parts (such as grinding wheels).

Any control measures implemented, such as guards and warning devices, must be regularly inspected and tested to ensure they remain effective.

You should keep an up-to-date register of the items of plant requiring regular inspection and maintenance. It should include information on:

- allocated responsibilities for people dealing with inspections
- standards against which plant should be inspected
- the frequency of inspections
- critical safety instructions to be followed during inspection, for example the isolation procedure
- the procedures for particular types of inspections including:
  - periodic inspections
  - specific tests
  - repaired or modified plant
- any variations from normal operation or dangerous occurrences and any trends that may be occurring.

Reasonably practicable control measures must be implemented to ensure the health and safety of the person conducting the inspection, for example by ensuring that plant is switched off or isolated from the energy source to avoid accidental re-energising of dangerous parts.

Any guards that are removed must be replaced correctly to prevent access to the hazardous part of the plant when it is returned to use.

3.7 Maintenance, repair and cleaning of plant

Plant must be maintained and repaired according to the manufacturer's specifications or, in the absence of such specifications, in accordance with a competent person's recommendations. For example, ensure fluid levels and pressures are correct and ensure brakes are functioning properly.

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Plant should be isolated before maintenance or cleaning commences. Where plant is isolated and plant shutdown will result, any total or partial shutdown should not allow a hazardous situation to be created.

Isolated or disengaged plant should:

- not hinder or interfere with the operation of any other plant
- have guards in place where a risk of injury is identified
- not obstruct access.

A process should be put in place to enable effective communication and consultation with affected workers and other persons conducting a business or undertaking to prevent any risk to health and safety arising from restarting the operation of the plant which has been shut down due to inspection, maintenance or cleaning.

Where plant cannot be isolated, methods to prevent accidental operation must be implemented. The work should be carried out under controlled procedures to allow for maintenance and cleaning without risk to the health and safety of the person performing the work.

WHS Regulation section 210: If there is a need to operate plant during maintenance or cleaning, the person with management or control of the plant must ensure that the operators' controls allow the safe operation of the plant while a person is undertaking the maintenance or cleaning.

If the plant is operated by a person other than the person who is carrying out the maintenance or cleaning, the person operating the plant must be authorised to do so by the person with management or control of the plant.

Following maintenance all guarding must be replaced prior to start-up of plant.

Damaged plant should be withdrawn from service until any risks to health and safety have been controlled.

3.8 Storing plant

WHS Regulation section 207: A person with management or control of plant at a workplace must ensure that plant not in use is left in a state that does not create a risk to the health or safety of any person.

Plant that is not in use must be stored so that it does not create a risk to workers or other people in the workplace. Where plant is to be placed in storage, you should:

- ensure relevant health and safety information supplied by the designer or manufacturer is provided to the person who is to dismantle or store the plant
- implement control measures to eliminate or, if that is not reasonably practicable, minimise the risks of damage to plant during storage, for example from corrosion as a result of exposure to residues of hazardous substances and deterioration of consumables.

Before plant is used after an extended period of storage, the plant should be re-commissioned by carrying out the same level of testing and inspection when it was first commissioned.

Plant that has been taken off-line constitutes plant not in use. For example, an automatic robot on a welding line may be taken off-line due to a product design modification no longer requiring the use of the robot for the particular product. The robot is therefore still fully functional but is no longer in use. The robot must not be left in a state that presents a risk to health or safety. This may be done by isolating the work station from the power supply, employing lock-out and tag-out systems, and providing physical stops to prevent movement in the event of accidental

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powering of the plant. Further information on isolating energy sources is provided at Section 4.5 of this Code.

Powered mobile plant may present a risk to health or safety if measures are not taken to prevent the plant moving of its own accord (for example rolling down a sloping surface) or to prevent unauthorised operation. For example, an industrial lift truck at the end of or during a shift is plant that is frequently not in use and unattended for short periods of time. The person with management or control should ensure that the operator of the truck understands the required safety procedures when leaving the truck unattended. This would include ensuring that the truck has been parked on a firm, level surface with the handbrake applied, the motor switched off and rendered inoperable, for example by removing the key.

3.9 Decommissioning, dismantling and disposing of plant

WHS Regulation section 204: A person with management or control of plant at a workplace must ensure that:

- plant is not decommissioned or dismantled unless it can be carried out without risks to health and safety so far as is reasonably practicable
- the person who decommissions or dismantles the plant is a competent person and is provided with all available information necessary to eliminate, or where this is not reasonably practicable, minimise risks to health and safety, and
- the processes associated with the decommissioning and dismantling include inspections to ensure, so far as is reasonably practicable, that risks associated with these activities are monitored.

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You should identify any hazards inherent in the process of decommissioning and dismantling the plant (for example exposure to hazardous substances). The plant should be dismantled in accordance with the designer's and manufacturer's instructions.

Disposing of plant may include reselling (in full or part) or scrapping (waste disposal and/or recycling). If the plant is to be resold, the seller will take on the duties of a person that supplies plant. The seller should ensure that the plant is safe to load, transport, unload and store. Any information relating to the plant design, registration, installation, operation and/or maintenance must be provided with the plant to the reseller or buyer.

If the plant is to be scrapped, you should consult with local waste disposal authorities or organisations so that the plant is safe to load, transport, unload and dispose of.

If the plant is to be used for scrap or spare parts, you must inform the person you are supplying the plant to that the plant is being supplied as scrap or spare parts and that the plant in its current form is not to be used as plant. This must be done in writing or by marking the item of plant.

4 SPECIFIC CONTROL MEASURES

4.1 Guarding plant

A guard is a physical or other barrier that can perform several functions including:

- preventing contact with moving parts or controlling access to dangerous areas of plant
- screening harmful emissions such as radiation
- minimising noise through the application of sound-absorbing materials
- preventing ejected parts or off-cuts from striking people.

WHS Regulation section 208: If guarding is used, the person with management and control must ensure that:

- if access to the area of plant requiring guarding is not necessary during operation, maintenance or cleaning, the guarding is a permanently fixed barrier
- if access to the areas requiring guarding is necessary during operation, maintenance or cleaning, the guarding is an interlocked physical barrier
- if it is not reasonably practicable to use a permanently fixed barrier or an interlocked physical barrier, the guarding is a physical barrier that can only be altered or removed using a tool, or
- if it is not reasonably practicable to use a permanently fixed barrier, an interlocked physical barrier or a physical barrier fixed in position, the guarding includes a presence-sensing safeguarding system.

Guarding must:

- be of solid construction and securely mounted so as to resist impact or shock
- prevent by-passing or disabling of the guard
- not create a risk in itself (for example it must not obstruct operator visibility, weaken the plant, cause discomfort to operators or introduce new hazards such as pinch points, rough or sharp edges)
- be properly maintained
- control any risk from potential broken or ejected parts and workpieces
- allow for servicing, maintenance and repair to be undertaken with relative ease, and
- if guarding is removed the plant cannot be restarted unless the guarding is replaced.

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Permanently fixed physical barriers

Permanently fixed physical barriers are designed to be welded or incorporated into the body of the machine. In Figure 1, the plant's power transmission is not required to be accessed during normal operation, maintenance or cleaning. It is therefore practicable to have the gear arrangements enclosed in gearbox housing to prevent access to moving gears. This has eliminated the risk associated with entanglement.

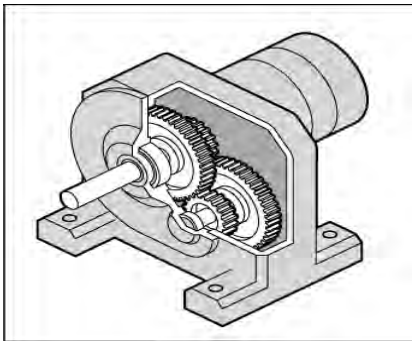


Figure 1 Cut-away view of a fixed physical barrier encasing the gear assembly and electric motor

Interlocked physical barriers

An interlock guard is connected to the plant's operational controls so that the plant is prevented from operating until the guard is closed. The guard cannot be opened or removed until the dangerous parts of the machine have fully come to rest. In Figure 2, the hinged top guard on the food mixer has a positively operating insertion key which automatically cuts off the plant's power when the lid is opened or removed. This allows the blades to come to rest. If the moving parts do not stop immediately once the power is cut off, then a guard should be designed to delay release of the locking mechanism until the moving parts have stopped.

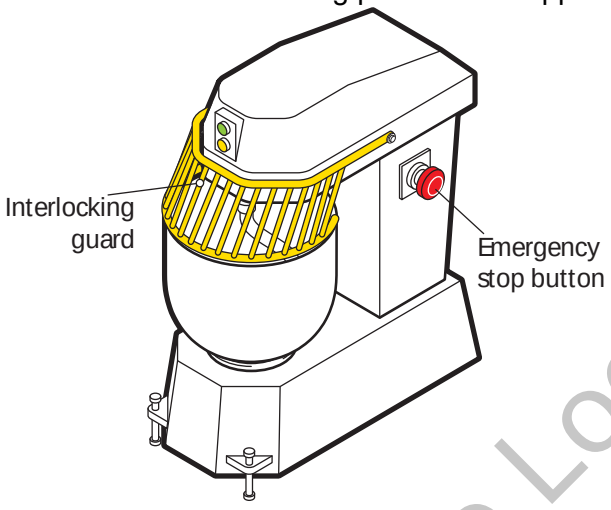


Figure 2 Food mixer with interlocking guard

Physical barriers fixed in position

Physical barriers that are securely fixed in position should be easy to remove and replace but only with the aid of a special tool, such as a spanner, Allen key or similar tool, and only when the machine is not in operation (see Figure 3). Devices such as wing nuts or wedge inserts, which can be operated using fingers or become stuck, should not be used.

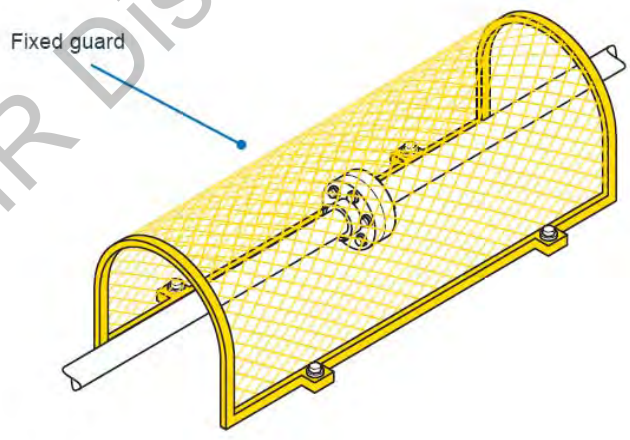


Figure 3 Fixed guard on rotating shaft or coupling

Physical barriers such as perimeter fences securely fixed in position may prevent access to dangerous areas. Any access points, for example gates and doors, should be secured with a lock and key or an interlocking system (see Figure 4). Isolation procedures may be necessary where there is a danger of machines activating while a person is inside the barrier. For example, when an interlocked door is accidentally closed the machine should not automatically restart.

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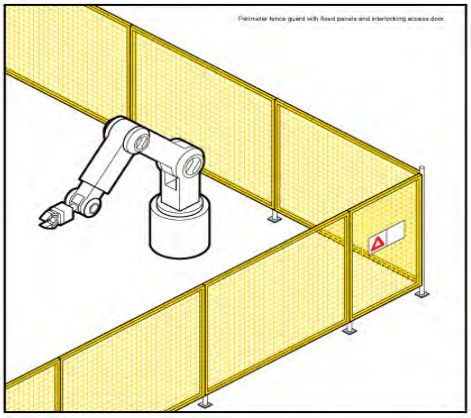


Figure 4 Perimeter fence guard with fixed panels and interlocking access door

Adjustable guarding incorporates movable sections or panels of the guard to allow materials to be fed into the guarded area while still preventing physical contact (see Figure 5).

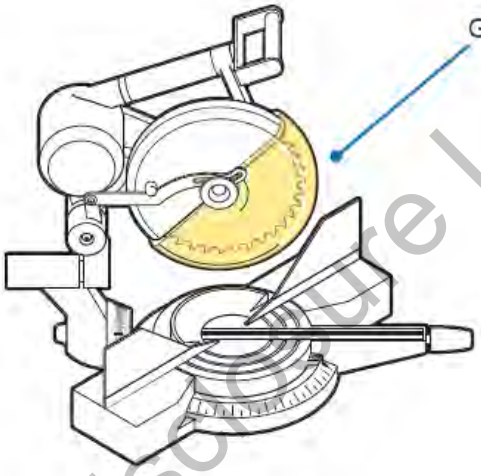


Figure 5 Self-adjusting guard for a drop saw

Physical barrier guarding should be strong enough to resist normal wear and shock that may arise from failure of the parts or processes being guarded; and to withstand prolonged use with a minimum of maintenance.

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Presence sensing systems

If physical guards are not reasonably practicable, then a presence sensing system can be used to control the risk. These systems detect when a person (or part of a person's body) enters the danger zone and stops the machine. Photoelectric light beams, laser scanners and foot pressure mats are examples of these type of guards. They rely on sensitive trip mechanisms and the machine being able to stop quickly, which may be assisted by a brake (see Figures 6 and 7).

Effective presence-sensing safeguard systems require the selection of a trip device appropriate for the work being done, and the correct location of beams with light activated devices, taking into account speed of entry and machine stopping time.

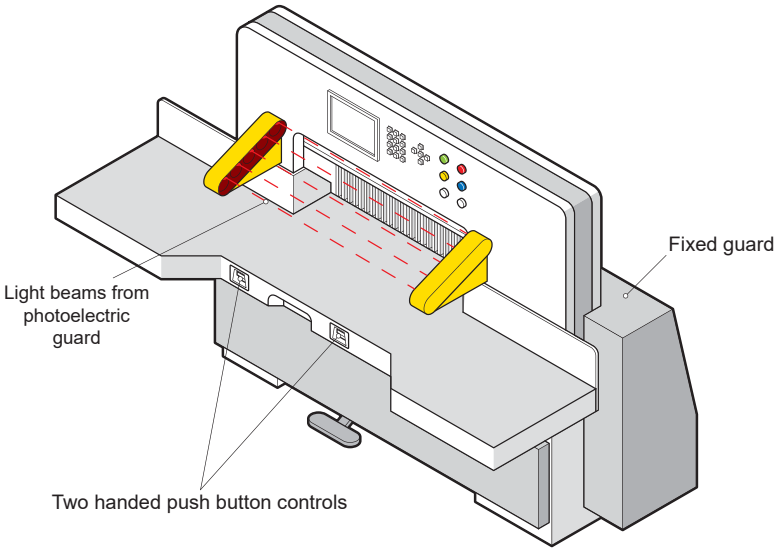


Figure 6 Paper cutting guillotine with a combination of guards including a photoelectric light curtain

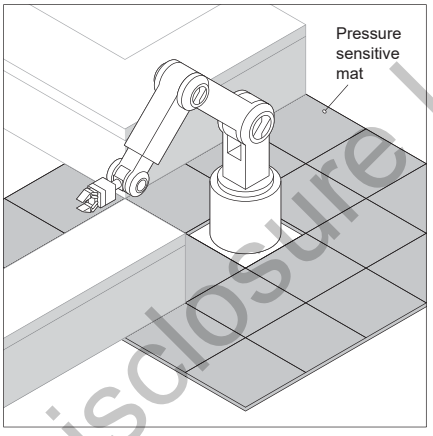


Figure 7 Pressure sensitive mat

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Environmental factors

When using a guard you should consider the environment in which it may be used. Some examples of poor guard selection include: guards on high frequency welders that become electrically charged, heating of guards in hot processes and wire mesh guards on machines emitting splashes.

If a guard is likely to be exposed to corrosion, you should consider corrosion-resistant materials or surface coatings.

Colour coding

It is good practice for all guards to be painted the same colour. For example:

- use high visibility yellow, provided it is different to the plant's colour, so that it can be clearly seen when a guard has been removed or when it is not in its proper place
- paint the surfaces behind the guard a contrasting or bright colour so that when the guard is removed, the exposed colour is clearly visible and it is easy to identify that the guard has been removed, alerting workers to possible danger.

For some types of plant, it may be necessary to choose colours that contrast with workpieces, where these need to be visible through the guarding.

Removal of guarding

If any type of guarding is removed for the purposes of maintenance or cleaning, it must be replaced before the plant is put back into normal operation. The plant should not be able to restart unless the guarding is in place. When removing guarding, eliminate the energy source by disconnecting the power supply or by locking out motive power sources.

4.2 Operator controls

WHS Regulation section 210: A person with management or control of plant at a workplace must ensure that any operator controls are:

- identified so as to indicate their nature, function and direction of operation
- located so they can be readily and conveniently operated
- located or guarded to prevent unintentional activation
- able to be locked into the 'off' position to enable disconnection from energy sources

Badly designed operator controls can lead to unintentional and unsafe operation of plant. For example, a control for setting the speed on a saw should not be a simple slider or rotary control that may be accidentally adjusted during operation. It should be graduated in fixed lockable steps.

Operator control devices should be designed:

- to enable the plant to be 'fail safe'. For example, when hand pressure is released on a lever controlling up and down movement, the lever will return to the neutral position and movement will stop
- to be within easy access of the operator
- so the intended function can be easily read and understood, especially in the case of dials and gauges
- so the movement of the control is consistent with established convention, for example anticlockwise to open, clockwise to close
- so the desired effect can only occur by intentional operation of a control, for example provision of a starting control
- to withstand the rigours of normal use, undue forces and environmental conditions
- so they are located outside danger zones
- so they are readily accessible for maintenance.

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4.3 Emergency stops

WHS Regulation section 211: If the design of plant at a workplace includes an emergency stop control, the person with management or control of the plant must ensure that:

- the stop control is prominent, clearly and durably marked and immediately accessible to each operator of the plant
- any handle, bar or push button associated with the stop control are coloured red
- the stop control cannot be adversely affected by electrical or electronic circuit malfunction.

Where plant is designed to be operated or attended by more than one person and more than one control is fitted, the multiple controls must be of the 'stop and lock-off' type so that the plant cannot be restarted after a stop control has been used unless each activated stop control is reset.

Emergency stop devices should not be the only method of controlling risks. They should be designed as a back-up to other control measures.

Once engaged, the emergency stop controls should remain that way. It should only be possible to disengage the emergency stop controls by a deliberate action. Disengaging the emergency stop control should not restart the plant. It should only allow the normal starting sequence to be activated.

In the case of plant or parts of plant designed to work together, stop controls (including the emergency stop control) should be capable of stopping the plant itself as well as all the equipment interrelated to its operation, where continued operation of this related equipment may be dangerous.



Figure 8 Emergency stop button

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4.4 Warning devices

WHS Regulation section 212: A person with management or control of plant at a workplace must ensure that an emergency warning device is positioned on the plant to ensure that the warning device will work to best effect.

WHS Regulation section 215: If there is a possibility of the plant colliding with pedestrians or other powered mobile plant, the person with management or control of the plant must ensure that the plant has a warning device that will warn persons who may be at risk from the movement of the plant.

Warning devices should be used where there is a likelihood of moving plant colliding with other plant or workers in the vicinity of the plant. There are a number of warning devices that can be fitted to moving plant to alert the operator and others in the workplace.

Automatic audible alarms

Automatic audible alarms are usually fitted to warn of forward or reversing movement. These alarms emit an intermittent sound which is activated when the gear or drive lever is engaged.

If automatic audible alarms are used, the sound should be distinct and clearly audible only in the hazard area. If several items of plant are using the same warning device it may be difficult for workers to be aware of which item of plant is moving or is about to move. It is also possible that workers will become desensitised to the sound. For this reason it may be more effective to combine audible alarms with other warning devices, such as flashing lights.

Motion sensors

Motion sensors also warn with sound. They are sensitive to movement and are activated by motion in the required direction. These devices are suitable for plant that moves suddenly in any direction, such as rollers, bulldozers, excavators, boom lifts or scissor lifts.

Motion sensor alarms usually deactivate after a short time. They should not be deactivated if the operator has restricted vision when reversing.

Lights

Lights are usually used to warn of forward and reversing movement. These lights are wired to operate continuously or in hazard mode by flashing, usually when reversing. They generally work when the gear or drive lever is engaged.

It is important to choose the intensity and colour of the lights appropriate to your workplace to ensure that the moving plant can be seen. For example, an orange warning light may be suitable inside a warehouse but may not be seen in sunlight.

Flashing lights

Rotary flashing lights are coloured revolving lights that are usually mounted in a prominent place, such as the top of a vehicle cabin. They can be wired to operate continuously or activated by a switch. They are suitable to be used on any items of plant that moves in the workplace, such as forklifts or skid steer loaders.

Flashing lights may not be suitable for plant that:
- is stationary for long periods of time
- operates in restricted areas, such as trucks travelling on defined site roads.

Percussion alarms

Percussion alarms are mechanical devices that are fitted to an axle or gear shift. When plant moves, a cam raises a hammer that drops repeatedly onto a bell or sounding plate. These alarms are relatively cheap to install, however they require regular maintenance to ensure they continue functioning effectively.

Radio sensing devices

Radio sensing devices activate when the operator selects reverse. A light and alarm sounds inside the cabin to alert the operator if a pedestrian is within a predetermined distance from the rear of the plant.

Air horns

Horns are suitable for powered mobile plant with long breaking distances, such as trucks. Some large workplace or sites may require a truck to “stop and sound horn before continuing”.

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4.5 Isolation of energy sources

An isolation procedure is a set of predetermined steps that should be followed when workers are required to perform tasks such as maintenance, repair, installation and cleaning of plant.

Isolation procedures involve the isolation of all forms of potentially hazardous energy so that the plant does not move or start up accidentally. Isolation of plant also ensures that entry to a restricted area is controlled while the specific task is being carried out.

The lock-out process is the most effective isolation procedure. The process is as follows:
- shut down the machinery and equipment
- identify all energy sources and other hazards
- identify all isolation points
- isolate all energy sources
- control or de-energise all stored energy
- lock out all isolation points
- tag machinery controls, energy sources and other hazards

- test by ‘trying’ to reactivate the plant without exposing the tester or others to risk. Failure to reactivate the plant means that the isolation procedure is effective and that all stored energies have dissipated. This may require further measures to safely release these energies, for example hydraulic or pneumatic pressure, suspended weight or compressed springs.

In order for the isolation procedure to be effective, you should identify all energy sources likely to activate the plant or part of it and isolate or de-energise these to avoid the plant being inadvertently powered. Energy sources include:

- electricity (mains)
- battery or capacitor banks
- solar panels
- fuels
- heat
- steam
- fluids or gases under pressure (water, air, steam or hydraulic oil)
- stored energy (e.g. compressed springs)
- gravity, and
- radiation.

In order to isolate plant you should use a device that effectively locks out the isolation points. These devices include switches with built-in locks and lock-out circuit breakers, fuses and valves. Other devices include chains, safety lock-out jaws (also known as hasps) and safety padlocks.

When isolating an energy source you should use a lock that allows one or more padlocks to be fitted. If more than one person is working on the plant at the same time, you should ensure that each worker is able to attach a padlock to the device (see Figure 9). This will prevent access to the energy sources while the work is being carried out.

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Figure 9 Example of lock-out with a tag and the padlocks of two workers

Another way to allow multiple locks to be used is to have one padlock on the isolation point, with the keys locked in a box that has been locked separately by each worker.

Each worker involved in the maintenance, cleaning or repair of the plant should have a lock, tag and key for each isolation point. There should be no duplicate key for any lock, except a master key that is kept in a secure location and should only be used in an emergency.

If more than one energy source needs to be isolated to enable safe shut-down of the plant, the single key to each lock-out device should be held by the same person.

Tags should only be used as a means of providing information to others at the workplace. A tag should not be used on its own as an isolation device; only a lock is effective at isolating the energy source.

5 PLANT REGISTRATION

Schedule 5 of the WHS Regulation requires certain plant designs and items of plant to be registered (registrable plant). Schedule 5 is reproduced at Appendix A.

You must not allow the use of any registrable plant in the workplace if it has not been registered.

5.1 Design and altered design registration

You must register a plant design if:

- it has not already been design registered
- you alter the plant design by modifying the plant and the alterations to the design may affect health and safety.

In order to register a plant design, the design must be verified by a design verifier who must provide a statement that the design has been produced in accordance with published technical standards or engineering principles specified by the designer. Examples of published technical standards are provided at Appendix C.

A design can only be verified by a person who is eligible to be a design verifier under the WHS Regulation. The types of people who would be competent to verify the design of plant may include someone who:

- has educational or vocational qualifications in an engineering discipline relevant to the design to be verified
- has knowledge of the technical standards relevant to the design to be verified
- has the skills necessary to independently verify that the design was produced in accordance with the published technical standards and engineering principles used in the design
- is certified by a body that is accredited or approved by the Joint Accreditation System—Australia and New Zealand or an equivalent overseas body to undertake conformity assessments of the design against the relevant technical standards.

For example, this could include someone who is registered on the National Professional Engineers Register administered by the Institution of Engineers Australia and is determined by that Institution to be competent to design or inspect the relevant type of plant, or is a member of the Institution of Engineers Australia with the status of Chartered Professional Engineer.

When registering a plant design, the WHS regulator will issue a plant design registration number. This number must then be given to the manufacturer, importer or supplier of plant. These duty holders must ensure that the design registration number is provided to the person with management or control of plant at the workplace.

The person with management or control of plant at the workplace must then ensure that the design registration number is kept readily accessible in the vicinity of the plant at all times. A reliable way to achieve this is to permanently mark the design registration number on the plant.

Changes to design registration

If a registered plant design is altered so as to require any new risk control measures, the altered design must be registered.

5.2 Item registration

A person with management or control of an item of plant specified in Part 2 of Schedule 5 of the WHS Regulation must apply to the WHS regulator to register that item of plant.

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In order to have an item of plant registered, the item must be inspected and a statement provided by a competent person stating that the plant is safe to operate. A person is competent to inspect an item of plant if the person has educational or vocational qualifications in an engineering discipline relevant to the plant, or knowledge of the technical standards relevant to the plant to be inspected.

If the design of the plant was also required to be registered, the design registration number must be included with the application.

Duration of registration

Registration of an item of plant applies for five years, and takes effect on the day the registration is granted and expires five years after that date.

Once the item of plant is registered

When the item of plant is registered, the WHS regulator will issue a registration document. This document will list the name of the registration holder, any associated business name, the registration number and the date of effect of the registration. This document must be kept and made available for any inspection required under the WHS Act.

If it is lost, stolen or destroyed, you will need to apply to the WHS regulator that registered the plant for a replacement document as soon as possible, outlining the reasons for needing a replacement.

The WHS regulator may impose any conditions it considers appropriate on the registration of the plant including conditions in relation to the use and maintenance of the plant, record keeping or provision of information to the WHS regulator.

You must ensure that the item registration number is permanently marked on the item of plant in a location that is readily accessible. It will generally be a simple task to mark large items of plant with the item registration number by either etching the number in place or by fixing the number in place on a plate in a position that will not lead to damage or removal over time.

On some items, such as a tower crane that may comprise many parts assembled in a variable configuration to suit a particular site, it may not be feasible to mark each component of the plant. In such cases the item registration number should be marked on those components that are readily accessible and able to be seen when the crane is fully assembled.

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Registration renewal

The registration of the item of plant will expire exactly five years from the date that the registration is granted. To renew the registration for the item of plant you must apply to the WHS regulator before the registration expires.

Changes to item registration

If there is any change to any information provided at the time of item registration, or in relation to the registration itself, you have 14 days to advise the WHS regulator of the change. This must be done in writing. In particular, you must provide written notice to the regulator if:

- the item of plant is altered to the extent that it requires new risk control measures
- the item of plant is usually fixed but has been moved
- the registration holder no longer has management or control of the item of plant.

6 KEEPING RECORDS

WHS Regulation section 237: A person with management and control of plant must keep a record for plant that requires design or item registration including records of all tests, inspections, maintenance, commissioning, decommissioning, dismantling and alterations of the plant.

These records must be kept for the period the plant is used or until the person relinquishes control of the plant.

The records must be available for inspection under the WHS Act and be made available to any person to whom the person relinquishes control of the plant, for example if you sell the plant, those records should be transferred to the person who purchased the plant.

If there is a presence sensing safeguarding system at a workplace the person with management or control of the plant must keep a record of safety integrity tests, inspections, maintenance, commissioning, decommissioning, dismantling or alterations for the life of the plant or until control is relinquished or in any other case for 5 years.

While you must keep records associated with plant requiring design or item registration, it is good practice to keep records for other types of plant in your workplace. Keeping records of the risk management process demonstrates potential compliance with the WHS Act and Regulation. It also helps when undertaking subsequent risk assessments.

Records on items of plant that may be kept could include:

- the unique plant identification number
- plant design registration information
- relevant data from commissioning
- compliance statements and/or test certificates
- manufacturer's specifications and user manuals
- results of inspections
- results of tests on the plant including safety devices (for example, protective earth continuity tests, testing of mechanical guarding, stop time measurement)
- information on maintenance and major repairs carried out
- information on major modifications
- information on use that deviates from intended operating or design conditions
- results of risk assessments carried out on plant
- information, instruction and training provided to workers, and
- competencies of operators.

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APPENDIX A – REGISTRABLE PLANT

List of plant requiring registration of design as outlined in Schedule 5 (Part 1) of the WHS Regulation

- Pressure equipment, other than pressure piping, and categorised as hazard level A, B, C or D according to the criteria in Section 2.1 of AS 4343: Pressure equipment – hazard levels
- Gas cylinders covered by Part 1.1 of AS 2030.1-2009: *Gas cylinders - General Requirements*
- Tower cranes including self-erecting tower cranes
- Lifts including escalators and moving walkways
- Building maintenance units
- Hoists with a platform movement exceeding 2.4 metres, designed to lift people
- Work boxes designed to be suspended from cranes
- Amusement devices covered by Section 2.1 of AS 3533.1-2009: *Amusement Rides and Devices – Design and construction* except amusement devices noted below
- Passenger ropeways
- Concrete placing booms
- Prefabricate d scaffolding
- Boom-type elevating work platforms
- Gantry cranes with a safe working load greater than 5 tonnes or bridge cranes with a safe working load of greater than 10 tonnes, and any gantry crane or bridge crane which is designed to handle molten metal or Schedule 11 hazardous chemicals
- Vehicle hoists
- Mast climbing work platforms
- Mobile cranes with a rated capacity of greater than 10 tonnes

Note: The plant listed as requiring design registration does not include:

- a heritage boiler
- any pressure equipment – other than a gas cylinder – excluded from the scope of AS 1200:2000: *Pressure equipment* – see section A1 of Appendix A to AS/NZS 1200:2000
- a crane or hoist that is manually powered
- a reach stacker
- an elevating work platform that is a scissor lift or a vertically moving platform
- a tow truck
- certain amusement devices including:
  - class 1 devices
  - playground structures
  - water slides where water facilitates patrons to slide easily, predominantly under gravity, along a static structure
  - wave generators where patrons do not come into contact with the parts of machinery used for generating water waves
  - inflatable devices, or other than inflatable devices-continuous blown-with a platform height of 3 metres or more.

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List of plant items requiring registration as outlined in Schedule 5 (Part 2) of the WHS Regulation

- Boilers categorised as hazard level A, B or C according to criteria in Section 2.1 of AS 4343: *Pressure equipment - hazard levels*.
- Pressure vessels categorised as hazard level A, B or C according to the criteria in Section 2.1 of AS 4343-2005: *Pressure equipment - hazard levels*, except for gas cylinders; LP Gas fuel vessels for automotive use, and serially produced vessels.
- Tower cranes including self-erecting tower cranes.
- Lifts including escalators and moving walkways.
- Building maintenance units.
- Amusement devices covered by Section 2.1 of AS 3533.1:2009: *Amusement Rides and Devices*, except for certain Class 1 structures (see below).
- Concrete placement units with delivery booms.
- Mobile cranes with a rated capacity of greater than 10 tonnes.

Note: The plant listed as requiring item registration does not include:

- any pressure equipment-other than a gas cylinder-excluded from the scope of AS/NZS 1200:2000: *Pressure equipment* – see section A1 of Appendix A to AS/NZS 1200:2000
- a crane or hoist that is manually powered
- a reach stacker
- certain amusement devices including:
  - o class 1 devices
  - o playground devices
    - o water slides where water facilitates patrons to slide easily, predominantly under gravity, along a static structure
    - o wave generators where patrons do not come into contact with the parts of machinery used for generating water waves, and
    - o inflatable devices, or other than inflatable devices-continuously blown-with a platform height of 3 metres or more.

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APPENDIX B – HAZARD CHECKLIST

Description of plant: _____

Activities (e.g. use, cleaning and maintenance): _____

Assessed by: _____

Date: _____

'Yes' to any of the following indicates the need to implement appropriate control measures

Entanglement	**YES**	**NO**
Can a person's hair, clothing, gloves, necktie, jewellery, cleaning brush or rag become entangled with moving parts of the plant?		
Crushing	**YES**	**NO**
Can anyone be crushed due to: • material falling off the plant? • uncontrolled or unexpected movement of the plant? • lack of capacity for the plant to be slowed, stopped or immobilised? • the plant tipping or rolling over? • parts of the plant collapsing? • coming into contact with moving parts of the plant during testing, inspection, operation, maintenance, cleaning or repair? • being thrown off or under plant? • being trapped between the plant and materials or fixed structures? • other factors not mentioned?		
Cutting, stabbing or puncturing	**YES**	**NO**
Can anyone be stabbed or punctured due to: • coming in contact with sharp or flying objects? • coming in contact with moving parts during testing, inspection, operation, maintenance, cleaning or repair? • the plant, parts of the plant or work pieces disintegrating? • work pieces being ejected? • the mobility of the plant? • uncontrolled or unexpected movement of the plant? • other factors not mentioned?		
Shearing	**YES**	**NO**
Can anyone's body parts be sheared between two parts of the plant, or between a part of the plant and a work piece or structure?		

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Striking	YES	NO
Can anyone be struck by moving objects due to: • uncontrolled or unexpected movement of the plant or material handled by the plant? • the plant, parts of the plant or work pieces disintegrating? • work pieces being ejected? • mobility of the plant? • other factors not mentioned?		
High pressure fluid	**YES**	**NO**
Can anyone come into contact with fluids under high pressure, due to plant failure or misuse of the plant?		
Electrical	**YES**	**NO**
Can anyone be injured by electrical shock or burnt due to: • the plant contacting live electrical conductors? • the plant working in close proximity to electrical conductors? • overload of electrical circuits? • damaged or poorly maintained electrical leads and cables? • damaged electrical switches? • water near electrical equipment? • lack of isolation procedures? • other factors not mentioned?		
Explosion	**YES**	**NO**
Can anyone be injured by explosion of gases, vapours, liquids, dusts or other substances, triggered by the operation of the plant or by material handled by the plant?		
Slipping, tripping and falling	**YES**	**NO**
Can anyone using the plant, or in the vicinity of the plant, slip, trip or fall due to: • uneven or slippery work surfaces? • poor housekeeping e.g. offcuts, cables, hoses obstructing walkways, spills not cleaned up? • obstacles being placed in the vicinity of the plant? • other factors not mentioned?		
Can anyone fall from a height due to: • lack of a proper work platform? • lack of proper stairs or ladders? • lack of guardrails or other suitable edge protection? • unprotected holes, penetrations or gaps? • poor floor or walking surfaces, such as the lack of a slip-resistant surface? • steep walking surfaces? • collapse of the supporting structure? • other factors not mentioned?		

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Ergonomic	YES	NO
Can anyone be injured due to: • poorly designed seating? • poorly designed operator controls? • high forces? • repetitive movements? • awkward body posture or the need for excessive effort? • vibration? • other factors not mentioned?		
Combination of hazards	**YES**	**NO**
Can anyone be injured due to unexpected start-up, unexpected over-run/over-speed (or similar malfunction) from: • failure/disorder of the control system(e.g. a hydraulic system)? • restoration of energy supply after an interruption? • external influences on electrical equipment? • other environmental factors (gravity, wind, etc.)? • errors in the software? • errors made by the operator?		
Other hazards	**YES**	**NO**
Can anyone be injured due to: • noise? • inadequate or poorly placed lighting? • entry into any confined spaces of the plant? • failure to select plant that is suitable for its intended use? • contact with hot or cold parts of plant? • exposure to hazardous chemicals, radiation or other emissions released by the plant? • lack of operator competency? • other factors not mentioned?		

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APPENDIX C – EXAMPLES OF TECHNICAL STANDARDS

The following table is a list of published technical standards that provide guidance on the design, manufacture and use of certain types of plant. These technical standards provide guidance only and compliance with them does not guarantee compliance with the WHS Act and Regulation in all instances. This list is not exhaustive.

Plant Description	Reference Number	Standard Title	Design	Make	Use
Amusement Structures	AS 3533	*Amusement Rides and Devices*	•	•	•
Cranes including hoists and winches	AS 1418 (Series)	*Cranes Including Hoists and Winches*	•	•	
	AS 4991 - 2004	*Lifting devices*	•	•	•
	AS 2550 (Series)	*Cranes – Safe use*			•
Conveyers	AS 1755 - 2000	*Conveyers - Safety requirements*	•	•	•
Electrical installation	AS 3000	*Electrical installation (known as the Aust/NZ wiring rules)*			•
Electrical installation within an industrial plant	AS/IEC 60204.1	*Safety of machinery: Electrical equipment of machines-General requirements*	•	•	
Earthmoving machinery	AS 2294.1	*Earthmoving machinery – Protective structures - General*	•	•	
	AS 2958.1	*Earthmoving Machinery – Safety – Wheeled machines-Brakes*	•	•	•
	ISO 6165	*Earthmoving machinery – Basic types – Identification and terms and definitions*	•		
	ISO 6746-1	*Earth-moving machinery - Definitions of dimensions and codes - Part 1: Base machine*	•		
	ISO 6746-2	*Earth-moving machinery - Definitions of dimensions and codes - Part 2: Equipment and attachments*	•		
	ISO 7133	*Earth-moving machinery - Tractor-scrapers – Terminology and commercial specifications*	•		
Explosive Powered tools	AS/NZS 1873 (Series)	*Power-actuated (PA) hand-held fastening tools.*	•	•	•
Hand-held electric tools	AS/NZS 60745	*Hand-held motor operated electric tools – Safety – General requirements*	•	•	•
Fall arrest	AS/NZS 1891.1	Industrial fall-arrest systems and devices - Harnesses and ancillary equipment	•	•	
	AS/NZS 1891.4	Industrial fall-arrest systems and devices - Selection, use and maintenance			•
	BS EN 1263-1:2002	Safety nets-Safety requirements, test methods	•		
Gas cylinders	AS 2030.1-1999	Gas cylinders-General requirements (known as SAA Gas Cylinders Code)	•	•	
	AS 2337.2 -2004	Gas cylinder test stations			•
	AS/NZS 3509	*LP (Liquefied Petroleum Gas) Fuel - Vessels for Automotive Use.*	•	•	

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Plant Description	Reference Number	Standard Title	Design	Make	Use
Industrial (Forklift) trucks	AS 2359 (Series)	*Powered industrial trucks*	•	•	•
Industrial rope access systems	AS 4488.2-1997	*Industrial rope access systems*	•	•	•
Lasers	AS/NZS 2211 (Series)	*Safety of laser products*	•	•	•
	AS 2397	*Safe use of lasers in the building and construction industry*			•
	AS/NZS IEC 60825.1: 2011	*Safety of laser products – Equipment classification and requirements*	•	•	•
Lifts	AS 1735 (Series)	*Lifts, escalators and moving walks (known as the SAA Lift Code)*	•	•	•
Machinery	AS 4024 (Series)	*Safety of machinery*	•	•	•
	AS 1657	*Fixed platforms, walkways, stairways and ladders-Design, construction and installation*	•	•	
	AS 1788.2 -1987	*Abrasive wheels-Selection, care and use*	•	•	•
	AS 1893-1977	*Code of practice for the guarding and safe use of metal and paper cutting guillotines*	•	•	•
	AS 2661-1983	*Vapour degreasing plant – Design, installation and operation – Safety requirements*	•	•	•
	AS/NZS 3947.3:2001	*Low-voltage switchgear and control gear, switches, disconnectors, switch-disconnectors and fuse combination units*	•		•
	AS 61508.6 -2011	*Functional safety of safety related systems*	•	•	•
	AS/IEC 61511	*Functional safety – Safety instrumented system for the process industry sector*	•	•	•
	AS 62061	*Safety of machinery: Functional safety of safety-related electrical, electronic and programmable electronic control systems*	•	•	•
	ISO 13849.1	*Safety of machinery: Safety-related parts of control systems-General principles*	•	•	•
	BS/IEC 6496-2:1997	*Safety of machinery, Electro sensitive protective equipment*	•		•
	AS 1121.1:2007	*Agricultural tractor power take-offs - rear-mounted power take-off types 1, 2 and 3 - General specifications, safety requirements, dimensions for master shield and clearance zone*	•	•	
	AS 1636	*Agricultural wheeled tractors - Roll-over protective structures criteria and tests*	•	•	
	AS/NZS 2153.1:1997	*Tractors and machinery for agriculture and forestry - Technical means for ensuring safety - General*	•	•	
	SAE J167-2011	*Overhead protection for agricultural tractors - Test procedures and performance requirements*	•	•	

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Plant Description	Reference Number	Standard Title	Design	Make	Use
Miniature boilers	AMBSC Code –Part 1	*Copper Boilers - Issue 7-2001*	•	•	
	AMBSC Code –Part 2	*Steel Boilers – Issue 4-1995*	•	•	
	AMBSC Code - Part 3	*Sub-Miniature Boilers – Issue 1-2008*	•	•	
	AMBSC Code – Part 4	*Duplex Boilers – Issue 1-2010*	•	•	
Pressure equipment	AS/NZS 1200:2000	*Pressure Equipment*	•	•	•
	AS 2593:2004	*Boilers – Safety management and supervision systems*	•		•
	AS 2971:2007	*Serially produced pressure vessels*	•	•	
	AS/NZS 3788:2006	*Boiler and pressure vessels – In service inspection*			•
	AS 3873 :2001	*Boiler and pressure vessels – Operation and maintenance*			•
	AS 3920.1-1993	*Assurance of product quality – Pressure equipment manufacture*	•	•	
	ASME I	*Power boilers*	•	•	
	ASME II	*Materials*	•	•	
	ASME V	*Non-destructive examination*	•	•	
	ASME VIII-1	*Pressure vessels*	•	•	
	ASME VIII- 2	*Pressure vessels – alternative rules*	•	•	
	ASME VIII-3	*Alternative rules for construction of high pressure vessels*	•	•	
	ASME IX	*Welding and brazing qualifications*	•	•	
	ANSI / NGV-2	*Basic requirement of compressed natural gas vehicle fuel containers*	•	•	
	CSA B51 Part 2	*High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles*	•	•	
	ISO 11439:2000	*High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles*	•	•	
	ISO/EN 13458 (Series)	*Cryogenic vessels – Static vacuum insulated vessels*	•	•	•
Pressure piping	AS 4041-2006	*Pressure piping*	•	•	
Machinery guarding	AS 4024 (Series)	*Safeguarding of machinery – general principles*	•	•	•
	ISO 12100:2010	*Safety of machinery – General principles for design*	•	•	•
Scaffolding	AS/NZS 1576.1:2010	*Scaffolding – general requirements*	•	•	
	AS 1577-1993	*Scaffold planks*	•	•	
	AS/NZS 4576	*Guidelines for scaffolding*			•
Ladders	AS/NZS 1892.1/1892.2/1892.3	*Portable ladders*	•	•	
Spray painting	AS/NZS 4114.1	*Spray painting booths. Part 1: Design, construction and testing*	•	•	•
	AS/NZS 4114.2	*Spray painting booths. Part 2: Installation and maintenance*			•

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Plant Description	Reference Number	Standard Title	Design	Make	Use
Turbines	BS/EN 60593-2:1996	*Rules for steam turbine acceptance tests*	•		
	API 612	*Special purpose steam turbines for refinery services*	•		
Ventilation	AS 1668.2	*The use of ventilation and air conditioning in buildings*	•	•	•
Work boxes- crane lifted	AS 1418.17 1996	*Cranes (including hoists and winches)*	•	•	
	AS 2550	*Cranes – Safe use*			•
	AS 3860-1991	*Fixed guideway people movers*	•	•	•
	ISO 2374	*Lifting appliances – Range of maximum capacities for basic models*	•	•	

Key:

Abbreviations Name

ANSI	American National Standards Institute
API	American Petroleum Institute
AMBSC	Australian Miniature Boiler Safety Committee
AS	Australian Standard
ASME	American Society of Mechanical Engineers
AS/NZS	Australian Standard / New Zealand Standard
BS	British Standard
CSA	Canadian Standards Association
EN	Europaische Norm (European Standard)
IEC	International Electrochemical Commission
ISO	International Standards Organisation
NZS	New Zealand Standards
SAE	Society of Automotive Engineers

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Office of Industrial Relations - 200339 RTI Document No. 142

Safety Alert

Refueling portable equipment

Alert on the risks of refueling portable equipment, such as petrol generators and demolition saws, and advice on controlling the risks

June 2016

Background

Refueling portable equipment can create vapours or fuel spills that can be easily ignited by hot engine parts, static electricity or other ignition sources resulting in an explosion and or fire. People have been burned, many seriously, while refueling portable equipment.

Incidents

Workers lining a dam with high density polyethylene (a plastic) suffered burns when petrol vapours ignited while they were refueling a portable generator. Their movement on the plastic liner generated static electricity which sparked and ignited the petrol vapours.

A worker was seriously burned when a portable generator caught fire while he was refueling it on the back of his ute. The fire was caused by either the petrol vapours igniting due to static electricity, or petrol spilling onto the generator's hot engine.

Another worker suffered burns from a fire caused by petrol that spilt onto the hot exhaust while he was refueling a running portable generator.

Control measures

The risks must be eliminated, so far as is reasonably practicable. If the risk or part of the risk cannot be eliminated, it must be reduced so far as is reasonably practicable.

Eliminate the ignition risks by using an alternative to fuel such as mains power, battery powered tools, or a deep-cycled battery and an invertor.

If it is not reasonably practicable to eliminate the risk, reduce the risk by substituting petrol equipment with diesel equipment if reasonably practicable. Diesel is a safer alternative to petrol as it has a higher ignition point.

When refueling petrol or diesel powered portable equipment there must be safe systems of work in place to reduce the ignition risk. These may include:

- When **refueling**:

  - turn the equipment off and give it time for the hot parts to cool down
  - remove the equipment from inside vehicles
  - remove the equipment from trailers or surfaces (eg plastic or rubber) to ground out any static charge built up on the equipment
  - refuel away from other heat and possible ignition sources
  - refuel in a well-ventilated area
  - do not refuel in low lying areas, where vapours can accumulate
  - refuel only from approved labelled fuel containers
  - use a funnel, to reduce the risk of static electricity and fuel spillage
  - suitable fire extinguishers are readily accessible
  - replace fuel caps on equipment and fuel containers tightly.

- When **transporting** portable equipment and fuel containers:

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- allow the equipment to cool down before loading it onto a vehicle
  - ensure fuel caps are on tight
  - secure in the upright position in a well-ventilated space.
- When **storing** fuel onsite:
  - only approved labelled fuel containers are used
  - fuel containers are outside vehicles or structures, in a well-ventilated area.
- Inform and provide instruction to users of the equipment on the hazards and control measures required to refuel safely.
- Wear personal protective equipment (PPE) such as safety boots, non-flammable long pants and long sleeve shirts, eye or face protection and gloves to further reduce the risk of injury if fuel ignites during refueling.

Further information

Australian Standards:

* AS/NZS 2906 - Fuel containers - Portable - Plastics and metal* AS/NZS 1940 - Storage and handling of flammable and combustible liquids

WorkSafe Victoria publications

* Service stations - Filling portable containers with flammable liquids

Other publications

* The operating manual for the portable equipment.

Contact Details

Call us on: **1800 136 089**

Email us at: info@worksafe.vic.gov.au

For more information on occupational health and safety, go to WorkSafe's website: **worksafe.vic.gov.au**

*This Alert contains information following inquiries by WorkSafe Victoria (**WorkSafe**) into the incident at the date of this report. The information contained in this report does not necessarily reflect the final outcome of WorkSafe's action with respect to this incident. WorkSafe does not warrant the information in this report is complete or up-to-date, and does not accept any liability to any person for the information in this report, or its use.*

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Refuelling safety

QFleet driver safety fact sheet

Refuelling can be a hazardous activity. The hazards are greater when highly flammable fuels such as petrol are being dispensed, because petrol releases flammable vapours that expand into the atmosphere.

When a flammable liquid flows, static electricity is generated from the friction between dissimilar materials (e.g. the fuel and the metal fuel filler neck). When the static electricity discharges, it produces sparks which can ignite the fuel vapours. The fuel dispensing pumps found at service stations and the fuel filler necks of motor vehicles are earthed to minimize and control the static electricity produced during normal vehicle refuelling.

Static electricity is dangerous because it is:

- invisible and unpredictable
- discharged in the form of a spark which can ignite flammable materials
- a natural phenomenon that cannot be prevented but can be controlled
- rarely understood by most people.

To control the effects of static electricity and for general fire safety during refuelling the following should be observed.

- Switch off the vehicle engine while refuelling and ensure the park brake is applied.
- Do not smoke or allow other ignition sources into the refuelling area.
- Do not use foreign items to lock the refuelling trigger in the “on” position.
- Do not re-enter the vehicle while refuelling is in progress. If the driver must re-enter the vehicle, any static electricity must be discharged before touching the refuelling nozzle by first touching the metal on the outside of the vehicle.
- In the event of a refuelling fire, leave the nozzle in the vehicle’s filler neck and back away from the vehicle. Notify the service station attendant immediately.
- Do not overfill the vehicle.
- Avoid using high speed fuel pumps, particularly when refuelling vehicles with plastic fuel tanks. Faster flowing fuel can develop static electricity.
- Clean up spilled fuel.
- Observe safety signage at service stations.



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The risk of refuelling fires is greater when fuel is dispensed into portable containers. To control the effects of static electricity and to control the risk of fire when refuelling portable containers and other plant, the following should be observed:

- Always read and observe the safety signs at service stations.
- Never use unapproved containers to store fuel.
- Always use a plastic fuel container that complies with AS2906 or an appropriate metal container with a well-sealed lid.
- Use only containers with serviceable caps / lids and seals.
- Always place the fuel container on the ground before filling with flammable liquid. This will discharge any static electricity prior to refuelling.
- Never fill a container in the boot of a car, or in the tray, or on the tailgate of a utility, particularly if it is fitted with a plastic tray liner.
- Fill containers slowly to avoid overflow and spillages.
- Do not lock the refuelling trigger “on”.
- Do not fill portable containers to more than 95% full; this allows for expansion.
- Secure portable fuel containers against transit damage.
- Avoid refuelling petrol operated equipment (mowers, generator sets, jet skis, etc.) while located within a utility tray.



For the full suite of QFleet Driver Safety Fact sheets visit qfleet.qld.gov.au

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