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Technical reference guide

Winding systems for small gemstone mines

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August 2022	1.0	Technical review and update to new format. Supersedes MDG 42.1 Guideline for person-riding hoists (winding systems) in small gemstone mines & MDG 42.2 Guideline for person-riding hoists in Gem mine.
October 2022	1.1	Update to current legislation and referenced sections, new template

Foreword

Winding systems are an important item of infrastructure in small gemstone mines.

This technical reference guide provides a benchmark to industry for the management of winding systems for small gemstone mines over their complete lifecycle.

This guide also includes reference to legislative requirements for those winding systems.

Adoption of this technical information and the appropriate use of risk assessment techniques should foster safe winding practices.

Conformance with this guide does not guarantee safety and will not address all risks related to a winding system. Therefore, appropriate risk management and lifecycle management processes must be carried out.

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1. Introduction

1.1. Purpose

The purpose of this guide is to assist mines to meet their work health and safety obligations in managing health and safety risks associated with winding systems for small gemstone mines.

Compliance with this guide does not negate the designer's, manufactures, supplier and installer work health and safety duties under the Work Health and Safety Act 2011 sections 22, 23, 25 & 26.

This guideline:

- provides guidance in design and operational risk assessments (identifying potential hazards, assessing risk, and implementing appropriate risk controls), refer to section 3
- specifies minimum design requirements, refer to sections 4
- specifies minimum operation requirements, refer to section 5
- specifies minimum maintenance and defect management requirements, refer to section 6
- provides a summary of standards and codes of practice to be considered, refer to section 7.
- provides a summary of common plant hazards, refer to appendix B.

1.2. Scope

This guide covers the general requirements applicable for the design, manufacture, installation, commissioning, operation, and maintenance of winding systems for small gemstone mines.

It applies to winding systems as defined in the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022, being plant other than a portable winch or plant that is manually operated, that is used in a shaft to lift a person to or from an underground mine, regardless of whether it is used exclusively for that purpose.

2. Work health and safety management

2.1. Legislative requirements

The *Work Health and Safety Act 2011* and Work Health and Safety Regulation 2017 apply to all workplaces in NSW, including mines and petroleum sites. They impose a general obligation to ensure the work health and safety (WHS) of people at work through a process of identifying hazards, assessing risks, and eliminating or controlling risks.

The *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 apply to all mines and petroleum sites in NSW. These support the WHS Act and WHS Regulation and provide additional provisions for WHS issues unique to mines and petroleum sites.

Refer to appendix C for further information.

3. Risk management

3.1. Design risk assessment

A design assessment shall be carried out to assess all risks to the health and safety of people from the intended lifecycle requirements of the winding system. The design assessment shall recognise the design intention and any lifecycle management controls necessary to maintain this design intent.

The assessment should comprise of determination of the use limits, hazard identification, risk estimation and the evaluation of the risk and the selection of controls.

Information for the design assessment should include:

- user specifications
- anticipated machinery specification including the description of use, design drawings, information for use, required energy sources and how they are supplied
- applicable Regulations
- relevant Standards
- relevant safety data sheets
- any accident, incident, or malfunction history of the actual or similar winding systems.

The design assessment should be reviewed, and an operational risk assessment carried out whenever alterations are carried out to the winding system or whenever a significant incident occurs.

3.2. Determination of limits of machinery

3.2.1. General

The design assessment should begin with the determination of the use limits of the winding system over its lifecycle.

This should include:

- the intended use and reasonably foreseeably misuse, for example overloading
- different operating modes
- levels of training, experience, or ability of users
- range of movement
- space requirements for people interacting with the winding system
- human interactions
- the life limits of components
- recommended service intervals
- environment - the recommended minimum and maximum temperatures, whether the machine can be operated under cover or outdoors, in dry or wet weather, in direct sunlight, tolerance to dust and wet, etc

The design assessment shall cover:

- hazard Identification
- risk analysis, and
- risk evaluation and selection of controls.

3.2.2. Hazard identification

The design assessment covering the lifecycle of the winding system should as a minimum cover:

Design and manufacture

Any conditions necessary to ensure that the plant is without risks to health and safety to a person using the plant for a purpose for which it was designed or when carrying out a reasonably foreseeable activity whilst using or maintaining the plant.

- Identification of safety functions.
- Known residual risks i.e., those that cannot be eliminated or sufficiently minimised by design.
- Standards to which plant was designed.

- The purpose for which the plant was designed.
- Risks to health and safety of workers that may be affected by its use.
- Winding systems intended purpose i.e. The maximum working load, operating environment etc. – this weight must be used for all calculations and testing.
- Rope, brake, sheaves, and drive system selection based on calculations.
- Failure modes of components such as broken winch rope, failed drive motor, broken drive belts, failed limit switches etc.
- Guarding of all moving components.
- Control system.
- Inadvertent activation.
- Winding system stopping mid shaft.
- Installation of overrun protection.

Specific hazards associated with winding system should also be considered such as:

- gravity including:
  - the shaft conveyance falling down the shaft (refer WHS(MPS)R section 52(4)).
  - objects or persons falling down the shaft.
- stability of the plant
- mechanical energy
- rotating and percussion machinery
- entanglement, entrapment include people being caught between the shaft conveyance and shaft or shaft gates
- electrical energy
- hydraulic energy
- human error.

Transport and handling

- Conditions for storage.
- Indications for transport and handling e.g., application points for lifting and tie down.

Assembly (installation) and commissioning

- Access.
- Energy sources and isolation of these energy sources.
- Environmental factors affecting installation and commissioning.
- Exposure to dangerous parts.
- Falling objects.
- Fire.
- Lifting procedures.
- Machine operation.
- Plant interacting with other plant, e.g., connected services and installations.
- Plant interacting with people.
- Stability during installation.

- The proposed method for installing and commissioning, including tests that should be carried out.
- Using special tools, jigs, fixtures, and appliances necessary to minimise the risk of injury during installation.
- Working at heights.

Operation, inspection, and testing (maintenance)

- Task identification to include testing, adjusting, programming, start-up, all modes of operation, stopping the machine, stopping the machine in an emergency, restart after unscheduled stop, fault finding, preventative and corrective maintenance.
- Any special training requirements.
- Access.
- Details of control measures like personal protective equipment that should be used to further minimise the risks associated with plant.
- Emergency situations, e.g., power failure, shaft collapse etc.
- Energy sources.
- Exposure to hazardous substances.
- Fire.
- Guidance on administrative control measures.
- How environmental conditions affect using the plant.
- Intended uses for the plant, including reasonably foreseeable misuse.
- Known residual risks i.e., those that cannot be eliminated or sufficiently minimised by design.
- Machine operation.
- Maintenance.
- Recovery of in-operative winder systems.
- Safe entry and exit.
- Working at heights.

Decommissioning – disassembly

- Decommissioning, dismantling and disposing of plant.

3.2.3. Risk analysis

A risk analysis of the hazards identified must then be conducted.

The analysis should include.

- the severity of harm that can result from the considered hazard, and
- probability of occurrence of that harm to include
- risk associated with the hazard
  - exposure of person(s) to the hazard
  - likely frequency of that occurrence; and
  - the possibility to avoid or limit the harm

Example.

***Hazard** – ladder rung brakes after emergency brake applied due to rope failure*

***Risk** – Worker in man basket falls to below*

Severity of harm – Worker severely injured or killed (this could be the person in the basket or below)

Probability of occurrence – Likely to happen over the lifecycle of plant (assume no controls are in place)

3.2.3.1. Severity of harm

Severity can be estimated by taking into account:

- the severity of the injuries or damage to health
- the number of people (one person, 2 people, 3 etc.)

3.2.3.2. Probability of occurrence

The following all influence the both the probability of occurrence and the likelihood of avoiding it or limiting harm and should be taken into consideration as part of the risk analysis.

Exposure

- The need to access or be exposed to the hazard or hazardous area both for operation and maintenance.
- The time spent in this area or on the winding system.
- The number of people requiring access.
- The frequency.

3.2.3.3. Occurrence of a hazardous event

- Accident history
- Industry safety alerts or bulletins
- Known failures.

3.2.3.4. Possibility of avoiding or limiting harm

- Different people who can be exposed, experienced, in-experienced.
- How quickly the hazard can lead to harm,
- Awareness to risk through training or signage,
- Ability for a person to avoid or limit harm,

3.2.4. Risk evaluation and selection of controls

After the risk analysis has been completed an evaluation of the risk shall be conducted and the selection of controls. The selection of controls shall take into consideration the following:

- ways of eliminating the risk
- availability and suitability of ways to eliminate the risk
- cost associated with ways to eliminate the risk
- ways of minimising the risk by:
  - substitution
  - isolation
  - engineering controls.
- availability and suitability of ways to minimise the risk
- cost associated with ways to minimise the risk.

If the risk then remains after the above has been applied, minimise the risk by:

- administrative controls.

If the risk then remains after the above has been applied, minimise the risk by:

- personal protective equipment.

Note: A combination of the controls set out in this clause may be used to minimise risks, so far as is reasonably practicable, if a single control is not sufficient for the purpose.

3.3. Operational and maintenance risk assessment

An operational and maintenance risk assessment shall be carried out to identify all hazards associated with operation and maintenance activities on the winding system that could give rise to a risk to health and safety of people.

WHSR clause 34 Duty to identify hazards

3.3.1. Information for risk assessment

The risk assessment should take into consideration:

- information from designer/supplier
- relevant safety data sheets, and
- any incidents or malfunction history of similar winding systems
- the environment the winding system will be operated in.

3.3.2. General hazards

General hazards associated with the winding system should also be considered as part of the risk assessment process which should include but not be limited to:

- exposure to hazardous substances. (hydraulic oil, grease etc.)
- emergency situations. (power failure, shaft conveyance stopped mid shaft, working becoming ill or injured etc.)
- entanglement
- entrapment includes people being caught between the shaft conveyance and shaft or shaft gates
- fire (electrical system faults, refuelling of generators etc.)
- gravity including:
  - shaft conveyance free falling down the shaft
  - objects or persons falling down the shaft
  - people falling from heights while operating, repairing, or maintaining the winding system.
- Hazardous energies including:
  - mechanical
  - electrical
  - hydraulic, Release of fluids under pressure
  - pneumatic.
- known residual risks i.e., those identified by the designer or supplier to be controlled by the end user as identified in the design assessment / operations manual.
- live testing of plant (fault finding or function testing).
- noise.
- recovery of in-operative plant. i.e., shaft conveyance becomes stuck in shaft
- remote or isolated work
- rotating components

- safe entry and exit
- working at heights.

3.3.3. Risk assessment process

The risk assessment process can be broken up into 5 steps.

Step 1

Identify all foreseeable activities involved in the operation and maintenance of the winding system to include but not be limited to:

- access and egress to surface with shaft conveyance stuck in shaft
- accessing stuck shaft conveyance in shaft
- adjusting components
- falling from one level to another
- fault finding
- inspecting
- operating
- power failure
- preventative and corrective maintenance activities
- restarting after an unscheduled stop
- start-up
- stopping the winding system in an emergency
- stopping the winding system
- testing
- working remotely.

Step 2

Identify all hazardous events or potential failures associated with the identified foreseeable activities.

Step 3

Evaluate the hazardous events or potential failure considering the:

- likelihood of the hazardous event or failure occurring, and
- degree of harm that might result if the event or failure was to occur.

A risk ranking matrix can be used to evaluate the risk impact.

Step 4

Identify controls for the hazardous events of potential failures taking into consideration:

- what the person concerned knows, or ought to reasonably know about the hazard or the risk
- ways of eliminating or minimising the risk
- availability and suitability of ways to eliminate or minimise the risk.

Refer to appendix A for further information.

Step 5

Implement the controls identified and ensure they remain effective.

Refer to appendix F for a WRAC type risk assessment example.

4. General requirements - design

Winding system(s) must be designed by a competent person and the design documented.

Winding system(s) must be designed using engineering principles and standards to ensure the system is fit-for-purpose for the required duty.

The winding system must be fitted with suitable safeguards for all electrical, mechanical, and other hazards.

The winding system is fitted with energy lock out devices to all mechanical and electrical plant associated with the winding system. Refer to WHS(MPS)R section 50(4).

All maintenance points that are required to be completed daily, weekly, or monthly should be accessible from either ground level or fixed access system.

The design of the winding system should:

- not carry more than 2 people
- lift no greater than 40 metres from the surface
- use a minimum of 120 kilograms per person for the purpose of load calculations, and
- include suitable controls to prevent person(s) falling down the shaft. This includes when accessing the shaft conveyance to ride it or when the shaft conveyance is in or at the bottom of the shaft.

The following information shall be readily available to the end user:

- Manufacturer of plant.
- Year of manufacture.
- Make and model.
- Safe load rating/number of people.
- Transport weight (kg).
- Maximum shaft depth.

4.1. Head frame assembly, shaft conveyance running frame and ladder system.

The winding system head frame should:

- be designed for the application and load conditions
- be made of materials of suitable strength for the intended application and the environment likely to be encountered
- have designated lift points for transport, and
- have designated anchor / hold down points.
- Shaft conveyance running frame should be designed:
- for the application and the load condition
- to hold the full load under dynamic conditions with the application of the emergency arresting device at any point in the shaft
- to withstand and control the forces applied from a loaded shaft conveyance moving as it operates up and down in the shaft
- to minimise the potential for jamming of the shaft conveyance during operation
- to minimise the potential for the rope to become entangled in an overspeed event.

The ladder system should be:

- designed for the application and the load condition
- designed to hold the full load of the shaft conveyance and person(s) with the application of the emergency arresting device at any point in the shaft
- fitted with suitable shaft hold offs to allow the shaft conveyance to traverse the shaft freely
- fitted with suitable anchor points to hold ladder in position to the shaft.

Refer to AS 1657 Fixed platforms, walkways, stairways, and ladders – design, construction, and installation for further information.

4.2. Landings

Appropriate landings shall be provided at the top and bottom of the shaft and any intermediate access points.

Landings shall have appropriate means to prevent a moving shaft conveyance injuring people or people falling down the shaft. e.g., gates/fences, guards.

4.3. Winch assembly

4.3.1. General

The winch assembly should:

- be capable of lifting and lowering the end of rope load
- not be capable of breaking the rope under any condition
- have a drive motor capable of lowering, raising, and holding stationary without run on, the shaft conveyance with the maximum foreseeable load
- have all drive components suitably rated for the loads being applied to them
- have an operating speed sufficiently slow enough to allow a person to react and stop the winding system to avoid a potential hazard
- have a means to bring the shaft conveyance to rest and hold which is based on a fail-to-safety principle, i.e., spring applied, or gravity applied
- have a positive type driving mechanism used between the drive drum and the device that holds the winch stationary. i.e., brakes or appropriate worm type gearbox that exhibits properties of static and total dynamic irreversibility.

Note: Clutches, vee belts or fluid couplings are not positive type driving mechanisms, and they should not be used between the drive drum and braking device. However, they may be used between the drive motor and the means to hold the winch stationary (i.e., brake) provided the winch remains stationary when the drive motor is stopped or if failure of power transmission was to occur.

4.3.2. Brakes

At least one brake and one emergency arresting device. Refer to WHS(MPS)R section 50(1)(c)(ii).

Brakes must be fitted to prevent a freefall event such as a rope failure, drum coupling failure, motor failure and hydraulic hose failure.

Where a worm-type gearbox is used, it should exhibit properties of static and total dynamic irreversibility throughout its lifecycle.

Brakes should comply with the following requirements:

- In the static condition hold a minimum of 1.6 times the rated capacity.
- From the dynamic condition, arrest a minimum of 1.2 times the winding system rated capacity from the maximum lowering speed without a damaging snatch effect and without unacceptable overheating within an acceptable braking distance for the winch.

Note:

Dynamic irreversibility occurs when the output shaft of the worm type gearbox stops as soon as the driving force applied to the input shaft is stopped.

Static irreversibility occurs when the output shaft of a worm type gearbox remains stationary after the application of a load.

The stopping or holding means must be capable of holding two times the end of rope load stationary when stopped.

4.3.3. Drum drive system

The maximum rope tension developed by the drive system shall not be capable of breaking the rope under any condition of operation, including accidental jamming of the shaft conveyance.

A factor of safety of at least 2.5 shall exist between the maximum rope tension developed by the drive under abnormal dynamic conditions and the breaking strength of the rope in use.

A clutch shall not be fitted to any rope drum drive system used for person-riding.

4.3.4. Emergency shaft conveyance lowering

When emergency shaft conveyance lowering is required, the brake shall be capable of being released manually. The mechanism shall be arranged to ensure that:

- the load is under control during lowering
- the lowering rate is limited to be compatible with the brake heat dissipation characteristics
- the brake can be released and reset without the requirement for tool, and
- the brake will reset automatically upon release of the manual override mechanism.

Instructions for the operation of the manual release mechanism shall be provided on the winding system and in the operating manual.

4.3.5. Drum

There are 2 types of drums. They are grooved and ungrooved.

Regardless of the type, drums shall be designed for the total load to be hoisted with a factor of safety of 10.

The minimum diameter of a drum to enable the lifting of material should be 18 times the nominated rope diameter.

There should always be a minimum of 2 turns of wire rope left on the drum.

The number of wraps across the width of the drum is calculated as drum width divided by rope diameter + 4%.

Example: *If drum width is 150 mm and rope width is 10 mm, we have:*

150 / (10 x 1.04) = 14 rounded down to give the number of full wraps.
Similarly, for the same rope on wider drums, rounded down to give the number of full wraps

200 mm/10.4 mm = 19
300 mm/10.4 mm = 28

400 mm/10.4 mm = 38.

4.3.5.1. Grooved drums

Grooved drums shall be designed to have no less than 2 occupied grooves, when the rope for each connected rope end is fully paid out.

The drum should be flanged at both ends, for a radial distance of no less than a 1.5 rope diameter.

Where the rope is in more than one layer, a rope guide should be made for the rope to guide it from one layer to the next.

The groove should be an arc having a minimum radius of 0.535 times the nominal diameter of the rope and subtending an included angle no less than 130°.

The groove should be smoothly finished and free from surface defects to avoid damage to the rope. The edge between grooves should be rounded.

4.3.5.2. Ungrooved drums

Ungrooved drums shall be flanged at both ends, for a radial distance of no less than 2 rope diameters beyond the rope in the outer layer, when the rope is fully wound on the drum.

The face of a brake, gear or other component mounted at the end of the drum, may be considered as being a flange, provided it is a flat face and of the correct outside diameter.

Figure 2: Grooved drum

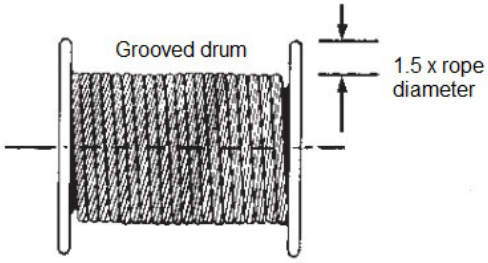
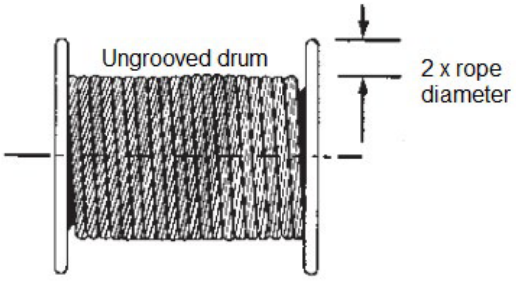


Figure 1: Ungrooved drums



4.3.6. Ropes

As a minimum the winding system rope(s) and devices must withstand all forces reasonably expected to be borne on the rope and devices. Refer WHS(MPS)R section 50(1)(a).

The selection of rope diameters and strengths should be consistent with recommendations set out in AS 3569 steel wire ropes – product specification. The final selection and recommendation of the wire rope should be made in co-operation with the wire rope manufacturer.

Ropes shall:

- have a minimum factor of safety of 10:1 when newly installed
- be compatible with the sheave(s). Refer to AS 3785.7 Underground mining equipment – Sheaves for further guidance
- be inspected by a competent person to ensure it is fit for its intended purpose before its first use
- not be joined by using a spliced connection.

4.3.6.1. Rope anchorage - drum

All drum ropes should be mechanically anchored.

Where the anchorage relies on a clamping action, it shall consist of two or more clamps.

The rope anchorage without any turns on the drum, must be capable of withstanding twice the load due to nominal force on the rope.

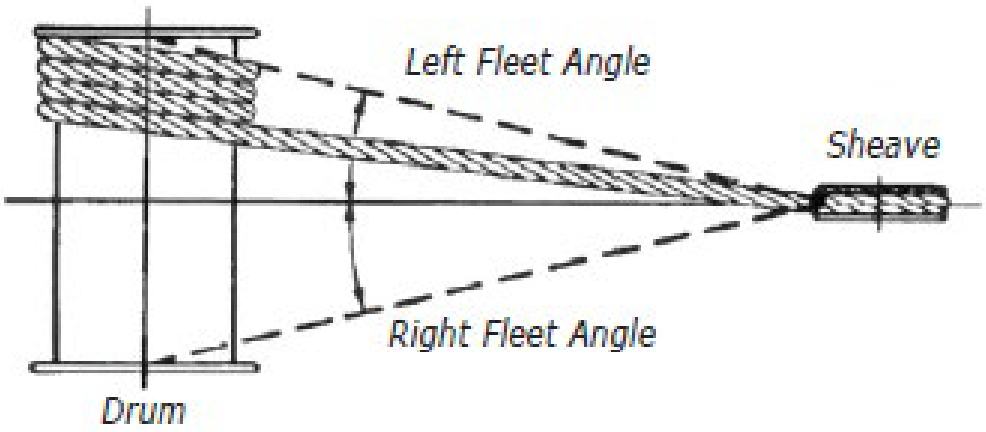
4.3.7. Fleet angle

For grooved drums and triangular or flattened strand or non-spin ropes, the fleet angle must not exceed 2.0 degrees. An angle of 1.5 degrees is a good working angle.

For un-grooved drums, the maximum fleet angle must be 1.5 degrees.

In the case of locked coil ropes, the fleet angle should not exceed 1 degree 20 minutes.

Figure 2: Fleet angle



4.3.8. Sheave(s)

Sheaves shall be designed so the component loadings are not exceeded while a load equal to the working load limit (WLL) of the winch is applied to the sheave block.

Sheaves shall:

- be rated for the load to be lifted and the power developed by the winch
- have a method of retention to prevent the rope from leaving the sheave groove
- have a grove depth no less than 0.585 times the diameter of the rope, except where the rope is less than 7 millimetres, then the depth of the groves is no less than 0.615 times the diameter of the rope
- have grooves that are tangential to the bottom arc and flared with an included angle of no less than 30°, symmetrical to the centre line of the groove
- be suitably secured by components that meet the design loads
- be capable of supporting a test load of 5 times its working load limit and be able to rotate while loaded to 1.25 times the working load limit.

The diameter of each sheave should be measured at the pitch diameter of the grove.

Figure 3: Sheave fitment guide

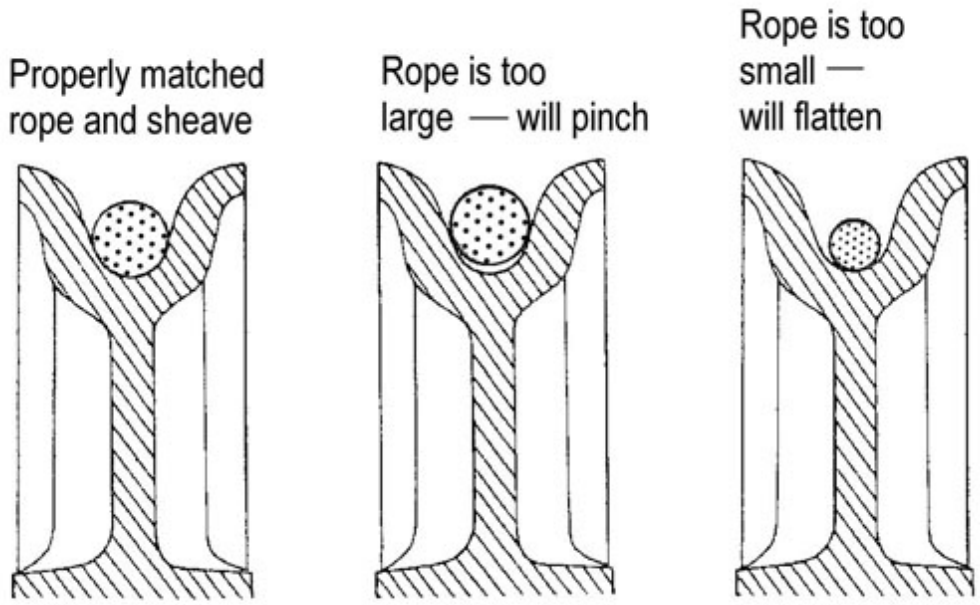
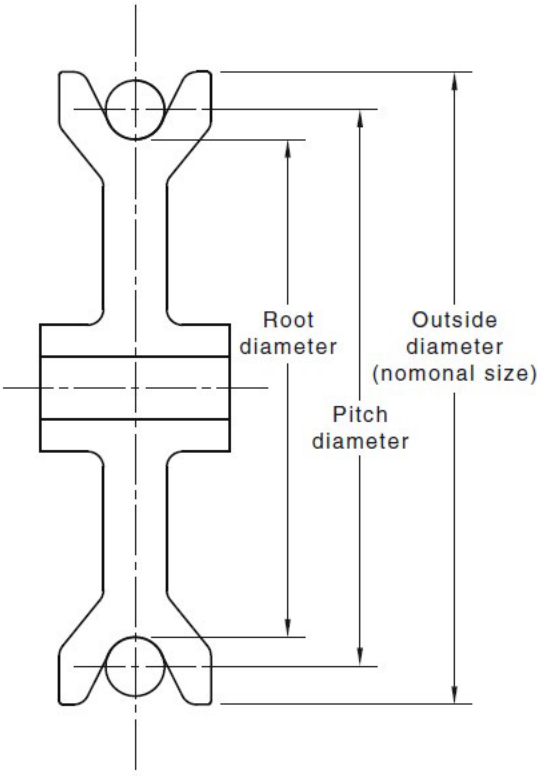


Figure 4: Sheave



4.3.9. Rope attachment to shaft conveyance

The rope attachment shall be properly designed for the service expected. Refer to WHS(MPS)R section 50(1)(d).

The attachment of the rope to the shaft conveyance shall be designed and installed to ensure that the load can be effectively transferred from the rope to the attachment point on the shaft conveyance assembly.

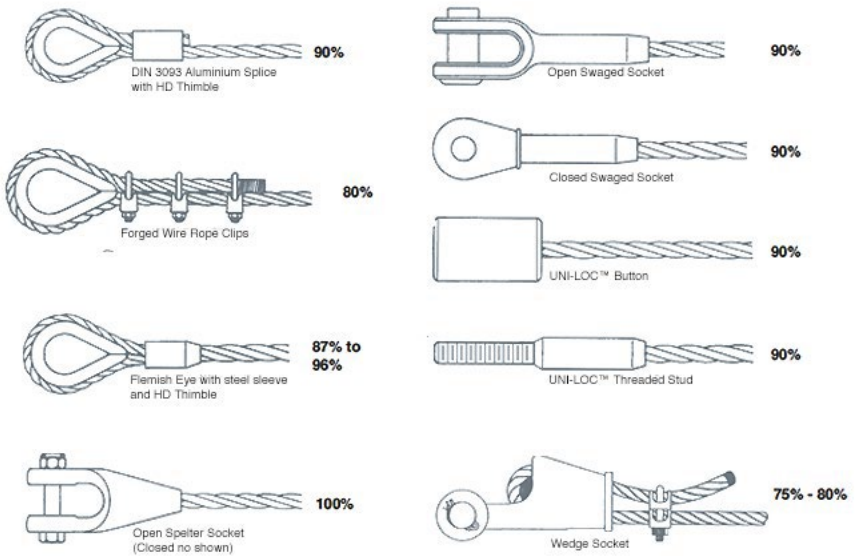
There are several types of rope fitting and end attachments to include:

- ferrule-secured rope attachment

- swaged end fittings
- poured sockets
- wedge grip capels
- wedge type sockets, and
- wire rope clips.

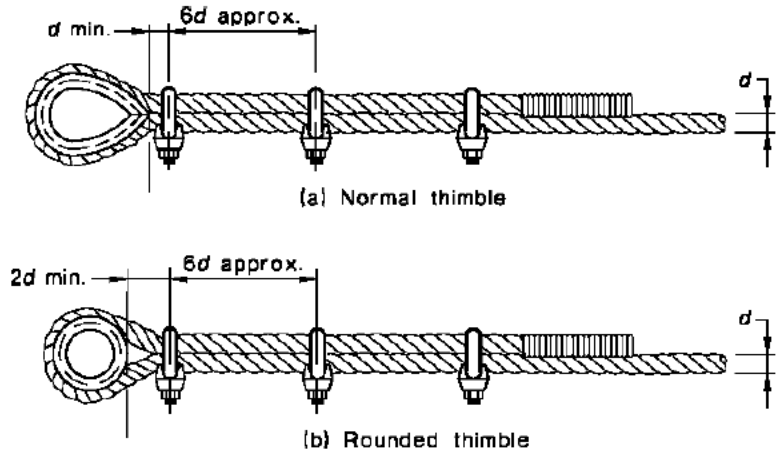
The end fitting impacts the efficiency rating of the rope and needs to be considered when selecting it for the application.

Figure 6: Rope end fitting and efficiency ratings



When wire is being secured using wire ropes clips, a thimble is to be fitted and clips are installed properly so that the rope is not damaged.

Figure 7: Wire rope clips and thimble



4.3.10. Shaft conveyance

People being carried in the shaft conveyance are adequately protected from material of plant being carried by the other shaft conveyance or the wall of the shaft or anything in the shaft. Refer to WHS(MPS)R section 52(2)(b) &(c).

If a shaft conveyance that combines a skip (material bucket), material must not be carried in the skip while persons are being carried. Refer to WHS(MPS)R section 52(3)

The shaft conveyance shall:

- be designed for the application and load conditions
- be designed to prevent a person from falling out of it
- prevent entanglement between the shaft conveyance and shaft while the person is being transported
- prevent workers coming into contact with shaft
- be fitted with fall protection in the event of rock fall whilst in shaft conveyance
- have an 'emergency arresting device (refer to WHS(MPS)R section 50(1)(c)(ii)).' fitted to the shaft conveyance so that in the event of a rope failure, the shaft conveyance will automatically be brought to rest safely with its maximum rated load capacity
- have suitably rated and spaced guides / connecting rollers that prevent the shaft conveyance from moving away or out of alignment from the ladder / winder frame assembly during travel at all loads and speeds.

The shaft conveyance should:

- have a 'manually activated emergency arresting device' fitted to the shaft conveyance so that in the event of a winch holding failure, the shaft conveyance can be manually brought to rest by the operator safely within its maximum rated load capacity

Note: The manual activation can be connected to the automatic emergency arresting device.

4.3.11. Electrical systems general

All winding systems electrical installation shall meet the relevant parts of AS/NZS 3000 Wiring rules.

All winding system must be fitted with a means of isolation. Refer to WHS(MPS)R section 50(4).

All motors and enclosures are to have a suitable degree of ingress protection in accordance with its intended operating environment.

As a minimum all motors and enclosures should be IP64 rated.

Refer to AS 60529 degrees of protection provided by enclosures (IP Code) and Appendix C for further guidance.

4.3.12. Wiring systems

Wiring systems shall be selected and installed to meet the following:

- protected against physical contact with live parts
- satisfy current carry capacity
- provide reliability and electrical continuity of connections, joints, and terminations
- provide adequate strength of supports and fixings
- suit intended use
- protection against mechanical damage, environmental and other external influences
- fitted with suitable circuit protection.

4.3.13. Control system

The winding system shall be designed to operate within pre-defined:

- travel limits
- speed limits
- acceleration and deceleration limits.

Refer to section 50(1)(a) WHS(MPS)R section 50(1)(b).

The winding system must be able to be brought safely to rest when it operates outside the above limits.

The winding system control system should provide a fail to safe operation. I.e., In the event of any safety-related device, feature, component, circuit or the like failing in such a manner that it becomes incapable of operating on demand, the shaft conveyance should be automatically brought safely to rest.

The control system should:

- have a voltage system no greater than extra low voltage
- enable the calling and sending of the shaft conveyance from the top of the shaft and bottom of the shaft
- be fitted with an overload protection device that prevents oversize loads being transported.
- The control system shall:
- be able to be controlled from within the shaft conveyance while a person is riding in it. Where manual controls are fitted, they should be 'hold and run' type, i.e., the operator must hold down the button for the shaft conveyance to move, once the button is released all motion should stop.
- incorporate an automatic means of stopping the shaft conveyance at both the top and bottom of the shaft
- have a slack rope device fitted that stops movement in the event of a slack rope or over spool event
- be fitted with an over travel device that prevents shaft conveyance from impacting the head frame pulley.

Control measures shall be fitted that detect one of more of the following malfunctions:

- slack rope
- broken rope
- rope detaching from a shaft conveyance or winding drum
- unsafe coiling of rope
- on detection of malfunction of one of the above, control measures are in place to bring the system to a safe state.

Refer to WHS(MPS)R section 50(1)(e).

Where limit switches are installed, the failure of those switches should not present a risk to the health and safety of people.

Where motion can be controlled from more than one control point or mode, the controls shall be interlocked to enable operation from only one point.

4.3.14. Operator controls

Operational controls must be:

- clearly identified to indicate their nature and function and direction
- located to be operated readily and conveniently by each person using the winding system
- located or guarded to prevent unintentional activation
- Able to be locked in the 'off' position or include an alternative method of power isolation to enable disconnection of all motive power and forces.

Refer to WHSR clause 210(1)(a)(b)(c)(d).

4.3.15. Emergency stops

Emergency stops shall be fitted on all winding systems.

The emergency stop(s) shall be a 'stop and lock off' (i.e. does not self-release) type so that the plant cannot be restarted after an emergency stop control has been used unless that emergency stop control is reset.

The emergency stop must:

- be prominent, clearly, and durably marked
- have any handle, bar or push-button red in colour which is associated with the stop control
- not be adversely affected by electrical or electronic circuit malfunction
- be accessible within the shaft conveyance
- be accessible to a person at the shaft entrance (near the winding system motor,) and
- be fitted at any other location identified in the design risk assessment.

Refer to WHSR 211(2)(a)(b) &(c).

4.3.16. Testing

The winding system shall be tested to ensure it can raise and lower safely.

The winding system, including the winch, sheaves, head frame, shaft conveyance, rope and attachments, should be statically tested to 2 times the maximum rope load.

The shaft conveyance emergency arresting system should be dynamically tested for correct operation at the rated payload.

All controls shall be tested for correct operation.

The brakes or holding means should be statically tested to 2 times the maximum rope load.

The brakes or holding means should be dynamically tested at the rated static load. The shaft conveyance should come to a stop within 0.3 metres of activation of any emergency stop device.

A competent person who was not involved in the production of the design should witness all tests and verify in writing that the above tests have been carried out satisfactorily and the winding system complies.

4.3.17. Documents

Design documentation must be kept on file by the designer and readily available.

The person with management or control of the winding system must be provided with adequate information to allow the winding system to be installed, commissioned, operated, and maintained in a safe condition for use.

Refer to Appendix D for further information.

This information should include but is not limited to the following.

- A drawing or sketch of the winding system showing and identifying all components of the winch.
- A block diagram showing the location of all electrical/hydraulic/pneumatic components on the winding system.
- A winch manufactures certificate with rated load and speed.
- A commissioning report with all test results listed by a competent person.
- Schematics for (where applicable):
  - electrical
  - hydraulic

  - pneumatic
- A schematic clearly showing the safety circuit and winding system control circuit.
- A commissioning report detailing all test results.
- A copy of the rope manufacturing certificate applicable to the installed rope. The certificate shall include rope construction, wire grade and tensile strength information.
- All relevant user information such as:
  - any known residual risks to be addressed by the end user
  - any known risk control measures provided
  - the purpose of the winding system
  - isolation procedure
  - specific conditions applying to the use of the winding system
  - testing, inspections, and maintenance to be carried out on the winding system
  - safe operating instructions for the winding system
  - systems of work for the safe use of the winding system
  - emergency procedures
- A type commissioning report detailing all test results and verification of design performance.

5. Operation

5.1. General

Owners or people in control of winding systems shall ensure that:

- a winding system is only used in accordance with the designer's/manufacturer's recommendations
- adequate information, training and supervision is provided to ensure the safe use of the winding system. Refer WHSR clause 39(2)
- hazards identified by the designer/manufacture have been adequately addressed
- the winding system is maintained
- the winding system is inspected before use (daily)
- defects are repaired
- safety features are used as intended by the designer of the winding system
- controls measures for hazards are implemented and maintained so they remain effective. Refer to the WHSR clause 37.
- people do not work near fixed and traversing parts of the winding system, where there is a risk to health or safety
- people do not work in the immediate area of remotely or automatically energised parts of the winding system without appropriate controls and systems of work in place
- no alterations are made to the winding system unless appropriately assessed by a competent person.
- an emergency plan is in place which includes the means to communication with emergency responders to enable assistance in the event of an emergency or becoming trapped in the shaft conveyance. Refer to the WHSR clause 43.

Workers shall ensure that they:

- only operate the winding system if they are competent to do so
- use the winding system in accordance with any information, training or reasonable instruction given to them by the person with management or control of the winding system or PCBU
- inform the PCBU of any damage to or defect with the winding system
- complete a pre use (daily inspection) on the winding system
- isolate the winding system when working on it
- are familiar with the emergency plan and the location of first aid and firefighting equipment
- do not intentionally misuse or damage the winding system
- do not use the winding system that has a defect that could affect the safe use of the winding system
- do not operate the winding system outside the design weight limits
- do not bypass safety devices such as limit switches, emergency stops, control system, brake system or winding system overload protection devices.

Refer to WHSA Section 28 for further information for duties of workers.

6. Maintenance and defect management

6.1. Frequency of inspections

The mine operator must ensure the condition and performance of the winding system, and its components, are test and monitored at intervals to ensure the safe performance of the system. Refer to the WHS(MPS)R section 50(3).

All winding systems are to be inspected before use.

The user shall inspect the winding system before use or once every 24 hours (before use the next day if used on consecutive days).

Routine maintenance is to be conducted as per the manufacturer's recommendations. Where no recommendations exist, maintenance is to be conducted as per a competent person's recommendations. Refer to WHSR clause 213(1) & (2).

Rope shall be regularly inspected and tested to ensure it is safe to use for the purpose of the winding system. Refer to WHS(MPS)R section 51(2).

6.2. Defects

6.2.1. Identification of defects

Any defect identified during either during the pre-use inspection or routine maintenance should be categorised in order of priority to ensure the continued safe use as follows:

Priority 1: Immediate work that must be completed before use.

- These include defects that are critical to the safe operation such as control system faults, emergency stops faults, brakes inoperable, damage to rope or shaft conveyance and others as identified by the designer of the winding system.

Priority 2: Urgent work that is to be completed as soon as practical.

- These defects include such items as worn belts, worn hydraulic hoses and cracks in guards.

Priority 3: Planned work which can be scheduled for the next service or when parts become available.

- These defects include repairs to paint (corrosion protection), worn safety signs etc.

All equipment which is deemed unsafe to use shall be removed from service and an out of service tag placed in a visible position.

6.2.2. Pre-use inspection

Before the operation of the winding system a pre-use inspection (daily inspection) shall be carried out to ensure it is safe to operate.

The inspection should include but not limited to checking that:

- the shaft is suitably protected to prevent unauthorised access. This includes fencing or gates are in place around the shaft.
- the winding system frame is secured to prevent tipping and is free from damage or cracking of the frame or welds
- rope sheaves are secured, free from damage and move freely. Grease in accordance with manufacturers or competent person's recommendations.
- the winch rope is not frayed and is secured at both ends, either by a swaged splice, thimble and three clamps, wedge and socket or clamped to drum with either two clamps or clamp plate. Refer to section 4.
- the winch rope is evenly distributed on the drum. Refer to section 4.
- two turns of rope are left on drum when fully paid out. Refer to section 4.
- guarding is in place and secured around rotating equipment to include couplings, belts, and pulleys
- belts and couplings are secure, correctly tensioned and in good condition, free from cracking or fraying
- the shaft conveyance is secured. Guide rollers and guide plates are secured, free from damage and move freely.
- electrical cables are free from damage and run in a way to prevent cable damage
- pumps and motors are secured, free from damage and leaks
- hydraulic hoses are free from damage, wear and tear and are routed correctly
- fluid levels are within range and topped up as required
- brakes, hydraulics, RCDs, emergency stops, limit switches, gauges, and winding system functions are all working correctly through function testing
- the ladder is secured top and bottom to prevent movement and is adequately stood off from the shaft to enable free movement of the shaft conveyance
- ladder rungs are free of cracks and that all joints are secured.
- Refer to Appendix E for winding system inspection check list.

6.2.3. Maintenance tasks

6.2.3.1. General

Maintenance activities are to be conducted by a competent person.

The aim of conducting maintenance is to:

- maintain the reliability of safeguards to keep people safe
- lower the risk to personnel by preventing secondary damage as a consequence of a failure
- maintain the operability of equipment by preventing failure and increasing reliability
- lower ownership costs by conducting maintenance in a more orderly and cost-effective manner than unscheduled repairs or replacement
- lower ownership cost by preventing damage to other parts of the winding system as a consequence of not carrying out maintenance

- comply with specific legislation.

All maintenance records (including repairs) are to be recorded and kept for the life of the winding system in a ‘Plant safety file’ or similar document.

6.2.3.2. Frequency of maintenance inspections

Maintenance tasks and their frequency will be identified through:

- requirements set out in legislation
- recommendations by the designer or manufacturer
- recommendations by a competent person
- systematic examination of failure mode,
- greater than expected deterioration of performance, and
- feedback from inspection or failure in service.

Appendix A: Definitions, acronyms, Standards and codes of practice

Definitions

Competent person means:

- for any other case — a person who has acquired through training, qualification or experience the knowledge and skills to carry out the task.
- for electrical work on energised electrical equipment or energised electrical installations (other than testing referred to in WHSR clauses 150 and 165) — a person who is authorised under the *Home Building Act 1989* to do electrical wiring work.

Shaft conveyance has the same meaning as it has in the WHS(MPS)R section 52(6) means a conveyance that is connected to a winding system.

Regulation means the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022.

Safety functions means function of a machine whose failure can result in immediate increase of the risk(s)

Small gemstone mine has the same meaning it has in section 3 of the Regulation.

TRG is a reference to technical reference guide produced by the NSW Government and published on the NSW Department of Regional NSW Resources Regulator website.

Winding system has the same meaning as it has in dictionary of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022.

Wiring rules means Australian and New Zealand Standard AS/NZS 3000:2018 Electrical installations (known as the Australian/New Zealand Wiring Rules).

Acronyms

AS Australian Standard

AS/NZS Australian Standard / New Zealand Standard

ISO International Organisation for Standardisation

PCBU Person Conducting a Business or Undertaking

TRG Technical reference guide

WHS Work Health and Safety

WHSR Work Health and Safety Regulation

WHS(MPS)R Work Health and Safety (Mines and Petroleum Sites) Regulation

WRAC Workplace Risk Assessment and Control tool.

Australian and International Standards

Table 1: Relevant Australian Standards

NUMBER	DESCRIPTION
AS /NZS 1170.0	Structural design actions - General principles
AS 1210	Pressure vessels
AS 1403	Design of rotating steel shafts
AS 1554.1	Structural steel welding –Welding of steel structures
AS / NZS 1554.4	Structural steel welding - Welding of high strength quenched and tempered steels
AS / NZS 1554.5	Structural steel welding - Welding of steel structures subject to high levels of fatigue loading
AS 1657	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS 2671	Hydraulic fluid power - General requirements for systems
AS 2759	Steel wire rope - Use, operation and maintenance
AS 2788	AS 2788 Pneumatic fluid power - General requirements for systems
AS/NZS 3000	Electrical installations
AS 3569	Steel wire ropes - Product specification
AS/NZS 3760	In-service safety inspection and testing of electrical equipment
AS 3785.7	Underground mining equipment – Sheaves
AS/NZS 3788	Pressure equipment – In-service inspection
AS 3990	Mechanical equipment - Steelwork
AS 4024 Series	Safety of machinery series of standards
AS/NZS 4024.1201	Safety of machinery - General principles for design - Risk assessment and risk reduction
AS/NZS 4024.1204	Safety of machinery – Electrical equipment of machines - General requirements
AS/NZS 4024.1303	Safety of machinery, Part 1303: Risk assessment - Practical guidance and examples of methods

NUMBER	DESCRIPTION
AS 4024.1503	Safety of machinery- Safety-related parts of control systems — General principles for design
AS 4024.1604	Safety of machinery - Design of controls, interlocks and guarding — Emergency stop — Principles for design
AS 4100	Steel structures
AS/NZS 4812	Non-destructive examination and discard criteria for wire ropes in mine winding systems
AS/NZS 4871.1	Electrical equipment for mines and quarries Part 1: General requirements.
AS 60529	Degrees of protection provided by enclosures
AS 61508 Series	Functional safety of electrical/electronic/programmable electronic safety-related systems
AS IEC 61511 Series	Functional safety - Safety instrumented systems
AS 62061	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems
AS/NZS ISO 9001	AS/NZS ISO 9001 Quality Management Systems – Requirements
AS ISO 31000	AS ISO 31000 Risk management - Guidelines

Table 1: Relevant International Standards

NUMBER	DESCRIPTION
BS 7608	Guide to fatigue design and assessment of steel products
ISO 12100	Safety of machinery – General principles for design – Risk assessment and risk reduction
SA/SNZ HB 89	Risk management - Guidelines on risk assessment techniques

Other

NSW Government code of practice - How to manage work health and safety risks.

NSW Government code of practice – Managing electrical risk in the workplace.

NSW Government code of practice – Managing the risk of falls at workplaces.

NSW Government code of practice – Managing the risk of plant in the workplace.

NSW Government code of practice – Safe design of structures.

NSW Resources Regulator – Opal and gemstone mining guide.

Appendix b: Common plant hazards

Table 2: Table of common plant hazards

Energy source	Hazard	Consequences for people
Bio-mechanical	Ergonomic design failure	Excessive effort. Human error, human behaviour. Injuries from not using PPE. Slips, trips, falls. Sprains, strains. Unhealthy posture.
Chemical	Dust Explosion Fires Fluids Fumes Gases Mists	Asphyxiation. Burn injuries. Cancer. Dust. Irritation. Lung damage. Poisoning.
Electricity	Earth or other faults of the electrical system.' Fire – hot joint or surface ignition	Electrocution Burns, scald injuries Asphyxiation
Gravity	Stored potential energy – weight in elevated machine components. Unintended movement of plant. Loss of control of suspended loads or transported materials resulting in: Slip or fall of materials from transport level to ground Fall of load Slip or fall of persons from height accessing plant for operation or maintenance	Minor or major crush injury to single or multiple persons Fatality to single or multiple persons.
High pressure fluid	Exposure to uncontrolled release of high-pressure fluid due to failure of pressure containing devices or pressure controlling devices. Exposure to uncontrolled release of high temperature fluid.	Direct fluid injection injury. Struck by projectile debris. Struck by whipping hoses. Catastrophic failure of pressurised components. Burns from contact with eyes or skin.
Kinetic energy	Unintended movement of plant resulting in collision with permanent structures	Minor or major crush injury to single or multiple persons. Fatality to single or multiple persons.
Mechanical	Crushing Drawing-in or trapping	Amputations. Crush injuries.

Energy source	Hazard	Consequences for people
	Entanglement Friction or abrasion Impact Shearing Stored potential energy – springs Unexpected movement	Entanglement injuries. Impact injuries.
Noise	Exposure to continuous operation noise source i.e., Diesel Engine, electric motors, etc. Exposure to discontinuous operation noise i.e., hammering, operation of functions etc.	Loss of hearing (short term) Loss of hearing (long term)
Pressure	Stored potential energy – liquids and gases under pressure	Fluid injection injuries. Struck by ejected projectiles.
Temperature	Contact with objects at extreme high or low temperatures. Explosions. Flames. Heat radiation. Hot or cold work environment.	Burns, scalds. Cancer. Freezing. Heat stress. Hypothermia.
Vibration	Exposure to continual low intensity vibration.	Disorders of joints and muscles including the spine. Cardiovascular and respiratory changes. Long or short term back, neck and other body part sprain and strain injuries. Contusions, fractures.

Appendix C: Ingress protection electrical enclosures

The below information is to assist in the correct selection of electrical enclosures to prevent intrusion from foreign bodies (tools, dirt etc) and moisture based on its intended application referred to as IP or Ingress Protection.

First digit (intrusion protection)

1. (or X - see section below): No special protection. Not rated (or no rating supplied) for protection against ingress of this type.
2. Protection from a large part of the body such as a hand (but no protection from deliberate access); from solid objects greater than 50mm in diameter.
3. Protection against fingers or other object not greater than 80mm in length and 12mm in diameter (accidental finger contact).
4. Protection from entry by tools, wires etc, with a diameter of 2.5 mm or more.
5. Protection against solid objects larger than 1mm (wires, nails, screws, larger insects, and other potentially invasive small objects such as tools/small etc).
6. Partial protection against dust that may harm equipment.
7. Totally dust tight. Full protection against dust and other particulates, including a vacuum seal, tested against continuous airflow.

Second digit (moisture protection)

1. (or X - see section below): No protection.
2. Protection against vertically falling droplets, such as condensation. ensuring that no damage or interrupted functioning of components will be incurred when an item is upright.
3. Protection against water droplets deflected up to 15° from vertical
4. Protected against spray up to 60° from vertical.
5. Protected against water splashes from all directions. Tested for a minimum of 10 minutes with an oscillating spray (limited ingress permitted with no harmful effects).
6. Protection against low-pressure jets (6.3 mm) of directed water from any angle (limited ingress permitted with no harmful effects).
7. Protection against direct high-pressure jets.
8. Protection against full immersion for up to 30 minutes at depths between 15 cm and 1 metre (limited ingress permitted with no harmful effects).
9. Protection against extended immersion under higher pressure (i.e., greater depths). Precise parameters of this test will be set and advertised by the manufacturer and may include additional factors such as temperature fluctuations and flow rates, depending on equipment type.
10. (K): Protection against high-pressure, high-temperature jet sprays, wash-downs, or steam-cleaning procedures - this rating is most often seen in specific road vehicle applications (standard ISO 20653:2013 Road Vehicles - Degrees of protection).

For example, IP 64 has an intrusion protection that partially protects against dust that may harm equipment and is protected against spray up to 60° from vertical.

Appendix D

General duties in relation plant

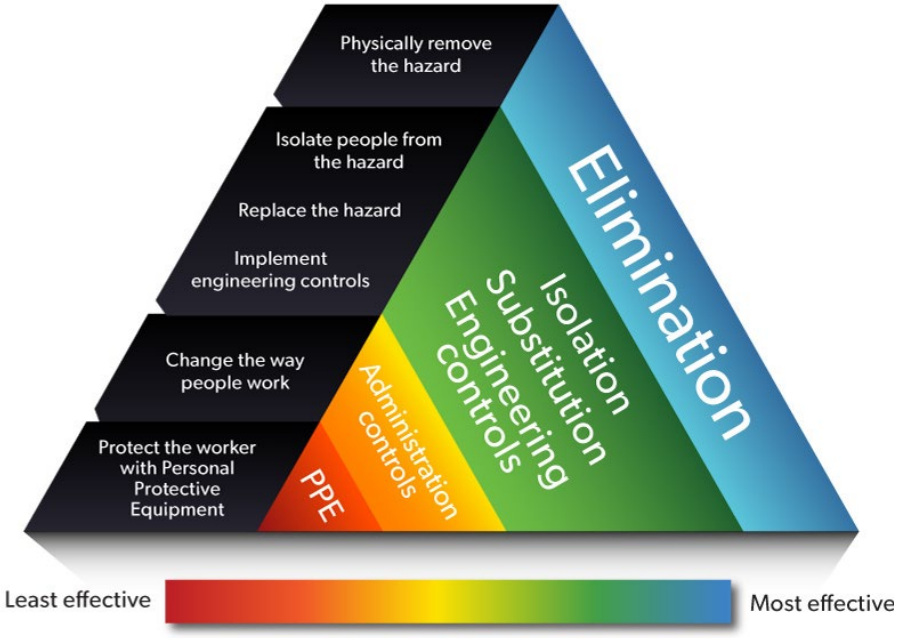
A PCBU has a primary duty under section 19 of the WHS Act to ensure, so far as is reasonably practicable, that workers and other people are not exposed to health and safety risks arising from the business or undertaking. This duty includes ensuring, so far as is reasonably practicable, but is not limited to:

- the provision and maintenance of safe plant and structures
- the provision and maintenance of safe systems of work
- the safe use, handling, and storage of plant, structures, and substances
- the provision of any information, training, instruction, and supervision that is necessary to protect all people from risks to their health and safety arising from work carried out as part of the conduct of the business or undertaking.

In meeting this duty at a mine, a PCBU must manage risks to health and safety associated with mining operations at the mine in accordance with Part 3.1 of the WHS Regulation and section 14 of the Work Health and Safety (Mines) Regulation 2022, including but not limited to:

- ensuring that a risk assessment is conducted by a person who is competent to conduct the particular risk assessment having regard to the nature of the hazard
- identifying all reasonably foreseeable hazards
- eliminate risks to health and safety so far as is reasonably practicable
- if it is not reasonably practicable to eliminate risks to health and safety – minimised those risks so far as reasonably practicable in accordance with the hierarchy of risk control measures. Refer figure 7.

Figure 5: Hierarchy of control



Design, manufacture, import, supply

Designers, manufacturers, importers and suppliers of plant, substances and structures have duties under sections 22-25 of the WHS Act. In relation to plant, substances and structures, these duties may be summarised as a duty to ensure, so far as is reasonably practicable, that the plant, substance, or structure is without risks to the health and safety of people at a workplace who use the plant, substance, or structure for a purpose for which it was designed or manufactured.

Calculation, analysis, testing or examination

Designers, manufacturers, importers, and suppliers must also carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary for the performance of the duty imposed by sections 22-25 of the WHS Act, or alternatively, in the case of importers and suppliers, ensure that such calculations, analysis, testing or examination have been carried out.

Information to be provided

Designers, manufacturers, importers, and suppliers must also give adequate information to each person to whom they provide the design, plant, or structure imposed by sections 22-25 of the WHS Act, (and subsequently upon request) concerning:

- each purpose for which the plant, substance or structure was designed or manufactured
- the results of any calculations, analysis, testing, or examination referred to above, including, in relation to a substance, any hazardous properties of the substance identified by testing
- any conditions necessary to ensure that the plant, substance, or structure is without risks to health and safety when used for a purpose for which it was designed or manufactured or when carrying out any activity.

Maintenance of control measures

Measures implemented to control risks presented by identified hazards at a mine must be maintained to ensure their effectiveness under clause 37 of the WHS Regulation, including by ensuring that the control measure is and remains:

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

Management of risk of falls

A person conducting a business or undertaking at a workplace must manage, in accordance with Part 3.1, of the WHSR risks to health and safety associated with a fall by a person from one level to another that is reasonably likely to cause injury to the person or any other person. Refer to WHSR clause 78.

Appendix E – Sample winder inspection

Table 1 Winder System sample inspection sheet

Date	Name	Full Name	Claim No.			
Indicate condition of winder by marking with a cross: Pass, Fail or N/A for checks that are not applicable						
Component check	**Checks to perform**			**Pass**	**Fail**	**N/A**
Shaft	Check that shaft is suitably protected to prevent unauthorised access to it.					
Frame	Check winder frame is secured to prevent tipping and is free from damage or cracking of frame or welds.					
Rope sheaves	Check rope sheaves are secured, free from damage and move freely. Grease as required.					
Winch rope and drum	Check winch rope is not frayed and is secured at both ends either by a swagged splice, thimble and 3 clamps, wedge and socket or clamped to drum with either 2 clamps or clamp plate. Check winch rope is evenly distributed on drum. Check 2 turns of rope are left on drum when fully paid out. Check winch rope is sitting in all rope sheaves.					
Guarding	Check that guarding is in place and secured around rotating equipment to include belts, pulleys, drive shafts.					
Belts & Couplings	Check belts and couplings are secure, correctly tensioned and in good condition free from excessive cracking or fraying					
Pumps / Motors	Check pumps and motors are secured, free from damage and leaks.					
Winder return mechanism	Check winder bucket return mechanism is in place and operates freely to allow auto return of bucket.					
Hydraulic hoses	Check hydraulic hoses are free from damage, wear and tear and are routed correctly.					
Oil and grease	Check fluid levels are correct, and components greased. Top up and grease as required.					
Cables	Check electrical cables are free from damage and run in a way to prevent cable damage.					
Shaft conveyance	Check shaft conveyance is secured, Check guide rollers and guide plates are secured, free from damage and move freely.					
Control system	Check control system is secured and operates as intended.					
Brake holding and lowering device	Check brake holding device operates.					
Emergency stop	Check emergency stops works, and plant does not restart unless emergency stop is reset.					
Limit switches	Check limit switches are adjusted correctly and operate as intended.					
RCD	Test RCD by pressing the test button.					
Shaft conveyance guide frame / ladder	Check shaft access ladder is secured top and bottom to prevent movement and is adequately stood off from shaft to enable shaft conveyance to freely traverse. Check ladder rungs for cracks and all joints are secured.					

Appendix F – WRAC example

Table 2: Health and safety risk matrix

Health & Safety Risk Matrix *Multiply Likelihood x Consequence to achieve risk score.*					
Consequence →	**Insignificant** 2	**Minor** 3	**Moderate** 6	**Major** 10	**Catastrophic** 20
Likelihood ↓	*May have little or no impact on health and safety*	*May have some impact on health and safety, but will be able to recover from or repair the damage within a relatively short term*	*A moderate permanent disability or long-term impairment*	*A single fatality or severe permanent disability*	*Multiple fatalities or significant irreversible effects on the health of many people*
Likely 5 *There is a very good chance this event will occur soon*	M *10*	M *15*	H *30*	E *50*	E *100*
Probable 4 *This event could easily occur in industry experience*	L *8*	M *12*	H *24*	E *40*	E *80*
Possible 3 *This event is known to occur over a 5-year period*	L *6*	L *9*	M *18*	H *30*	E *60*
Unlikely 2 *Known to occur but rarely*	L *4*	L *6*	M *12*	M *20*	E *40*
Rare 1 *It is theoretically possible for this event to occur, but extremely unlikely that it will*	L *2*	L *3*	L *6*	M *10*	M *20*

Risk tolerance guide –all risks must be eliminated or controlled as soon as practical

2-9 ***Low*** Risk may be tolerated based on cost and practicality, otherwise complete actions within 6 months.

10-20 ***Med*** Additional actions must be completed within 3 months of approval.

24-30 ***High*** Implement controls within 1 week or sooner.

40-100 ***Extreme*** Stop at risk activity immediately and make it safe.

NOTE: Impact/Risks rated 10 and above, (Medium to Extreme) are deemed ***significant***.

Table 3= WRAC type risk assessment example

General Heading: 1. Winding system operational and maintenance risk assessment								
Subheading: 1. Pre use inspection on winder system								
				RR				
1. Entanglement in rotating components to include rope, drum, and motor coupling	1. Guarding fitted around winch assembly and secured by a tool to prevent access.	6	1	6				
	2. Isolation of winder system while conducting visual inspection.							
2. Worker falls down shaft	1. Shaft cover	10						
	2.Fence and gate around shaft							