GLENCORE

GROUP STANDARD

Shafts and Winders

SHAFTS AND WINDERS

Contents

1 Purpose

The purpose of this Standard is to eliminate or minimise the potential for fatalities, injuries and incidents arising from the risks associated with the operation and maintenance of shafts and winders/hoists.

This may include: the failure of shaft geotechnical stability, shaft linings and fittings, internal support structures, headgear, foundations, winding/hoisting facilities, winding and guide ropes and conveyances.

Shafts and winders/hoists include vertical shafts and drifts/inclines, those in the course of development or shaft sinking, as well as lifts installed within buildings.

2 Scope

The requirements herein apply to all Glencore managed Industrial Assets, Sites and Complexes where mining shafts, drifts, and inclines are under development or sinking as well as to lifts installed in buildings.

3 Key terms

Attachments – components used to connect a conveyance to the end of a rope. Components may include: rope sockets, capels, pins, couplers, chain bars, detaching hook, rope swivels and swivel hooks or similar.

Competent person – a person authorised by the Departments/Assets Manager as having the knowledge, experience and skill to carry out the prescribed activity.

Competent Engineer – a qualified civil/mechanical/structural engineer who has graduated from an accredited engineering institute and is appointed by the senior Asset Manager.

Conveyance – refers to any: car, carriage, cage, skip, kibble, counterweight or stage in which persons, minerals or materials travel through a shaft or drift.

Engineering Audit Inspector – a qualified civil/mechanical/structural engineer who has graduated from an accredited engineering institute, has theoretical and practical knowledge and experience relevant to the type of inspection to be performed and, holds a current registration or equivalent with a relevant professional body.

Engineering standards – a set of engineering standards that is applied to the mine to ensure equipment is safe to use. This includes: competency of persons, design, installation, commissioning, operation and maintenance, and decommissioning

Permit to Work – is an authorisation for work involving areas of inherent or potential danger where the application of stringent precautions is necessary.

Qualified Engineer – a qualified civil/mechanical/structural engineer who has graduated from an accredited engineering institute and holds a current registration or equivalent with a relevant professional body and has experience in the type of equipment or structure.

Winders/hoists – include: drift winders, vertical shaft winders (friction and drum types), and shaft sinking winders.

4 Requirements

4.1 Design and approval

4.1.1 Shafts, winders/hoists and associated attachments must be designed to meet engineering standards specified by the regulator. Where local requirements are absent or do not meet generally accepted international standards, suitable standards must be referenced and applied. A design basis must be maintained summarising the standards applied in the design.

4.1.2 Designs must be certified by a Qualified Engineer, and all original plans and records retained.

4.1.3 Where specified in legislation, designs must be approved, certified or registered by the regulator or an authorised body.

4.1.4 A reference list of relevant legislation requirements for shafts and winders/hoists must be available within the site's document records.

4.2 Critical controls and systems

4.2.1 All critical functions required for the safe use of the winder must be identified and documented by the designer or Qualified Engineer.

4.2.2 Processes must be established to regularly inspect, monitor and verify the effectiveness of critical controls.

4.2.3 Processes must be in place to verify any modifications to the critical controls and systems including reviews and verification during commissioning.

4.3 Risk management

4.3.1 The designer, manufacturers and suppliers must carry out a risk assessment to evaluate all risks to the safety of people from the use of the winding/hoisting system. They must identify the design requirements and any other actions as required to control the risk in accordance with the hierarchy of controls.

4.3.2 For new installations, the designer or Qualified Engineer must determine through the risk assessment process the minimum safety integrity level or the required minimum category level for each identified safety function and design an appropriate critical system to control the risk.

4.3.3 The risk assessment should be in a form which systematically analyses the failure causes/modes and integrity of each critical system.

4.3.4 The Operator must complete an operational risk assessment prior to operations, reviewing all hazards associated with operations to identify necessary operational controls.

4.3.5 The risk assessment must be reviewed using Change Management processes whenever there are changes to operations, alterations are made to the winding system, or whenever a significant incident occurs.

4.3.6 Any proposed modification to the existing shaft winding/hoisting systems will require the application of a Management of Change process, including consultation between site engineering personnel and the equipment designer. Final approval is required from the equipment designer or a Qualified Engineer.

4.3.7 All modifications to winding/hoisting systems and associated equipment must be managed in accordance with the legislative requirements and consider all existing and potential risks that may result from a proposed change.

4.3.8 All changes to the critical maintenance tasks including scheduled intervals must be managed in accordance with legislative requirements and will be reviewed, approved in the master preventative maintenance schedule, and communicated to those who need to know.

4.4 Shafts and Winders Management Plan

4.4.1 With reference to the completed risk assessments, Assets must develop a Management Plan describing how shafts and winders/hoists will be managed. The following are to be included in the Management Plan:

a) A description of the shaft and winder facilities;

b) The method and key outputs of the hazard identification and risk management process, including a bow tie;

c) Identification of critical controls and the process of verification;

d) The competency requirements of people involved in design, operation and maintenance;

e) An inspection schedule including requirements for recording results, management review, sign off and retention of records;

f) A description of relevant design requirements in providing “fit for purpose” equipment, and the means of management throughout its lifecycle e.g.:

1. Design standards, registration, installation and commissioning;
2. Maintenance management systems (preferably computerised);
3. Master preventative maintenance schedule including all planned inspections, tests, maintenance, their required intervals and whether they are a critical activity;
4. Defect management;

5. Modification processes; and
6. Decommissioning processes;

g) Safe work practices including Safe Work Procedures (SWP's), Job Safety Analysis (JSA's) and Work Permits;

h) Implementation including instruction, training and supervision;

i) Emergency preparedness;

j) Measurement and evaluation - the monitoring of the winder status including: operational status, location and direction of conveyances, and speed of conveyances;

k) Triggers for auditing, review and improvement of the Management Plan; and

l) Accountabilities.

4.5 General design requirements

4.5.1 Every winding/hoisting system used must include the following criteria:

a) Ropes and devices designed to withstand all forces reasonably expected to be borne by the ropes and devices, suitable safety factors must be established and maintained;

b) An independent safety monitor that prevents any shaft conveyance from overwind, moving at an unsafe speed, excessive acceleration and deceleration, and uncontrolled movement. The monitor must directly trip the winder in the case of faults or loss of power or communication;

c) Where people are transported at least 2 independent braking (or equivalent) systems that can establish and maintain control of the winder/hoist in the event of a failure in any one of the systems. At least one of the braking systems must apply directly to the winder/hoist drum;

d) A failsafe control loop that removes power from the winder/hoist motor(s) and causes the winder to be brought to a safe state when the following applicable malfunctions are detected:

1. slack rope,
2. rope slip,
3. unsafe balance rope conditions,
4. unsafe coiling of rope,
5. shaft obstructions,
6. power system failure, overload, short circuit, loss of phase,
7. activation of the emergency stop by an operator,
8. fault from the safety monitor,
9. fault from any other critical (safety) device,
10. movement of the clutch of an operating double drum hoist,

11. brake component failure, and
12. fault in ancillary systems such as ventilation fans or hydraulic power units;

e) Warning systems to alert persons at the mine to any emergency in a winding system which requires a response;

f) If it is reasonably practicable, remote monitoring of the functions of the system;

g) An effective means of communication:

1. between the surface and any shaft conveyance used for carrying persons,
2. between the point of control of the winder and the entry points to every shaft that is in use, and
3. telephone or radio communication systems must supplement bell type signals where practical;

h) A closed or positive connecting device that safely attaches ropes to conveyances;

i) An interlock between the clutch and the brakes of a double drum hoist to release the brakes on the clutched drum while the clutch is disengaged; and

j) In the case of multi-rope winders/hoists, a means to load the ropes as uniformly as possible.

4.5.2 The condition and performance of the winding system and its components must be tested and monitored at intervals to ensure the safe performance of the system.

4.5.3 Energy lockout devices must be fitted to all mechanical and electrical plant associated with any shaft, including any mechanical and electrical plant associated with the operation, maintenance or use of the shaft.

4.5.4 The following matters must be considered in developing the control measures to manage the risks associated with winding/hoisting systems:

a) the potential for instability and loss of integrity of the shaft,

b) the potential for fires in: underground operations, the shaft or winder areas,

c) the potential for any unintended or uncontrolled movement of the conveyances within the shaft,

d) the potential for a conveyance to fall down the shaft, and

e) the potential for failure of or damage to equipment and control systems.

4.5.5 Ropes must be designed and procured with a Factor of Safety (FoS) that takes into account all forces reasonably expected to be borne by the ropes and devices. This shall be in accordance with recognised engineering standards and form part of the design validation process.

4.5.6 New ropes must meet the winder design specification and may not be placed into service unless the rope manufacturer's certificate is retained at the operation and contains the following information:

a) date of manufacture,

b) tensile strength, diameter, length and mass, and

c) class of steel used in its construction.

4.5.7 The Competent Engineer must confirm all winder ropes have their tensile strength tested and confirmed by a nationally accredited testing station e.g.: National Association of Testing Authorities (NATA) accredited laboratory.

4.5.8 Criteria must be established to determine when a rope is no longer suitable for any such use.

4.5.9 Attachments shall be certified and subject to a validation process that confirms the factor of safety required under recognised engineering standards has been met.

4.5.10 Certifications and other relevant documentation must be provided and retained within the plant file.

4.5.11 Shaft conveyances must be designed to protect any person being injured from or due to:

a) falling objects,

b) material being carried in a conveyance with the person,

c) material falling from a conveyance,

d) the person falling from a conveyance,

e) a part of the person extending out of the conveyance,

f) any material or plant being carried by other shaft conveyances, or

g) the wall of the shaft or anything in the shaft.

4.5.12 Interlocked shaft cage doors and/or platform gates (or keps) must be installed where practical to prevent movement of the conveyance whilst the door is not fully closed.

4.5.13 The maximum number of persons and/or maximum weight of material that may be carried shall be specified and posted at the shaft collar and/or cage entrance and the winder/hoist operation station.

4.5.14 Material or plant being carried in a shaft conveyance:

a) Must not protrude from the shaft conveyance while it is moving so as to contact a wall of the shaft or anything in the shaft; and

b) Must be so secured to the shaft conveyance that it cannot leave the shaft conveyance except by being deliberately removed.

4.5.15 Where shaft conveyances that combine a cage and skip are used, material must not be carried in the skip while persons are being carried in the cage.

4.5.16 Control measures must be implemented to prevent:

a) A conveyance travelling into the dump or loading station while transporting people unless positive zero energy measures are implemented to loading/dumping of the conveyance;

b) A shaft conveyance from falling down the shaft or incline; and

c) A conveyance over-travelling into a sump, and to maintain sumps at a safe level of water and atmosphere.

4.5.17 Provisions must be provided for the emergency exit of persons from a conveyance.

4.6 Implementation, operation and maintenance of the winding/hoisting system

4.6.1 The design of the winding systems must ensure that reasonable operating forces have been determined/communicated and the winder is operated within the design parameters, including rope factors of safety.

4.6.2 Acceleration and deceleration parameters must be maintained and tested in accordance with the winder design to prevent excessive forces on ropes, attachments and conveyance. Systems that prevent overloading of the skip, such as load flasks, shall be regularly maintained and tested.

4.6.3 A specific maintenance strategy must be developed for the shaft winders/hoists including daily, weekly and periodic maintenance tasks.

4.6.4 Each rope used for the purposes of a winding system must be regularly inspected and tested to ensure that it is safe for that use, including regular inspection and testing (non-destructive and destructive) by a certified testing authority in accordance with recognised engineering standards.

4.6.5 Slack rope detection systems must be inspected, calibrated and maintained. The system must be regularly tested to confirm slack rope is continually being monitored.

4.6.6 Rope slip devices must be regularly inspected, tested, calibrated and maintained to confirm the system is continually monitoring and preventing the unintended or uncontrolled movement of the conveyances within the shaft.

4.6.7 The brake system installed on the shaft winders/hoists must be regularly inspected, tested and maintained in accordance with the winder maintenance strategy to validate the braking system is functioning as per its design. The results must be recorded for monitoring and trending purposes.

4.6.8 Static brake tests and/or Maximum Out of Balance Torque (MOBT) testing (as applicable) must be carried out in accordance with the maintenance strategy to indicate the holding capacity of each brake path.

4.6.9 Dynamic brake tests and/or MOBT (as applicable) must be carried out in accordance with the maintenance strategy, but only after static tests have been done and the results are acceptable. Independent brake testing must also be completed by the Original Equipment Manufacturer (OEM) in accordance with the maintenance strategy.

4.6.10 Non-Destructive Testing (NDT) of brake components must be conducted by an approved testing authority in accordance with the maintenance strategy.

4.6.11 Guarding and barricading must be installed at each shaft entry to prevent the unplanned entry and fall of mobile plant or other structure into the shaft. These must be regularly inspected and maintained in accordance with the maintenance strategy.

4.6.12 Loads must be secured within a conveyance through the provision and use of approved tie downs and/or anchor points.

4.6.13 Persons must be restricted from entering the shaft whilst work is being undertaken in the shaft or on the headframe/structure. Persons using hand tools must use tool lanyards whenever practical.

4.6.14 The shaft winder control systems must be inspected, tested and maintained to ensure it operates as per its design, including failing to safe function. Furthermore, all control parameters must be set with password protection to operate within the design criteria.

4.6.15 All winder protection systems must be tested in accordance with the maintenance strategy, further independent testing must be completed by the designer or competent third party on a periodic basis.

4.6.16 Procedures must be available and applied if a failure of any critical protection system occurs and must trigger a shutdown of the winder system until the fault or defect has been repaired.

4.6.17 Overloading of the winding system must be prevented by systems designed to trip the winder operation when overloaded or excessive torque is detected.

4.6.18 Overload protection systems must be regularly inspected, tested and maintained in accordance with the winder maintenance strategy.

4.6.19 Periodic, scheduled inspections by competent site personnel must be carried out on the structural components of the shaft winding systems, including but not limited to:

a) headframe,

b) foundations,

c) guarding,

d) walkways, platforms, handrails,

e) conveyances,

f) maintenance and inspection platform, and

g) shaft linings, guides, services and their supports.

4.6.20 The head frame and associated structures and services within the head frame and the shaft must be maintained in accordance with the maintenance strategy.

4.6.21 Third party structural inspections in line with recognised engineering standards, including inspections and sign off by a Qualified Engineer must be competed according to the master

maintenance schedule with corrective work orders generated and completed based on the findings of the inspections.

4.6.22 Attachments must be inspected and certified by an approved testing authority as per the rope maintenance strategy, and be subject to periodic in-service inspections.

4.6.23 New attachments procured for shaft hoisting application must be certified and compliant to recognised engineering standards.

4.6.24 Failure of drive line components must be managed in accordance with the maintenance strategy. Inspections, testing and maintenance must be scheduled via the maintenance management system including third party testing including but not limited to oil and vibration analysis, crack testing, ultrasonic testing.

4.6.25 Protection features such as gear loss protection must be regularly tested to ensure it remains fail to safe.

4.6.26 Undue horizontal movement of the conveyance, in stationary, ascending and descending scenarios must be maintained by guide ropes or fixed guides. These ropes, associated attachments or fixed guides must be regularly tested, inspected and maintained.

4.7 Protection of workers within a shaft

4.7.1 When work or examinations are taking place within a shaft or headframe:

a) Winding/hoisting must be suspended, except where necessary to conduct the activity;

b) Protection from accidental contact with any moving part or falling objects must be provided; and

c) The power supply to conveyor belts, gates and other devices above the worker/s must be isolated and mechanically secured in the closed position through a Permit to Work process.

4.8 Instruction, training and competencies

4.8.1 Shafts and winders/hoists must be under the control of a Competent Engineer. All persons involved in winding/hoisting systems including designers, supervisors, operators and maintenance personnel must be trained and assessed for their competencies.

4.8.2 The minimum acceptable competencies are to be nominated; areas covered must include:

a) knowledge and understanding of hazards and controls, in particular critical controls,

b) safety procedures including emergency procedures,

c) operating, maintaining and repairing of the winding systems,

d) energy isolation and restoration,

e) inspection and testing of the winding system,

f) understanding the purpose and function of safeguards that protect personnel,

g) reporting of faults and defects, and

h) use of protective equipment.

4.9 Audits

4.9.1 Winders/hoists must undergo safety audits by an independent and recognised specialist Engineering Audit Inspector at least every five years that verifies:

a) The winding/hoisting system is operating within the specified design specifications;

b) The operation, servicing, testing and maintenance of the winding/hoisting system;

c) The Management Plan is adequate and is being followed; and

d) The Management of Change process is in place and is being used effectively for all changes.

4.10 Records

4.10.1 Safety related aspects of winders/hoists must be fully documented. Records must include:

a) design specifications, functions and other documents,

b) designs documentation for certification, registration,

c) hazard identification and risk assessment documents,

d) risk control methods,

e) consultation records,

f) components certification and test certificates,

g) commissioning and test results,

h) identification of all safety critical systems,

i) maintenance records, safety inspections and test reports,

j) defects management system,

k) change of procedures, monitoring and audit and review reports,

l) reports of accidents, incidents and associated safety statistics,

m) training and competency records,

n) winder/hoist modifications or alterations, and

o) audit reports and associated actions.

5 Additional resources

External resources:

- Mine Design Guideline MDG 33 Mine Winders Parts 1 to 7 (New South Wales, Australia).

- Part X - Regulation 854 – Mines and Mining Plants (Ontario Canada).
- Pending – AS_NZS 4730.2 & 4730.1.

6 Accountabilities

Team	Accountabilities
Corporate HSEC Leads	• Publish and maintain this document, use it as a basis for relevant corporate audits.
Commodity Departments	• Apply the requirements of the Standard within the Department and monitor its application.
Industrial Assets	• Apply the requirements of the Standard within the Asset and appoint relevant people to manage the process.
All employees/contractor	• Be aware of the hazard and signs of shaft or winding system failure, and report any associated incident, damage or indications of concern. • Follow all rules regarding access, operations and maintenance associated with shafts and winders.