

Guideline



Vertical opening safety practice in underground mines



Department of Consumer
and Employment Protection
Government of Western Australia

Resources Safety



 **MIAC**

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Further details of publications produced by Resources Safety can be obtained by contacting:

Resources Safety
Department of Consumer and Employment Protection
Locked Bag 14
CLOISTERS SQUARE WA 6850

General queries

Telephone: +61 8 9358 8002
NRS: 13 36 77
Facsimile: +61 8 9358 8188
Email: ResourcesSafety@docep.wa.gov.au

For publication orders

Telephone: +61 8 9358 8154
Email: RSDComms@docep.wa.gov.au

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GUIDELINES

A guideline is an explanatory document that provides more information on the requirements of legislation, details good practice, and may explain means of compliance with standards prescribed in the legislation. The government, unions or employer groups may issue guidance material.

Compliance with guidelines is not mandatory but they could have legal standing if it were demonstrated that the guideline is the industry norm.

Foreword

This guideline is issued by Resources Safety under the *Mines Safety and Inspection Act 1994*, and has been endorsed by the Mining Industry Advisory Committee.

The Act

The *Mines Safety and Inspection Act 1994* (the Act) sets objectives to promote and improve occupational safety and health standards within the minerals industry.

The Act sets out broad duties, and is supported by regulations, together with codes of practice and guidelines.

Regulations

The Mines Safety and Inspection Regulations 1995 (the regulations) provide more specific requirements for a range of activities. Like the Act, regulations are enforceable and breaches may result in prosecution, fines, or directions to cease operations and undertake remedial action.

Application

The provisions of this guideline apply to all mines as defined in section 4(1) of the Act.

WHO SHOULD USE THIS GUIDELINE?

This guideline should be used by everyone working near or in vertical or subvertical openings in underground mines, or responsible for such personnel.

1 Introduction

The purpose of this guideline is to emphasise the nature of some of the more obvious hazards associated with vertical openings, and to recommend a system of procedures to avoid or minimise the risks associated with them.



2 Risk statement

All mines to which this guideline applies should be able to demonstrate that the hazards associated with vertical openings are being effectively managed. Risk management is essential to prevent fatalities and injuries. It includes:

- spotting the hazards
- assessing the risks
- making the changes necessary to eliminate the hazard or minimise the risk of injury or harm to health.

3 Nature of the hazard

Vertical openings within underground mines present a range of potentially serious hazards, usually due to space and visibility constraints.

It is essential that all personnel are made fully aware of these hazards at induction, and that they are regularly given reminders, particularly when there are new developments or when operating procedures are changed or revised.

Issues relating to “old” underground openings exposed during openpit mining are addressed in a guideline on openpit mining through underground workings (DoIR, 2000).

The Mines Safety and Inspection Regulations 1995 contain regulations that cover aspects relating to vertical openings (see Appendices A, B and C).

4 Approach to vertical opening safety practice

The design of vertical openings underground must ensure that effective safety precautions can be readily applied. It is particularly important in the case of sublevel open stopes, or other stoping systems where there could be access to vertical openings at a number of horizons, that well-established vertical opening procedures are clearly promulgated and rigidly adhered to.

5 Developing a system of vertical opening procedures

Safe vertical opening procedures must be devised and implemented in underground mines where operations at two or more horizons are linked by vertical or subvertical openings.

Such procedures must be approved by the registered mine manager and will carry the authority of the Mines Safety and Inspection Regulations 1995 if there is deviation from the approved procedures.

This system must apply to all personnel, including survey, geological and rock mechanics staff, working near or in vertical or subvertical openings.

6 Procedure for ore passes

6.1 Location of passes

Some recommendations in this section refer to mining techniques that are becoming less common. However, those techniques are still being used and the recommendations remain relevant.

Any access to the top of a pass or any other horizon that allows tipping into a pass (via a finger rise in the case of multilevel use of the pass) should be of an adequate length off the tramming level or decline. The length depends on the size of development headings and equipment used, but will typically be in the range from 5 to 16 m.

Locating the tip point off the tramming or haulage way in this fashion:

- provides clearance of the vehicle to passing traffic while tipping
- minimises the risk, to personnel at a lower horizon, resulting from spillage falling into the pass from passing vehicles
- facilitates the control (e.g. using sprays and flaps) of dust emitted from the pass as a result of tipping at other horizons.

There should be provision for the straightforward fitting of appropriate barricading and signage, including reflective signs and battery-operated traffic-type flashing lights.

A stop log (block) or other suitable secure structure should be placed at every tipping point.

Figure 1 illustrates these points with respect to passes.

Where the location of a pass adjacent to a drive or travelway is unavoidable (e.g. due to previous mine design or existing development constraints), the pass must be protected by a raised concrete parapet or other effective barrier.

Where there is any danger of personnel or spillage from passing vehicles falling into such a pass, a steel or timber cover operated by mechanical means (e.g. air or hydraulic cylinder, rope, pulley) must be provided.

The tipping point into any pass must be provided with adequate warnings to prevent inadvertent entry. Reflective signs, tape, or securely fastened safety mesh are required, in addition to a requirement to securely barricade the access when not in use.

Where passes are pulled or extracted at drawpoints, millholes or grizzlies, the design and brow configuration must be such that persons passing through the area or working on extraction are not at risk from uncontrolled fall or discharge of rock.

6.2 Operation of passes

The legislative requirements applicable to ore passes are given in Appendix B.

Given that the ore pass system must be designed to suit the nature and scale of the mining method, it is essential that proper operating control is exercised on the material tipped into the pass. Excessive oversize creates hang-ups, and the bringing



KEY POINTS — ORE PASSES

- The chute, drawpoint, chain control or other extraction system on the pass must be locked out, barricaded and signposted to prevent inadvertent drawdown.
- Where feasible, a staging should be constructed that is supported independent of the loose rock in the pass.
- Properly rigged safety belts or harnesses, preferably with inertia reels, must be provided for anyone working on a grizzly.

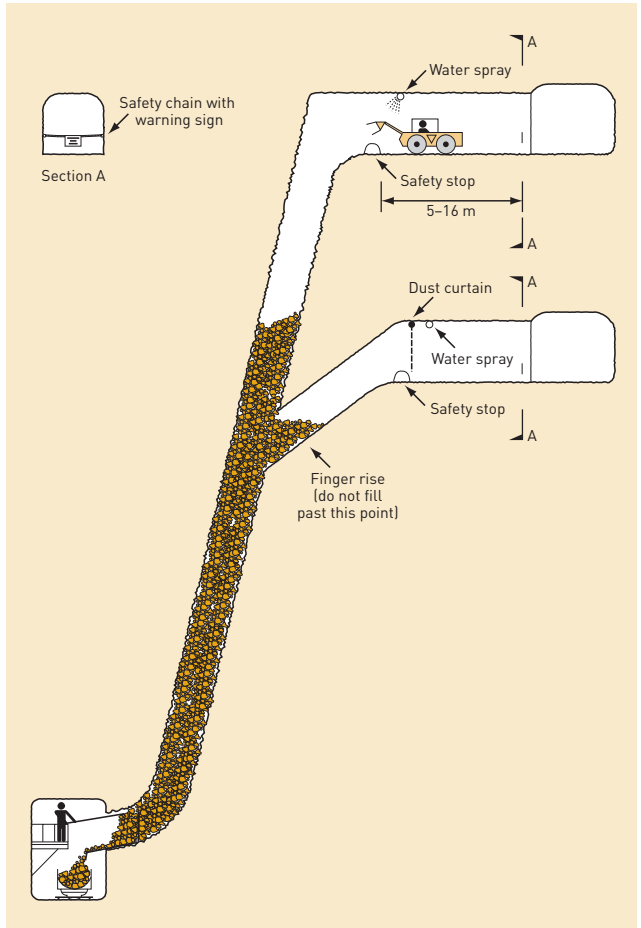


Figure 1: Ore pass layout

down of hung passes by blasting or other means introduces additional hazards that should be eliminated where possible.

The addition of water to the top of passes to bring down hang-ups can result in the accumulation of water in the pass, above the hang-up. This can create an extremely hazardous situation, and catastrophic accidents have resulted from what is called a mud-rush. The use of water in this fashion must be strictly controlled and only carried out under the direction of informed and experienced people with the approval of the registered mine manager.

When blasting is essential to bring down any pass, meticulous care must be taken after the hang-up is accurately identified to warn and protect all persons who may be working adjacent to the pass on any horizon to which it connects, and at the extraction point if the charge is to be fired from any horizon above it. The size of such charges should be strictly limited, as determined by the underground manager or his or her delegate.



Where finger rises are used to provide tipping points from a number of levels or sublevels to a common ore pass, the finger rise itself should not be filled. That is, if the main pass is filled above the finger rise junction, then tipping into the finger rise should cease. This provision is only effective if a dependable, accurate means of establishing the level of material in the ore pass is available.

Experience has shown that filling of finger passes is a major cause of hang-ups, and hazards have been created in bringing them down.

When a grizzly is installed on a pass, provision of a safety belt, preferably the inertia reel type (e.g. Sala block), is essential to ensure the safety of any person who works on the grizzly. This equipment must be properly installed, inspected and maintained, and inertia reels checked regularly by a competent person.



Bulkhead and signage isolating a disused ore pass

Where ore passes have a number of fingers, those not in use should be scaled down, blown off and a bulkhead constructed, and this action recorded. Signs should be attached to the bulkhead indicating the nature of the excavation that has thus been secured.

When ore passes (or any vertical opening) are to be closed off, whether on a temporary or a permanent basis, details of the status of the pass or opening must be recorded on mine plans and written records.

6.3 Working in or near passes

No-one should move onto or stand on broken rock in any ore pass, nor attempt to do any work in such a position until appropriate safety precautions have been taken.

A check should be made to determine whether there is any possibility of a hang-up in the pass, which could result in a void in the pass below the working horizon that could suddenly collapse.

Material falling through an ore pass can entrain air as it travels by any openings into the pass. There are many recorded instances of people being drawn into the excavation through such openings. Where the potential for this hazard to arise has been identified, suitable barricades (e.g. air-grating, heavy gauge mesh) should be installed securely and appropriate warning signs provided.

If work is required within a pass, a safe means of entry from the top must be provided, and the whole of the pass made safe down to the working area. Suitable overhead protection must be provided, signs posted, and effective communication provided to a responsible person, who will remain at the top of the pass for the duration of the work.

7 Procedure for open stopes

No-one should ever throw material into open stopes, except where waste rock, scrap metal or steel pipe is being disposed of in a completed stope prior to filling. Such work must be supervised and only carried out after a clearance procedure has been followed. No organic or

combustible material should be disposed of in a stope, except in a stope that is to be tight filled with hydraulically placed sand or tailings. Where the disposal of such materials in this way is contemplated, a risk assessment should be carried out to address any possible adverse outcome from this activity.

Any person who is to work closer than 10 m from the edge of a stope (other than the miner or ring blasting crew who normally operate in the stope and the extraction horizon crew) should only do so according to an established vertical opening procedure.

Precautions must be taken to protect ring blasting crews charging rings in open stopes. When the brow has been overpulled at stope drawpoints, the brow should be closed by bringing down the rill, or other measures taken to provide protection. If there is any opening at the brow during charging, all stope accesses above should be barricaded to prevent inadvertent entry and “Danger — Men Working Below” signs must be installed.

Similar precautions are required for any rock bolting or service crew working in a drawpoint. Such work should normally be done when the brow is choked, except where it must be done immediately for the security of persons required to work in the area.

No mucking unit should be allowed to tip or push any material into an open stope without the permission of the underground manager, and then only as part of a prearranged, approved operation.

Appropriate barricades must be erected at any place where ore can rill accidentally into a stope.

8 Procedure for ladderways

It is essential that all ladderways are constructed and maintained to a safe standard (Appendix C).

The top of any permanently established ladderway between levels or part of an escape route must be properly constructed and decked to prevent any material being inadvertently dropped or dislodged into the raise below.



KEY POINTS — OPEN STOPES

- No material should be thrown into open stopes, except where waste rock, scrap metal or steel pipe is being disposed of under supervision prior to filling.
- Precautions must be taken to protect ring blasting crews charging rings in open stopes.
- Precautions must be taken for any rock bolting or service crew working in the drawpoint.
- No mucking unit should tip or push ore into an open stope without permission.

KEY POINTS — LADDERWAYS

- All ladderways are to be constructed and maintained to a safe standard.
- Adequate clearance must be provided for persons using the ladderway.
- No material must be dropped down any ladderway or raised or lowered in the ladderway while any person is using it.
- Both hands must be free when climbing or descending ladders.
- Every access area on a ladderway must have a safe means of entering and exiting.

There must be adequate clearance from pipes, cables or other services for people using ladderways.

Appropriate measures must be taken to ensure that no material can be dropped down any ladderway.

No material should be raised or lowered in the ladderway while any person is using it.

Both hands must be free when climbing or descending on ladders. Any load slung on the back and shoulders must be secured safely, and not be of such bulk or weight as to present a risk of falling. Heavy or bulky loads must be hoisted. Where a ladderway is equipped with a slide for landing materials with a winch or by a hand rope, no person may travel in the ladderway during the haulage of material.

Every ladderway must afford a safe means of entering and exiting at any sublevel to which it gives access, as well as the top and bottom entry. Access ladderways to stopes must also have protection or a covering, readily removable for the transfer of equipment, to prevent people working in the stope falling into the ladderway.

Ladderways must be constructed and maintained to a safe standard



9 Procedure for changing raisebore drillheads or cutters

When a raisebore drillhead is lowered to the bottom of the raise to change the cutters or remove the head, the crew should be adequately protected against the possibility of rockfall. This protection may consist of a canopy secured to the drillstring or a shaft-closing bladder designed to fit around the drillstring.

No water should be allowed to drain into the raise from the drill chamber during such activity.

The New South Wales Department of Primary Industries has published a comprehensive treatment of raisebore safety (NSW DPI, 2003).

10 Further information

DEPARTMENT OF INDUSTRY AND RESOURCES, 2000, Open pit mining through underground workings — guideline: Safety, Health and Environment Division, Department of Industry and Resources, Western Australia, 16 pp. Available at ww.docep.wa.gov.au/ResourcesSafety

NSW DEPARTMENT OF PRIMARY INDUSTRIES, 2003, Guideline for raiseboring operations: Mineral Resources, NSW Department of Primary Industries, Mining Design Guideline MDG 1030, 12 pp.



KEY POINTS — CHANGING RAISEBORE DRILLHEADS OR CUTTERS

- Crews must be protected against rock fall when a raisebore drillhead is being lowered.
- Water must be stopped from draining into the raise when cutters are being changed or drillheads removed.

Appendix A — Legislative requirements for vertical opening safety practice

Mines Safety and Inspection Regulations 1995

Fall arrest equipment

- 4.5. (1) The manager of, and each employer at, a mine must ensure that —
- (a) fall arrest equipment is provided to employees at a workplace if the risk of injury to employees from falling cannot be eliminated from the workplace or the system of work at the workplace; and
 - (b) the equipment referred to in paragraph (a) is —
 - (i) appropriately designed for the task for which it is to be used;
 - (ii) used in such a way as to reduce, so far as is practicable, the possibility of injury to the user; and
 - (iii) properly maintained.

Penalty: See regulation 17.1.

- (2) If any fall arrest equipment is used to arrest a fall, the manager and each employer must ensure that the equipment is checked by a competent person and is serviced or discarded in accordance with the manufacturer's specifications.

Penalty: See regulation 17.1.

Shaft entrances to be fenced

- 10.17. (1) The manager of an underground mine must ensure that the top and each level entrance to a shaft in the mine is kept securely fenced or protected by a gate.

Penalty: See regulation 17.1.

- (2) Subregulation (1) does not prevent the temporary removal of a fence or gate for the purposes of repairs or other operations if other proper

precautions are taken to protect the entrance to the shaft.

Winze sinking operations

- 10.20. (1) The manager of an underground mine must ensure that, so far as is practicable, each winze sunk at the mine is clear of a travelling way.

Penalty: See regulation 17.1.

- (2) The manager of an underground mine must ensure that the brace of each winze at the mine is constructed in a way that will prevent loose rock or material from accidentally falling down the winze.

Penalty: See regulation 17.1.

- (3) The manager of an underground mine must ensure that a signalling system is installed in a winze if depth, ambient noise or other factors in the winze make verbal communication difficult or ineffective.

Penalty: See regulation 17.1.

- (4) The manager of an underground mine must ensure that if hoisting appliances are utilized in a winze at the mine, a knocker line or other contrivance approved by the district inspector is provided in the winze to enable signals to be communicated to the driver from each part of the winze.

Penalty: See regulation 17.1.

- (5) The manager of an underground mine must ensure that a secure ladderway fastened to bearers at intervals of not greater than 5 metres is installed in a winze in the course of construction to ensure a safe means of exit from the bottom of the winze.

Penalty: See regulation 17.1.

- (6) Notwithstanding subregulation (5) a chain ladder or temporary steel ladder may be used to provide access to the bottom of a winze in advance of the installed ladderway but only for a distance not greater than 2 bearer intervals.



(7) A person must not raise or lower any tool in a winze or other confined place in which persons are working in an underground mine, except in a bucket or other approved receptacle, and any projecting tool must be secured so as to prevent it falling out of the bucket or receptacle.

Penalty: See regulation 17.1.

(8) The manager of an underground mine must ensure that, at the beginning of each shift and after each blast, the walls of a winze in the mine are inspected for loose rock and scaled if necessary.

Penalty: See regulation 17.1.

Travelling ways in shafts

10.22. The manager of an underground mine must ensure that if one compartment of a shaft at the mine is used for the ascent and descent of persons by ladders and another compartment of the same shaft is used for raising persons, materials or counterweights, the ladderway compartment is close timbered or otherwise securely sealed from the other compartment.

Penalty: See regulation 17.1.

Travelling ways to be made safe

10.23. If the natural rock walls of a winze or shaft used for travelling at an underground mine are not safe, the manager of the mine must ensure that the walls are securely timbered, lined, or otherwise made safe.

Penalty: See regulation 17.1.

Vertical opening safety procedures

10.35. (1) At any underground mine where operations at 2 or more horizons are interlinked by vertical or sub-vertical openings, the manager of the mine must ensure that systems of work and precautions are devised and implemented which will minimize any risk of injury or harm to health if persons are

required to work on those horizons at locations near the vertical or sub-vertical openings.

Penalty: See regulation 17.1.

- (2) In this regulation “vertical or sub-vertical openings” includes —
- (a) stopes and access rises;
 - (b) fill, ore and waste passes;
 - (c) ventilation rises; and
 - (d) shafts and escape ways.

Note: The only authorised versions of the Act and regulations are those available from the State Law Publisher (www.slp.wa.gov.au), the official publisher of Western Australian legislation and statutory information.



Appendix B — Legislative requirements for ore passes

Mines Safety and Inspection Regulations 1995

Chute and pass safety precautions

10.31. (1) The manager of an underground mine must ensure that a standard written procedure that complies with subregulation (2) is followed when clearing any chute, pass, millhole or stope drawpoint at the mine that is blocked or hung up.

Penalty: See regulation 17.1.

(2) The procedure must include —
a supervisor being responsible for control of action taken to remove the obstruction and ensuring that a person does not enter the pass beneath the hang up;
a person not being exposed to any risk of the hang up releasing until the chute, pass, millhole or stope drawpoint has been checked from above the hang up for the presence of accumulated water or slurry;
a person not being present in or around a stope or any location where the release of the hung up chute, pass, millhole or stope drawpoint will constitute a hazard; and

if blasting is to take place, all adjacent workplaces and travelways (including other levels or sublevels) where persons may be affected by the blasting, or the sudden movement of air or rock, being effectively closed and guards being posted to prevent access to those areas.

(3) If a person uses standard procedures to clear any chute, pass, millhole or stope drawpoint at an underground mine that is blocked or hung up and those methods fail to remove or clear the obstruction, the person must notify the underground manager.

Penalty: See regulation 17.1.

(4) If the underground manager of a mine receives notification under subregulation (3), the underground manager must —
(a) determine what further action is to be taken; and
(b) ensure that the further action is then taken.

Penalty: See regulation 17.1.

Appendix C — Legislative requirements for ladderways

Mines Safety and Inspection Regulations 1995

Ladderways and footways

10.25. (1) The manager of an underground mine must ensure that in each underground workplace in the mine a proper ladderway or footway or other means of travel is provided that enables safe entry and exit.

Penalty: See regulation 17.1.

(2) The manager of an underground mine must ensure that if any rise or winze is driven at the mine and the rise or winze is to be used as an accessway or travelway to a workplace or to another horizon in the workings, a ladderway that is properly constructed and safe is installed in the rise or winze.

Penalty: See regulation 17.1.

(3) The manager of an underground mine must ensure that if a ladderway at the mine may be used as a means of providing access for mine rescue, the opening of the ladderway is wide enough to be used for that purpose.

Penalty: See regulation 17.1.

Ladderway in shafts

10.26. The manager of an underground mine must ensure that each ladder in the mine that is constructed and fixed in a shaft for the ascent and descent of persons working in the mine —

- is inclined at the most convenient angle which the space allows;
- has substantial platforms at intervals of not more than 10 metres and spaces for foothold of not less than 150 millimetres from the wall;
- projects at least 600 millimetres above the platform or, if that is not practicable, has hand grips provided at the top of each ladder; and
- is maintained in a safe condition.

Penalty: See regulation 17.1.







Resources Safety
Locked Bag 14
CLOISTERS SQUARE WA 6850

General queries

Telephone: +61 8 9358 8002
NRS: 13 36 77
Facsimile: +61 8 9358 8188
Email: ResourcesSafety@docep.wa.gov.au
Website: www.docep.wa.gov.au/ResourcesSafety

For publication orders

Telephone: +61 8 9358 8154
Email: RSDComms@docep.wa.gov.au



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