RWANDA STANDARD

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Mining and quarrying —

Part 2: Health and safety requirements

ICS 73.020; 13.100

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In order to match with technological development and to keep continuous progress in industries, standards are subject to periodic review. Users shall ascertain that they are in possession of the latest edition

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 117-2 was prepared by Technical Committee RSB/TC 57, *Mining and related activities*.

In the preparation of this standard, reference was made to the following standard:

MINING SAFETY STANDARDS of March 2016 (Revised in December 2020). Rwanda Mines, Petroleum and Gas Board (RMB)

The assistance derived from the above source is hereby acknowledged with thanks.

RS 117 consists of the following parts, under the general title *Mining and quarrying*:

— *Part 1: Code of practice*

— *Part 2: Health and safety requirements*

Committee membership

The following organizations were represented on the Technical Committee on *Mining and related activities* (RSB/TC 57) in the preparation of this standard.

CIMERWA Plc

D&D Resources Ltd

Integrated Polytechnic Regional College (IPRC) - Karongi

Inter-African Mining Corporation (IMC) Ltd

LuNa Smelter Ltd

New Bugarama Mining (NBM) Ltd

Ngali Mining Ltd

Piran Rwanda Ltd

Rutongo Mines Ltd

Rwanda Environment Management Authority (REMA)

Rwanda Extractive Industry Workers Union (REWU)

Rwanda Housing Authority (RHA)

Rwanda Mines, Petroleum and Gas Board (RMB)

Rwanda Quarries Association (RQA)

Standards for Sustainability (SfS)

Trinity Metals

University of Rwanda - School of Mining and Geology (UR - SMG)

Wolfram Mining and Processing (WMP) Ltd

Rwanda Standards Board (RSB) – Secretariat

Introduction

Mining and quarrying sector implies health and safety management to prevent harm to workers at the site. This responsibility imposes duties and promotes excellent health and safety management by employers. The environmental issues, safety and human rights should be the major concern of employers during the whole process of mining and quarrying production.

The present standards on health and safety requirements for mines and quarries is designed to support the national mining law and includes other subjects that are not dealt with in the current law on mine and quarry operations and that may have an influence on mineral traceability, transparency, good practice and on the environmental impact of mining and quarrying operations for mineral certification system by an independent certifier based on the levels of compliance with the requirements provided in this document.

The requirements in this document may be helpful to all operators of the mining industry in Rwanda. Those requirements in the standard do not carry a regulatory status and a commitment by companies i.e. implementing this Rwanda Standard does not remove obligations for such companies to comply with all applicable laws and regulations."

Mines and quarries — Part 2: Health and safety requirements

1 Scope

This Draft Rwanda Standard provides health and safety requirements and a framework for the management of hazards and risks associated with mining/quarrying activities, to enable mining companies to provide safe and healthy workplaces by preventing work-related injuries and ill-health for employees and neighbourhood as well as by proactively improving occupational health and safety (OH&S) performance.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16321-1, *Eye and face protection for occupational use — Part 1: General requirements*

ISO 19434, *Mining — Classification of mine accidents*

ISO 23872, *Mining structures — Underground structures*

ISO 3873, *Industrial safety helmets*

RS 109, *Water quality — Discharged industrial wastewater — Requirements*

RS 117-1, *Mining and quarrying — Part 1: Code of practice*

RS 236, *Acoustics — Noise pollution — Tolerance limits*

RS 237, *Vibration — Tolerance limits*

RS 354, *Occupational health and safety for non-food industry workers — Facility requirements*

RS 407-2, *Emission limits — Performance evaluation Part 2: Non-road mobile machinery*

RS 427, *Round and sawn timber — Nomenclature of timbers used in Rwanda*

RS EAS 325, *Wood preservatives and treated timber — Guide to sampling and preparation of wood preservatives and treated timber for analysis*

RS EAS 751, *Air quality — Specification*

RS ISO 20347, *Personal protective equipment — Occupational footwear*

RS ISO 3941, *Classification of fires*

RS ISO 45001, *Occupational health and safety management systems — Requirements with guidance for use*

RS ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

ISO maintain terminological databases for use in standardization at the following address: http://www.iso.org/obp

3.1

law

national law regulating specified operations in Rwanda

Note 1 to entry: Example of national law includes the law regulating mining and quarry operations in Rwanda, and law regulating labour Rwanda.

3.2

employer

company or cooperative that employs workers at the mining site

3.3

environmental impact study

document comprising of the environmental and social impact assessment carried out for the project and approved by the relevant environmental authority

3.4

mine operator

representative of the holder of the exploitation license

Note 1 to entry: An example of the mine operator could be the Director, Manager or Chief Executive Officer of the license holder

3.5

minerals industry

companies and co-operatives engaged in exploration and extraction of minerals including metallic minerals, industrial minerals, non-metallic minerals, sand aggregate and gravel and clay

3.6

hazard identification

process of recognizing that a hazard exists and defining its characteristics

3.7

hazard

source or a situation with a potential for harm in terms of human injury, ill-health, damage to property, damage to the environment, or a combination of these

3.8

harm

that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard

3.9

holder

individual or institution in whose name a mining right is registered

3.10

mine

any place, quarry, pit, shaft, drive, level or other excavation, and any drift, gutter, lead, vein, lode, reef, saltpan or working, in or on or by means of which any operation connected with mining is carried on, together with all buildings, premises, erections and appliances, whether above or below the ground, that are used in connection with any such operation or for the extraction, treatment or preparation of any mineral or for the purpose of dressing mineral ores

3.11

adit

horizontal or nearly horizontal tunnel driven from the surface for the working of a mine

3.12

mineral

substance of economic value obtained by mining

[SOURCE ISO 22932-2:2020, 3.13.4]

3.13

mining

extraction of material, whether solid, liquid or gaseous from land or from beneath the surface of the earth in order to win minerals and includes any operations directly or indirectly necessary or incidental thereto

3.14

mining area

area of land subject to a mineral licence granted under the law regulating the issuance of mineral licence or mining licence

3.15

mining operations

operations carried out in the course of mining

3.16

mining plant

any building, plant, machinery equipment, tools or other property that has been used for mining, whether or not affixed to land, but does not include any timber or other material used or applied in the construction or support of any shaft, drive, gallery, terrace, race, dam or other work

3.17

mineral licence

mining licence, quarry licence or an exploration licence, granted under the law

3.18

risk

combination of the likelihood and consequences of a specified hazardous event occurring

3.19

risk assessment

overall process of estimating the magnitude of risk and deciding whether or not the risk is tolerable or acceptable

3.20

abandoned place

any place where work has ceased and through which persons no longer travel

3.21

barricade

structure designed to prevent the entry of persons to an area

3.22

competent person

person having the knowledge, experience, skill, and qualifications to carry out a particular task of supervision, drilling, blasting, plumbing, mining, electrical, civil and mechanical technician in mining as deemed as adequate by the Competent Authority upon assessment

Note 1 to entry: The qualifications and experience for competent persons shall be set by the Competent Authority.

Competent Athority

public institution responsible for implementing national standards, laws and regulations related to mining and quarrying operations

Note 1 to entry: Competent Authority includes the authority in charge of mines and quarries, the authority in charge of environment management, the authority in charge of labour, investment or the local authority.

3.23

machinery

assembly of linked parts or components, at least one of which moves, with appropriate machine actuators, control and power circuits, joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material

[SOURCE ISO 14159:2002, 3.13]

3.24

incident

unplanned event which results in damage or production loss but does not result in harm

3.25

inspector

personnel appointed by the Competent Authority in charge of mining and quarrying operations in Rwanda

3.26

quarry

any working open to the surface beneath the original surface for the purpose of extracting building or industrial minerals

3.27

accident

any unplanned event which results in harm

3.28

near miss/potential incident

unplanned event, which under slightly different circumstances, could have resulted in an incident/accident

3.29

ladder way

part of any shaft, or raise where permanent ladders are installed for the use of persons travelling

Note 1 to entry: ladder includes a step ladder, a chain ladder, and extension ladder

3.30

employer

any physical or moral, public or private person that employs one or several workers, even in a discontinuous way

3.31

worker

any person who commits him/herself to put his/her professional activity in return for payment under the direction and authority of another physical or moral, public or private person

Note 1 to entry: worker includes employees, sub-contractors and artisanal miners

3.32

inspector of labour

person appointed as inspector of labour under the law governing labour in Rwanda

3.33

employers' professional organization

association of employers executing similar or related professions with the exclusive purpose of studying and defending their economic, and social interests

3.34

workplace

places where workers carry out their services, or where an employer carries out or directs two or several operations that are independent due to their size or mission. Each of these operations constitutes a separate workplace. A workplace may also be a place where one travels to or where the worker performs his/her functions while on mission

3.35

mining area

part of or whole mine where excavation operations are carried out or have been carried out previously

3.36

mineral processing area

part or whole mine designated for the processing of minerals

3.37

child

any human being below the legal age of work as defined in the Labour Law in Rwanda

3.48

professional organization

organization that aims at advancing a particular profession, support the interests of people working in that profession and serve the public good

Note 1 to entry: Professional organization can also be referred to as a professional association or professional body

3.38

owner

person holding a valid mining or quarry licence

Note 1 to entry: The owner can be an individual or an organization

3.39

manager

person directly appointed by the owner

Note 1 to entry: The owner can be the manager.

3.40

employee

4 person having agreed to work for an employer under a contract concluded between them, and in return for remunerationManagement of mines and quarries

4.1 General

The owner of mines and quarries shall ensure proper management of activities at sites in accordance with Clauses 4.2 and 4.3 of this standard.

4.2 Management in mines and quarries

4.2.1 Competent authority

4.2.1.1 The competent authority shall ensure that mining works are carried out in way that does not contravene provisions of the laws on employees' health and safety and the environment.

4.2.1.2 Persons authorized by the competent authority have rights to enter premises of operations for the purpose of monitoring the operations.

NOTE Persons authorized by the competent authority may include mines inspectors, labour inspectors, and other persons authorized by the competent authority such as the organizations in charge of mines and quarries, environment or labour in Rwanda.

4.2.2 Mine/quarry owner

4.2.2.1 The owner of a mine or quarry shall have permit issued by the competent authority in order to begin mining/quarrying activities.

4.2.2.2 The owner shall appoint a competent manager responsible for the management, control and direction of mines/quarries in accordance with the provisions of mining regulations.

4.2.2.3 When the owner has the required competence, he/she can be responsible for the management, control and direction of mines/quarries activities.

4.2.2.4 The competent authority in charge of mines and quarries shall define minimum competence of managers.

4.2.2.5 Mining/quarrying or allied operations shall commence only if a manager has been appointed and is available at the mine/quarry.

4.2.2.6 The appointment of a manager shall be documented and communicated immediately to the competent authority in charge of mines and quarries.

NOTE Documented appointment requires the appointment letter and job contract between the owner and the appointed manager.

4.2.2.7 The owner shall ensure that there is a full-time, competent and responsible person(s) in charge of mining operations, environment, geology, and health and safety of employees. The competent authority may require the appointment of additional persons as deemed necessary.

4.2.2.8 The owner may appoint assistant managers when deemed necessary to assist the principal manager. The requirements for the appointment of assistant managers shall be in accordance with paragraph 2 of 5.2.2 of this Standard.

4.2.2.9 The owner shall ensure that each and every employee has documented appointment letter and job contract clearly defining his/her responsibilities.

4.2.2.10 The owner shall provide required resources in order to comply with the requirements of this Standard and statutory and regulatory requirements.

NOTE 1 Statutory and regulatory requirements mean laws, ministerial orders, regulations, guidelines and other regulatory documents issued by the competent authority.

NOTE 2 Resources means financial, human and material resources

4.3 Responsibilities of managers

4.3.1 The responsibilities of managers shall be clearly documented in the appointment letter and/or job contract.

4.3.2 Whenever a Manager is absent from a mine, he/she shall appoint, in writing, a competent person to act as Manager during his/her absence. This shall be documented in accordance with Annex K and shall be communicated immediately to the competent authority.

4.3.3 The acting manager shall, during the period of acting, be liable for undertaking all the responsibilities of the Manager.

4.3.4 The manager shall:

a) enforce the requirements of this Standard, applicable statutory and regulatory requirements and other national standards related to mining and quarries. He/she shall ensure that they are observed by every person at the mine;

NOTE Example of other national standards related to mining and quarries include RS 117-1, RS 354, RS EAS 751, RS ISO 14001 and RS ISO 45001.

b) appoint competent persons as may be necessary to assist him to comply with and enforce observance of the requirements of Clause 4.3.4 (a) of this Standard. ;

c) take all necessary measures to provide for the safety and proper discipline of persons employed at the mine;

d) as soon as it is practicable after the occurrence of a breach of any requirements of this Standard:

(i) report such breach to the competent authority in charge of mines and quarries; and

(ii) take such other disciplinary steps as that the competent authority requires and, in any event cause particulars of such breach and of any disciplinary steps taken to be entered in a register kept for the purpose, which shall be open for inspection at all reasonable times by the Inspector;

(a) ensure that the times of the working shifts and of blasting operations in every section of the mine are so arranged that mine workers shall not be exposed to fumes and dust from blasting;

(b) ensure that there are required infrastructure waiting places as may be necessary for the use by mine workers prior to entering their working places and that they are at all times clearly marked.

(c)

(d) At all times, ensure that the “miner in charge” or blasting certificate holder who is responsible for the safety of these working places is the first person to enter such working places and all related approaches. However, this shall not be construed to mean that:

(i) the miner in charge or blasting certificate holder may not be accompanied into a working place by such assistants as are necessary to assist in making such working place safe; or

(ii) an official who is the holder of a blasting certificate may not in the execution of his duties enter a working place before the miner in charge or blasting certificate holder.

(e) ensure that there is in force a system to enable determination of the number of persons in the underground workings at any time and that any person who knowingly fails to conform to the system is guilty of an offence;

(f) not allow any miner or competent person to be placed in charge of a group(s) of workmen if, taking into account the nature or position of the working places, such miner or competent person is unable to efficiently supervise the workmen during his working shift in accordance with the requirements of the mining regulations;

(g) not allow any miner to be in charge of many working places, equipment or persons than necessary and that may compromise health and safety of mine workers;

(i) wherever necessary, provide and maintain in working order, both underground and on surface, adequate and standard fire-fighting equipment as directed in writing by the competent authority, which equipment shall be conveniently located and conspicuously marked;

(h) ensure that each staff is trained as necessary before commencing work. The training and training plan shall be documented and kept at the mine;

(i) on taking over a mine, acquaint himself with such notices as may have been issued to his predecessor(s) by the competent authority. The manager shall document any notices to the mine issued by a competent authority;

(j) develop a system that ensures that when any person employed in the mine receives an injury by accident or otherwise, the same shall be reported to him without delay; and

(k) ensure that all activities are documented and all copies are available at mine sites;

4.3.5 The manager shall ensure that all plant, material and other things in the mine that are necessary for ensuring compliance with the mining health and safety regulations are provided and maintained in good order and repair.

NOTE The required documented information include mining/quarrying license, environmental impact assessment (EIA), production document, insurance document, mining/exploration reports, mining plans, environmental and social management plans, emergency preparedness and response plans, rehabilitation/reclamation plans, and book of accounts such as payment records.

4.3.1 Responsibility of the mining engineer

The mining engineer shall mainly:

- ascertain extraction risks;
- produce models or plans for mining sites;
- monitor and evaluate mining operations;
- ensure that operations comply with health and safety requirements of this Standard; and
- ensure that the equipment used are safe

4.3.2 Responsibilities of employee

Each and every employee shall:

a. take responsibility for ensuring own and workmates health and safety while at work;
b. comply with lawful instructions given by the competent authority, and his/her employer or manager;
c. take necessary steps to report hazards that employees are unable to control individually;
d. refuse to undertake work under any unsafe practices;
e. wear properly personal protective equipment (PPE) while at mine site and shall ensure their proper management;
f. co-operate with the competent authority through providing information as requested;
g. produce any account, survey, licence, statement, report or document required by the competent authority; and
h. not knowingly provide or cause any other person to provide false information to the competent authority.

5 Hazard and risk management

The owner shall establish an occupational health and safety management system based on RS ISO 45001. Hazards and risks management shall be performed in accordance with Clause 9 of RS 1171-1. Annex H provides template with guidance on how to conduct hazard and risk management.

6 Making the working area safe

6.1 Working place examination for potential falls of ground checklist

6.1.1 The Manager shall appoint a responsible person who shall identify all loose ground (rocks and soil), geological disturbances and take remedial action to ensure that no ground falls are left uncontrolled.

6.1.2 The checklist using the following general conditions shall be carried out before the commencement of work:

a) has an early examination of the area been carried out?

b) are all the personnel in the area able to recognize poor ground conditions?

c) is ground condition good?

d) is ground condition fair?

e) is ground condition poor?

6.2 Tools and equipment checklist

6.2.1 A checklist on the tools and equipment for making the working area safe shall be carried out on a daily basis. The following shall be checked:

a) do personnel have appropriate PPE?

b) are required tools and equipment available?

NOTE Tools and equipment may include, among others, the following:

a) first aid kits;

b) mine signs;

c) dust monitors;

d) ventilators;

e) breathing apparatus;

f) air compressors;

g) fire extinguishers;

h) hazard detection devices (e.g.: proximity warning systems and gas detection units); and

i) pinch bars of correct lengths which have guards fitted.

6.2.2 The manager shall ensure that the tools and equipment are in good condition and are calibrated/verified by a competent authority.

6.3 Condition of mining site

A checklist on the prevailing environment of the mine site shall be conducted in the area to ensure suitable condition for employees to see and/or hear signs of failing ground. The checklist shall also include:

a) noise levels;

b) ventilation of site;

c) levels of dust;

d) adequate water supply;

e) availability of power supply; and

f) visibility.

NOTE During conditions of poor visibility due to fog, employees shall wear high-visibility vests.

7.4 General poor ground control measures:

7.4.1 The general control measures for poor ground upon entry to the mine shall be on the start with barring down loose rocks.

7.4.2 The person barring down the loose rocks shall apply the rules of barring down i.e. starting from the worse affected areas to the good areas.

7.4.3 If barring down blasting is not fully done, installing temporary support or barricading off the area shall be carried out following the correct procedures and standard practices.

7.4.4 Permanent support (if any) is recommended for the area:

a) if the temporary support that is installed requires replacement;

b) if the support is not in compliance with Clause 9; and

c) if existing support is damaged.

7.4.5 Scaling by using high pressure water or a crowbar shall be done at a safe distance such that the falling loose rocks cannot cause injury to the scaling person.

NOTE Scaling after blasting usually starts by spraying high pressure water on the rock face to remove smaller loose rocks and then, followed by manual removal of large boulders.

7 Underground mine excavations

7.1 General

In addition to the requirements of ISO 23872, the requirements specified below shall also apply.

7.2 Access to underground mine working areas

7.2.1 The standard mining operations cycle of drilling, charging, blasting, lashing and transportation shall be linked and carried out in a safe manner at all times.

7.2.2 Where no blasting is required, the mining cycle of breaking through digging (mechanical or manual), lashing and transportation and activities shall be carried out in a safe manner.

7.2.3 Mine workings shall be accessed through vertical/inclined shafts and/or horizontal/inclined adit drifts that meet the requirements in terms of size and secure entrance, walls and roof.

7.2.3 The access points shall be used for transportation of people and materials and shall at all times be maintained in safe conditions at all times. In this case, a log book detailing examinations carried out, condition of the access and remedies carried out shall be maintained at site. Annex I gives a typical example of working logbook.

7.3 Second means of access and egress

7.3.1 At every mine, a second means of egress, independent and separate from the primary access, shall be planned and put in place as soon as practicable.

7.3.2 The second access shall serve dual purpose of ventilation and exit route in case of emergency evacuation.

7.3.3 The access shall be developed in such a way that it is usable for safe evacuations as well as intake/outlet of air.

7.3.4 The second access shall be kept in a condition in which it is safe to use and is free of obstruction on the walkways.

7.3.5 Regular and period examinations shall be carried out for the second means of access.

7.3.6 A log book, in accordance with Annex I, detailing examinations carried out, condition of the access and remedies carried out shall be maintained at site.

7.4 Access to working areas through shafts

7.4.1 General

7.4.1.1 The shaft shall be developed in such a manner that it serves as one of the main fresh air in-takes into the mine as well as lowering of personnel and hoisting of ore/waste through the shaft.

7.4.2 A clear partition separating the hoisting and manway shall be provided and made safe.

7.4.3 The manway/travelway shall be provided with ladders and platforms between levels that are properly constructed and decked to prevent any potential of any material being unknowingly dropped or dislodged below.

7.4.4 Every manway/travel way shall have an access area with safe means of entering and exiting and with adequate clearance from pipes, cables or other services for people using it.

7.4.5 Stability of the travel ways roofs and side walls shall be inspected regularly to ensure any loose rocks are scaled down or supported accordingly.

7.4.6 Ore from the mine loading areas shall be hoisted and tipped at the surface stockpiles.

7.4.7 Mine Manager/Technician shall put in force a code of safe practice covering all work in underground and appoint a supervisor, as a responsible person to undertake the responsibility for the safe operations and maintenance of the shafts.

7.4.8 Where manual labour in lifting of waste/ore is involved, health consideration shall be taken into effect on following:

a) the weight of the materials;

b) distance covered; and

c) fatigue management process.

7.4.9 The hoisting mechanism through the shaft shall be installed in such a way that it has a built-in braking mechanism.

7.4.10 As a requirement, examinations shall be carried out at different frequencies for the shaft and the different winding equipment as per mine procedure.

7.4.11 A log book on the examinations of the shaft shall be maintained at the site at all times.

7.4.2 Mine shaft

7.4.2.1 Minimum of cross-section 2 m x 2 m of the main vertical shaft shall be followed.

7.4.2.2 The following guidelines shall be followed to construct a main vertical shaft

a) Vertical shafts are dug to allow people to enter and exit mines, to take out ore, and for ventilation.

b) They shall be straight at a 90-degree angle and be free from obstacles along the walls that could impede the lowering and lifting of miners and ore.

c) The load shall be lifted precisely in the middle of the shaft

7.4.2.1 Supporting a main vertical shaft

7.4.2.1.1 Mining shafts shall be supported both inside and outside in order to prevent collapses and landslides. The softer, looser rock areas of the shaft need to be supported by timber frames with joined notches. Other materials such as stones, concrete, wood, and sandbags can also be used as shaft supports.

7.4.2.1.2 The rock layer beneath the soil is comprised of different kinds of rocks, which are classified as either stable or unstable. The topsoil on the surface is generally unstable and loose, therefore it is necessary to ensure there is proper support for shaft entrances.

7.4.2.2 Guidelines on how to support a main vertical shaft using timber

The softer, looser rock areas of the shaft shall be supported with timber frames with joined notches. This prevents the surrounding rock from heaving, preserve the dimensions of the cross-section, and absorb rock pressure. In areas where there is a higher risk of collapse, the timber supports shall be more tightly positioned. When the shaft reaches the hard and stable rock, the distance between the support frames can be increased accordingly.

7.4.2.3 Supporting shaft collar

The following steps shall be following while supporting shaft collars:

a) A Shaft wall support shall continue 20 cm above the surface,
b) The shaft collar shall be framed with thick planks of wood/timber to prevent collapse and the flow of rainwater,
c) Trenches shall be dug around the entrance to the shaft to channel the flow of rainwater,
d) The position of windlass legs should be marked when making the shaft collar support,
e) The area around the shaft should be regularly cleaned,
f) Locks can be used to tighten the timber in unstable rock areas.
g) The timber used for locking shall be positioned at the boundary between stable and unstable rock areas, in order to make locks, holes called cups are made in the walls of the shaft. The timber is then positioned across the shaft with the ends placed in the cups. The cups are then filled with stones and sand for stability. Wooden support frames are placed on top of the locks in unstable rock areas.

Figure 1 illustres illustrates a typical example of a shaft collar.

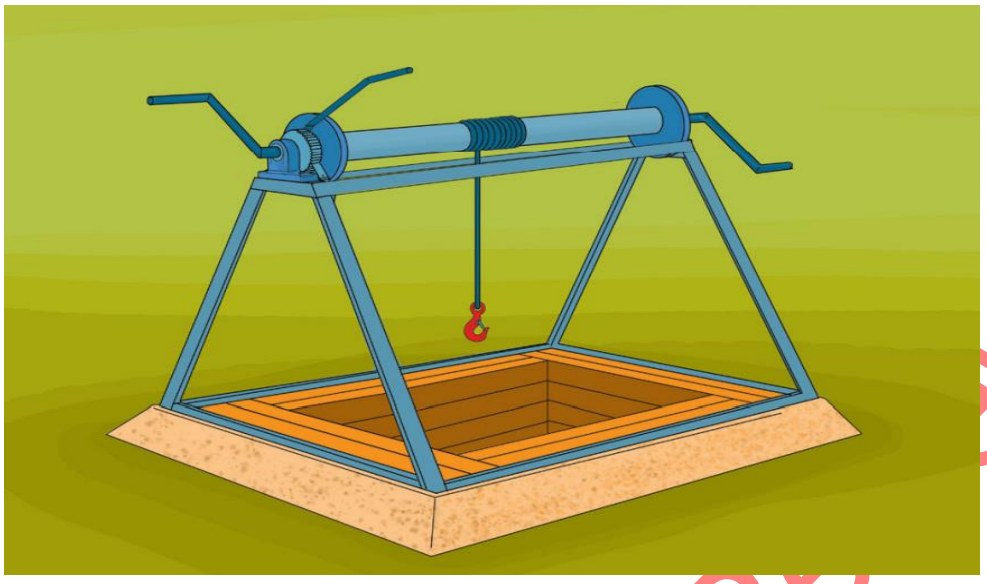


Figure 1 — Typical example of a shaft collar

7.4.3 Ladderway in the mine

7.4.3.1 The manager of an underground mine shall 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.

7.4.3.1 There shall be provided a sufficient number of ladder ways and traveling ways permanently maintained and kept free from obstruction to enable every person to leave every part of a mine.

7.4.3.1 Any shaft or raise at an inclination of more than fifteen degrees above the horizontal or any winze at an inclination of more than 15º fifteen degrees below the horizontal, through which persons travel, or at any shaft, winze, or raise having mechanical haulage and through which persons travel, shall have a separate ladderway compartment.

7.4.3.1 There shall be adequate clearance from pipes, cables, or other services for people using ladderways. Appropriate measures shall 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 shall be free when climbing or descending on ladders. Any load slung on the back and shoulders shall be secured safely, and not be of such bulk or weight as to present a risk of falling, 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.

7.4.3.1 Every ladderway shall 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 shall also have protection or a covering, readily removable for the transfer of equipment, to prevent people working in the stope from falling into the ladderway.

7.4.3.1 Dry, slip-free, surfaces are important when using a ladder. Therefore, ensure that your hands and shoes are dry as well as the ladder rungs. Do not use sandals, flip-flops, or similar loose-fitting footwear. Do not paint a ladder as this can possibly result in it becoming more slippery.

7.4.3.1 The manager of an underground mine shall 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.

7.4.3.1 **T**he following pre-use checks shall be performed:

a) The stiles – make sure they are not bent or damaged, as the ladder could buckle or collapse;
b) The feet – if they are missing, worn, or damaged the ladder could slip. ...
c) The rungs – if they are bent, worn, missing, or loose, the ladder could fail;
d) The locking mechanism – does the mechanism work properly?
e) Always check the extension locks to make sure they are properly seated.

7.4.4 Ladderway in shaft

The mine manager shall 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 and the following shall ensure that:

(a) If is not projected vertically, the distance between the wall and the base of your ladder should be one-quarter of the ladder's height (putting the ladder at a 75° angle),
(b) When the ladder is projected vertically, shall provide a minimum of 150mm of the clear distance between the ladder rungs (centrelines) and the walls, this 150mm minimum stand-off clearance protects the person climbing the ladder from likely trip hazards that would exist with less free space between the ladder and walls,
(c) Ladder rungs, steps, and cleats shall have a minimum clear width of 40 cm,
(d) the ladder shall have substantial platforms at intervals of not more than 4 meters for wooden ladders and 10m for fiberglass or metal (aluminum) ladders,
(e) Extended ladder at 1m high above the access level or landing platform at the top of the ladder,
(f) Ladder in shaft projects at least 600 millimeters above the platform or, if that is not practicable, has hand grips provided at the top of each ladder

8.4 Access to working areas through adits

8.4.1 The adit shall serve as one of the main fresh air intakes into the mine and for accessing the underground working by personnel as well as transportation of ore/waste.

8.4.2 Tunnels shall be excavated in such a way that the incline angle is not more 45 degrees for safety of employees during access to development ends as well as when transporting ore and waste from the ends. Where a tunnel incline angle exceeds 45 degrees, the tunnel shall be fitted with steps with ladders on foot or walkways.

8.4.3 Where stairs are excavated on the ground, side handrails shall be provided to provide support to a person ascending or descending the travel way.

8.4.4 Stability of the travelway roofs and side walls shall be inspected regularly to ensure any loose rocks are scaled down or supported accordingly.

8.4.5 Wherever practical, the tunnel shall be excavated at a positive gradient of +0.5 degrees to allow water draining.

8.4.6 The Mine Manager/Technician shall put in force a code of safe practice covering all work in adits and a supervisor to undertake the responsibility for the safe operations and maintenance of the shafts.

8.4.7 Where manual labour is involved, health consideration shall be taken into effect on the weight of the materials, distance covered and fatigue management process.

8.4.8 As a requirement, examinations shall be carried out at different frequencies for the condition of the adit and transportation ways as per mine procedure.

8.4.9 A log book detailing examinations carried out, condition of the access and remedies carried out shall maintained at site.

8.5 Types of ladders used in underground mines

8.5.1 There are three types of ladders that are commonly used in underground mining:

d) ladder with wooden rungs that is commonly used in shafts and raises;

e) ladder with iron pipe rungs that is commonly used in shafts; and

ladder made of iron chain commonly used during sinking vertical shafts and raises and that is usually 5 m – 6 m long and is hung from the last set of shaft/raise timbers and extends to the bottom of the shaft/raise. **8.5.1.1** Sometimes in prospecting shafts, a rope ladder may be used, but the iron chain ladder, while heavier than the rope ladder, shall last longer and is safer, as it is not easily damaged by blasting.

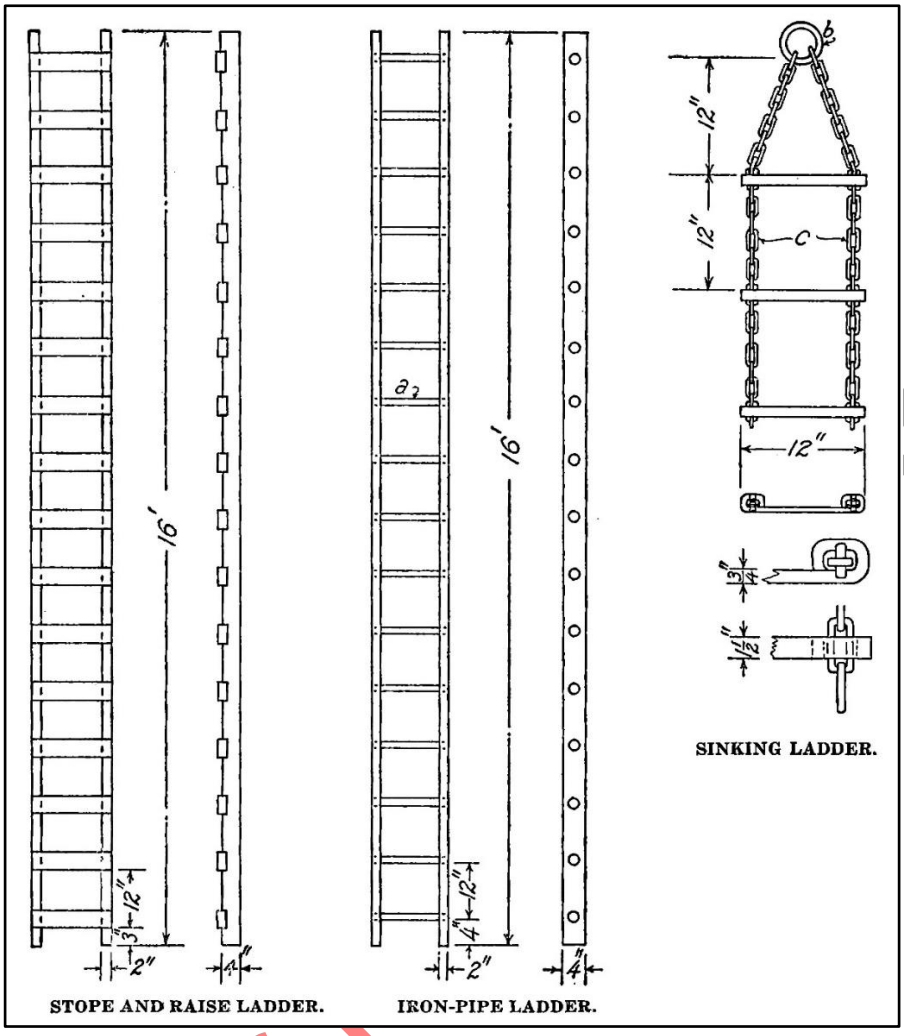


Figure 2 — Type of Ladders used in underground mining

7.5 Size of mine development ends (tunnels)

7.5.1 Each mining site shall have a standard established on the number of personnel to carry out the work underground depending on the size of the heading or end and amount of air.

7.5.2 The mine shall clearly define the minimum size of the main tunnels depending on the method of mining and equipment and shall not be less than 1.50 x 1.80 meters in the main drive.

7.5.3 The mine shall define the size of the other development drifts depending on number of men, ventilation and mining technology to be employed.

7.5.4 The main development drive or tunnel shall have sufficient cross-sectional area throughout to allow the free and unrestricted passage of persons on foot.

7.6 Ventilation for development ends

7.6.1 The shall be established crew of pipe laying personnel who shall work under a competent person for safe laying and maintenance of ventilation pipes.

7.6.2 As the development ends are worked, the pipe laying crew shall ensure that pipes are extended and ready for the drilling crew in advance in order to:

a) ventilate;

b) extend compressed air to the drill face; and

c) extend water lines, to the drill face.

7.6.3 The fans shall be used to ventilate the development drives drill faces.

7.6.4 The recommended sizes of fans and ventilation pipes/tents shall depend on the size of openings of headings.

7.6.5 Typical ventilation quantities in small mine head with fan sizes is given in Table 1.

Table 1 — Fan size and air delivery in different headings

Fan Size	Air Quantity (Cubic metres per sec)	Where fan is used
380 mm	1.6	Small heading
405 mm	1.7	Small heading
480mm	3.3	Service drift

7.7 Instructions on pipe laying for water and air

a. Pipe laying for water and air shall be in accordance with applicable standards
b. Installation work shall be carried out by personnel who have received the necessary training, where:

i) Only approved clamps shall be used during pipe installation. All clamps shall be carefully examined before installation, i.e for cracking.
ii) At every material crosscut an air-line of required diameter (e.g.: 150mm) and a diameter water line of required set diameter (100mm) shall be laid from the Haulage pipe line. The air-line shall in all cases be carried on top and the water line below.
iii) Service holes shall be drilled such that every pipe is supported at each end, that is, two holes per pipe. Each shall be equipped with either an appropriate eyebolt or J-hook which shall be firmly anchored. The support eyebolt holes shall not be less than 0.2m in depth.
iv) Main air and water valves and an air pressure gauge shall be installed to specifications on the pipes

7.8 Preparation of a working face or end

7.8.1 When working a face by mechanical means, the drilling crew members are required to collect from surface and underground stores and make the materials and equipment available at the work place.

7.8.2 The following shall be the equipment and accessories that shall be available:

a) drill bits shall be allocated to drilling crews with the required number and bit sizes;

b) grease bottles, operators and Spanner-men shall be allocated grease bottles;

c) socket plugs, drill steels, charging sticks, paints, marking chalk and twine shall be allocated;

d) hand shovels, 1.8 m and 3.0 m pinch bars and machine, man's bag containing machine accessories;

e) drill machines, air-legs; and

f) hand picks.

7.8.3 After preparing and marking the end, the drill crew with tools shall move into position and where needed use a platform for drilling and charging.

7.8.4 In case of development by non-mechanical means, the development crew shall collect the tools and equipment and take them to the working face. The equipment shall comprise the hand tools for digging, mucking and lashing.

7.9 Procedures on washing and cleaning at the tunnel face

7.9.1 Ventilation shall be extended to within 5m of the face ensuring the ventilation pipes are properly connected to one other and to the ventilation fan

7.9.2 The hanging wall, sides and footwall shall be washed down in order to:

a) suppress dust that is settled on the rock face and suspended in the body of air;

b) expose cracks in the rock face for barring down;

c) dissolve the gasses in any unlashed muck-pile; and

d) cool the working place.

7.10 Standard practices for barring down of hanging rocks

The roof and side walls are barred down of any loose rocks, using a 1.2 m – 4 m pinch bar, minding to protect equipment and installations from loose rocks being dropped (Figure 1).

7.10.1 Procedure

7.10.1.1 Use standard length of pinch bar with sharp point and pinch, fitted with a guard as demonstrated in Figure 2. It shall have one sharp end (Moil) with the other end forged like an angled chisel with lengths ranging between 1.2 m – 4 m depending on the use.

7.10.1.2 Start from good ground and work towards area with bad ground.

7.10.1.3 Assume balanced stance with good footing for both legs, have good grip of pinch bar below the guard.

7.10.1.4 Maintain clear area in which to maneuver when avoiding falling and rolling rocks.

7.10.1.5 Probe the rock face to detect loose hanging by listening out for the dull thudding of separated rock strata, and the solid sound of intact rock.

7.10.1.6 Price out the loose rock with the pinched end of the bar and enlarging the cracks with the pointed end.

7.10.1.7 Watch the loosened and barred rock fall to settle in the muck pile.

7.10.1.8 Avoid standing on unstable rock pile whilst barring down.

7.10.1.9 Loose hanging that cannot be barred down shall be blasted down or prop supported.

7.10.1.10 Lash to expose the solid foot wall from the face to 3.0m back.

7.10.1.11 Scaling after blasting usually starts by spraying high pressure water on the rock face to remove smaller loose rocks and then followed by manual removal of large boulders.

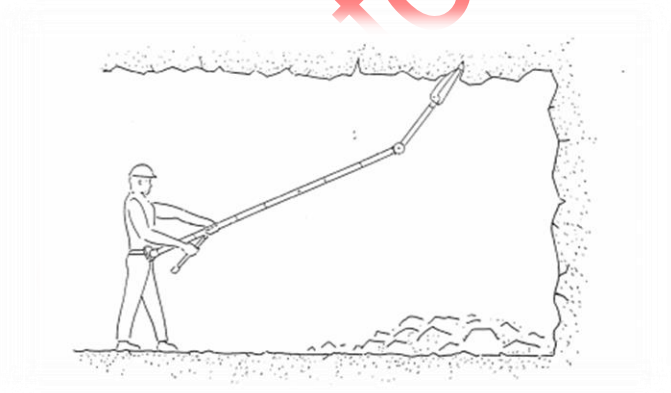


Figure 3 — Barring Down – making work safe using pinch bar

Figure 4 — Pinch bar (one Version)

7.11 Procedure on washing or pumping out sockets

7.11.1 Ensure any sockets from previous rounds are exposed for pumping and cleaning.

7.11.2 Wash the drill face thoroughly well with water.

7.11.3 Use an approved copper blow pipe for pumping all sockets and misfires. Two approved explosive bags shall be available for keeping fuse and fracture explosives being pumped.

The approved Copper blow pipe shall be:

a) longer than the hole to be pumped; and

b) made of non-sparking material and shall have a ninenty - degree bend to allow the miner to stand clear from the direction of the hole being pumped.

7.12 Standard practices for marking the heading/face for drilling

7.12.1 Hang the back-line peg (BLP) and front line peg (FLP) chains on the appropriate survey pegs positions in the hanging wall. Check the length of the chains from bottom of spud to bottom of survey plates on the chains.

7.12.2 Secure mason lines on the side line pegs, each crossing the haulage from one side line peg to the other peg. Ensure the mason lines are taut and horizontal.

7.12.3 One man sights through the survey chains, instructing the helper at the face to mark three reference points with a paint brush on the face.

7.12.4 Sight through the mason lines, instructing the helper at the face to mark three reference points horizontally across the face. One mark about the centre of the face, and one on either side about 1.0 m from the side walls.

7.12.5 Connect the three reference marks down the face with a continuous line 5 cm in width, from hanging wall to footwall, forming a direction line.

7.12.6 Connect the three horizontal reference marks in similar manner, forming a grade line. Paint the grade line backward to connect to the permanent one on either side.

7.12.1 Determining and marking of the centre line

7.12.1.1 Grade and centre lines shall be painted continuously during the development phase of the heading.

7.12.1.2 From the FLP read the offset dimensions. Add the right and left offsets and divide the sum by two. The difference between this and each of the offsets shall indicate the position of the centre line from the direction line on either left or right.

7.12.1.4 Mark the reference points for the centre line from the direction line. Paint the centre line down the face to the footwall. Continue painting the centre line and backwards to connect to the permanent one.

7.12.2 Procedure on marking of drill holes for drifts/tunnels, crosscuts and raises

7.12.2.1 Drill holes shall be marked according to the drilling patterns at the mine. Wax chalk or paint is used to make marks that shall be visible and last the period of the drilling cycle

7.12.2.2 Mark the Machineman's Jumper Direction Lines and mark the drill holes and Pilot hole positions following the appropriate drill pattern.

For Example, Select a 0.2m x 0.2m x .02m space on the face, for the cut. Mark the holes as follows.

i. Five-hole Burn-cut:

Mark a centre hole to the stub, relief or void hole. Mark four holes around the centre.

ii. First easers

Mark four holes one on each side of the cut square, 0.3m measured from the centre of the line joining the two holes on each side.

iii. Second easers

Four holes, each marked 0.4m from the centre of the line joining each pair of the first easers making and side of the easers square

iv. Perimeter holes

Top holes - marked 0.1m below the hangingwall line and at 0.6m intervals. Side holes - marked 0.1m inward from the sidewall limiting line, on left and right, at 0.6m intervals.

v. **Lifter holes** - marked 0.1m above footwall limiting line at 0.6m intervals.

vi. Extra holes

Because of the presence of sockets on the face, extra holes may be required in the space where intended hole directions may leave toe burdens not more than 0.6m

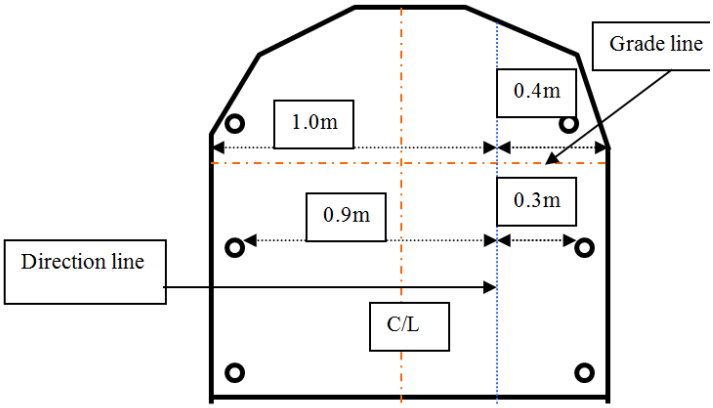


Figure 5 — Across section view of machine men direction lines in a straight end

7.12.3 Number of blast hole in hard rock mined underground

Table 2 — Average number of blast holes common in underground hard rock mining

Reference number	Size	Total number of blast holes
1.	1.2 x 1.2m	12
2.	1.5 x 1.5m	16
3.	1.8 x 1.8m	18
4.	2.4 x 2.4m	19

7.12.4 Procedure on drilling activity of the ends

7.12.4.1 Rig up drilling equipment.

7.12.4.2 All connections on hoses shall be done with hose menders and steel gauge wire. No copper wire shall be used at any connections. Hose connections shall be adequately bridged.

7.12.4.3 Check attachments of reducers, grease bottles, spuds and tail pieces to be firmly fastened.

7.12.4.4 The compressed air tap is closed off while connections to the Jack hammer drill machine are made.

7.12.4.5 When connections are completed, open compressed air tap fully to ensure adequate operating pressures.

7.12.4.6 Open the water tap adjusting to a low pressure not to cut supply to machine when not. drilling.

7.12.4.7 Check control valve fixture and quick release valve for sound operation.

7.12.4.8 Fix bits onto the drill rods.

7.12.5 Lashing of development ends or faces

7.12.5.1 Manual and mechanical lashing of development ends involving removal of broken rock after a primary or secondary development end has been drilled and blasted shall be carried out under safe procedures.

7.12.5.2 Prepare the equipment depending on the method to be used. during mechanical lashing, the equipment may include the loaders, battery locomotive and cars. For example, ensure a battery locomotive is adequately charged, check tip installation for safety and orderliness and other equipment pre checks.

7.12.5.3 During manual or hand lashing, which shall be undertaken by personnel using tools as hand shovels and wheelbarrows, the following shall be taken into consideration:

a) ensure that the rock/soil piles are made wet thoroughly and frequently;

b) maintain a sloping muck-pile by working it from the top, to avoid accidents from rolling rocks;

c) ensure that the ground is lashed down to solid footwall, exposing any lifters and plugging them.

7.12.5.4 In both cases, ensure the following:

a) inspect the walls of the tunnel, and installations for blasting effects and stability shall be checked;

b) rectify unsafe conditions;

c) loose rocks shall be attended to immediately;

d) extend ventilation to at least 5.0m from the face;

e) scale/bar down loose rocks;

f) wash down the tunnel walls, face and muck-pile in order to suppress, dust and dissolve any gasses;

g) search for misfires on the tunnel face;

h) if any misfires are observed, manage by plugging with socket plug;

i) circle misfired hole with chalk/paint and write “M/F” clearly.

7.12.6 Housekeeping during development of ends and end of shift procedure

7.12.6.1 Close water taps, coil hoses and store in crosscuts. Leave fans and air hoses ventilating ends at appropriate discharges.

7.12.6.2 Lash and clean around unit areas and leave drains open, water control in good condition.

7.12.6.3 Return tools to stores or areas borrowed.

7.12.6.4 Leave prop supports, timber packs or other support in place and orderly.

7.12.6.5 Clean all platforms of rock debris.

7.12.6.6 Defects in equipment are communicated and recorded.

7.12.6.7 Crew cards are marked and all work record sheets signed.

4.19 Mining of two approaching development end or tunnels

When a tunnel is being developed towards another working tunnel and the distance between the two tunnels is 10 m or less, the following shall be ensured:

a) only one end shall be developed at a time;

b) the stopped end is effectively barricaded off at a safe distance; and

c) the stopped end is cleaned out and checked for misfires and all sockets in the stopped end shall be cleaned out with high pressure water.

7.12.7 Work in two development ends approaching water or gases

7.12.7.1 In a mine which is liable to an in burst of water or gas, the responsible person appointed by the Mine Manager/Technician shall at all times be aware of the locations of faces being advanced, and shall identify all the relevant precautions and steps that personnel shall take in the event of an in burst are clearly defined.

7.12.7.2 Suitably directed boreholes shall be drilled from the working face and be sufficient in number and length to give ample warning of presence of water or gas.

7.12.7.3 A competent person, appointed by the Mine Manager, shall inspect every part of the mine where in burst is likely:

a) immediately before the commencement of every shift; and

b) during the course of every mining operation.

7.12.8 Safety crown pillars to be set

7.12.8.1 Safety (crown) pillars shall be set out and defined at every mining operation taking in consideration the geological conditions of the rocks.

7.12.8.2 The Mining technician shall ensure that a safety crown pillar of reasonable thickness is provided to prevent collapse of the roof in the following situations:

a) pillar above the first horizontal tunnel off the shaft taking;

b) pillars defining the distance between two horizontal drives, tunnels or sublevels; and

c) pillar above the adit drive.

8 Blasting operations

8.1 Design requirements for open-pit mining/quarries

8.1.1 The owner shall have a documented procedure for blasting operations. The procedure shall require a technical design and report detailing the expected results and impact of the basting operations. The design for blasting operations shall include pre-blasting survey (conditions of neighbour infrastructure within at least 2 km radius) and technical requirements in accordance with Annex M.

8.1.2 The owner shall submit blasting plans as required by the competent authority. The blasting plans shall include pre-blasting technical designs.

8.1.3 A pre-blasting survey shall be conducted by the inspection team composed of the owner, an authorised person from a competent authority and local authority.

NOTE The competent authority means the authority in charge of mines and quarrying. Other authorities may be included as deemed necessary by the competent authorities.

8.1.4 The owner shall carefully design blasting operations so as to avoid affecting safety to neighbour community including infrastructure and the health and safety of people in the blasting area.

8.1.5 Where repetitive blasting operations are to be conducted in the same area, effect of repetitive blasting shall be assessed.

8.1.6 The design for blasting operations shall be approved by a competent blasting engineer.

8.2 Blasting operations

8.2.1 Charging operations standard procedures

8.2.1.1 Only persons approved by the competent authority shall be permitted to carry out blasting operations.

8.2.1.2 The approved person shall:

a) ensure that drilled holes are pumped clean before charging them with explosives;

b) be responsible for the safety of any person assisting him in charging up operations;

c) ensure that all other persons not engaged in the operations are removed to a safe place;

d) carry out inspections of chargings/explosives before any blasting operations;

8.2.1.3 All holes to be blasted shall be charged at scheduled primary blasting times only and within a reasonable time before blasting.

8.2.1.4 If such charged holes for any reason are to be left unattended before being blasted, the blaster shall ensure all entrances are effectively barricaded and bearing the words 'CHARGED UP AREA, NO ENTRY' or GUARDS TO BE PLACED.

8.2.1.5 Before blasting any charges, all entrances to the area shall be effectively guarded either by means of suitable barricades and notices or by the placing of persons to act as guards to avoid any danger from such blast from flying debris, dust or fumes.

8.2.1.6 Communicate the intention to blast by various means including use of sirens.

8.2.1.7 Ensure that any explosives taken into working place are kept in a safe place at a reasonable distance from any drilling or other operation.

8.2.1.8 Do no enter, permit or instruct anybody to enter a place where charges have been blasted until the fumes have been dispelled.

8.2.1.9 Wait at least 30 min from the time of lighting the fuses before approaching a place where a misfired charge is known or suspected.

8.2.2 Blasting vibrations

8.2.2.1 Ground Vibrations

Any mine using explosives shall undertake measurement (and keep records) of the vibrations resulting from blasting and ensure that for locations close to residential areas ground vibrations do not exceed 4 mm/sec (Peak Particle Velocity – PPV) within a radius of 300 m from the epicentre/point of blasting and 10 mm/sec for in open space far from residential areas and underground blasting.

8.2.2.2 Air Vibrations

In measuring air vibration, the Decibel A (dBA) shall be used to measure audible community noise levels. On the other hand, the measurement of the impact from blasting noise shall be measured using Decibel (Linear Peak or dBL Peak). As such, air blast at sensitive sites, e.g., near residential areas, shall be below 80 dB (Lin Peak*) at all times. On the other side, measurement of audible noise from blasting shall not exceed 120 dB.

8.2.2.3 Vibrations measurements and equipment

8.2.2.3.1 Blasting vibrations measurements shall be performed in accordance with applicable regulations.

8.2.2.3.1.1 Ground vibration resulting from blasting shall be measured through Peak Particle Velocity (PPV) or the velocity of motion of a particle on/in the ground induced by the passing of the blast vibration wave. The PPV is measured using a “Blasting Seismograph” that consist of a transducer connected to a processor that collects and analyses the signals.

8.2.2.3.1.2 Air Vibration shall be measured using a microphone with suitable frequency and dynamic response. For measurement of inaudible air vibration (low frequency vibrations < 20Hz), the “over-pressure” of “concussion” that is responsible for impacts on infrastructure, the measuring equipment shall be able to measure in Decibels (dB (Linear Peak or dBL)). For measurement of audible, sound pressure (high frequency > 20 Hz) that is experienced as “noise”, the equipment shall be able to measure it in dBA.

8.2.2.3.1.3 Choose equipment that can be used to measure both ground vibrations and air vibrations from the same unit. An example of such equipment can be connected to both the geophone and the microphone to measure both ground and air vibrations is given in Figure 6.

Figure 6 — An example of the equipment (Instantel Micromate) that can be used to measure vibrations. Instantel Micromate can be connected to both the geophone and the microphone to measure both ground and air vibrations

8.2.3 Determining safe distance from blasting

8.2.3.1 Measurement of vibrations from blasting shall assist to determine safe distance from the blast to where communities and their properties or any other infrastructure are located.

8.2.3.2 As such, one shall undertake a number of blasting vibration monitoring measurements following a number of blasts and determine the safe distance. This is called “Initial Monitoring” and is used to determine a safe buffer zone between blast area and the sensitive infrastructure.

8.2.3.3 After the buffer zone has been determined, “ongoing monitoring” is then undertaken on every blast to confirm that the ground and air vibration levels are in compliance with the legal requirements.

8.2.3.4 In every case where the activities at a mine involve blasting operations, either on surface or underground, and the Manager is the holder of a “Blasting Certificate”, he shall be responsible for supervising such blasting operations. If the Manager is not the holder of a blasting certificate, he may outsource one or more competent persons who is a holder of an appropriate class of a blasting certificate to supervise such blasting operations.

8.3 Safety and health requirements during blasting

8.3.1 The owner shall meet statutory and regulatory requirements applicable to blasting operations.

8.3.2 The following shall be specified and documented during blasting operations:

a) type of audible warning signals and signal sequence;

b) name of company that will deliver explosives to the project site;

c) pre-blast surveys documents;

d) location of any vibration monitoring; and

e) location of any air blast overpressure monitoring.

8.3.3 If seismographs will be used, the manufacturer's name, model number, and documentation of calibration performed within the last 12 months shall be provided. Also, name(s) of seismograph operators and relevant training and experience shall be specified.

8.3.4 For surface mining Steps that will be taken to control flyrocks, dusts, misfire and airblast (noise) shall be documented.

8.3.5 Post blasting survey is also required.

8.3.6 Peak particle velocity (PPV) from blasting operations shall not exceed:

a) 4 mm/s for blasting dynamites close to residential centres and infrastructure; and

b) 10mm/s for blasting dynamites in the open space far from residential centres and infrastructure and underground blasting.

8.3.7 Noise level shall not exceed 80 dB for any explosion or blasting activity in a mining or quarry operation.

8.4 Determination of the bounds of blast area

The bounds of blast area shall be determined in accordance with relevant standards on requirements for blasting safety.

8.5 Pre-blasting survey.

8.5.1 Prior to a permit to conduct a blast, the applicant shall submit to the Regulatory Authority a pre-blast survey carried out on the dwelling and building located within 2 km of any part of the permit area.

8.5.2 In other cases, the regulator can appoint personnel to conduct the survey to determine the condition of the dwelling or building and to document any pre-blast damage and other physical factors that could

reasonably be affected by the blast. Assessments of structures such as pipes, cables, transmission lines and wells, and other water systems should be limited to surface conditions and other readily available data. Particular attention should be paid to the pre-detonation condition of wells and other water systems used for human, animal, or agricultural purposes, as well as the quantity and quality of the water.

8.5.3 A written report of the survey shall be prepared and signed by the person or persons who conducted the survey and prepared the written report. The report shall include recommendations on special conditions or proposed adjustments to the blast plan and damage prevention procedures. Copies of the report shall be made available to the person requesting the survey and to the inspecting authority

8.6 Blasting procedures

8.6.1 General

8.6.1 All blasting shall only be carried out during daylight hours, defined as sunrise to sunset. Due to public inquiries or other considerations, including proximity to residential areas, the regulator may set more restrictive periods.

8.6.2 Blasting shall not be carried out at times other than those announced in the blasting schedule, except in emergency situations where rain, lightning, other atmospheric conditions, or the safety of the operator or the public necessitates an unscheduled blasting

8.6.3 Warning and all-clear signals of various characters that are audible within a range of 2km of diameter from the blasting site, shall be given. All persons in the permitted area shall be made aware of the meaning of the signals by appropriate instructions and signs

8.6.4 Access to the blasting area shall be regulated to protect the public and livestock from the effects of the blasting. Access to the blasting area shall be controlled at least 20 minutes prior to each blasting to prevent unauthorized entry and until the permit holder's authorized representative has determined that there are no unusual circumstances such as impending landslides or undetonated explosive charges and that access to and the Entering or traversing the area can safely be resumed

8.6.5 Areas where loaded holes await firing shall be guarded, barricaded, and posted or marked against unauthorized entry

8.6.6 Airblast shall be controlled so that it does not exceed 128 decibels linear peak at any man-made housing or structure located within one km of the permit area

8.6.7 Except where lesser distances are permitted by the Regulatory Authority (based on a pre-blast survey or other appropriate investigation), blasting shall not be carried out within:

a) 300m of any building used as a dwelling, school, church, hospital, or nursing facility;

b) 150m of facilities including, but not limited to, disposal wells, petroleum or gas-storage facilities, municipal water-storage facilities, fluid-transmission pipelines, gas or oil-collection lines, or water and sewage lines; and

c) 150m of an underground mine not totally abandoned except with the concurrence of the Mining Enforcement and Safety Administration.

8.6.2 Airblast

8.6.2.1 The following limits shall be observed:

i) Airblast shall not exceed the limits set forth below at any residence, public building, school, church, or community or institutional building outside the permit area,

ii) Lower frequency limit of the measuring system, in Hz (±3 dB) shall be in accordance with Table 3.

Table 3 —Lower frequency limit of measuring system

Lower frequency limit of the measuring system, in Hz (±3 dB)	**maximum level in dB**
0.1HZ or lower-flat response	134 Peak
2 HZ or lower-flat response	133 Peak
6HZ or lower -flat response	129 Peak
c-weighted-slow response	105 Peak dBC

8.6.2.2 Only with the approval of the supervisory authority. If necessary to prevent damage, the regulatory authority may set lower maximum allowable airblast levels than those listed above in the vicinity of a particular blasting operation.

8.6.3 Monitoring.

8.6.3.1 The operator shall conduct periodic monitoring to ensure compliance with the airblast standards. The regulatory authority may require airblast measurement of any or all blasts and may specify the locations at which such measurements are taken.

8.6.3.2 The measuring systems used shall have an upper-end flat-frequency response of at least 200 Hz.

8.6.4 Flyrock.

Flyrock traveling in the air or along the ground shall not be cast from the blasting site at more than one-half the distance to the nearest dwelling or other occupied structure.

8.6.5 Ground vibration

In all blasting operations, except as otherwise authorized, the maximum ground vibration shall not exceed a value approved by the regulatory authority.

8.6.6 Maximum peak-particle velocity.

8.6.6.1 The maximum peak particle velocity shall not exceed the value specified in Clause 8.2.2.1 of this Standard at any residence, public building, school, church, community, or institutional building outside the permit area.

8.6.6.2 Ground vibration shall be measured as particle velocity. Particle velocity shall be recorded in three mutually perpendicular directions. The maximum allowable peak particle velocity shall apply to each of the three measurements and a seismographic record shall be provided for each blast.

8.6.7 Scaled-distance

8.6.7.1 The operator may use the scaled-distance equation (1) to determine the allowable charge weight of explosives to be detonated in any 8-millisecond period without seismic monitoring.

$$W = \left(\frac{D}{D_s}\right)^2$$

where:

W is the maximum weight of explosives, in pounds;

D is the distance, in feet, from the blasting site to the nearest protected structure; and

D_s is the scaled-distance factor, which may initially be approved by the regulatory authority.

8.6.7.2 The development of a modified scaled distance factor may be approved by the Regulatory Authority upon written request from the operator supported by seismographic records of blasting at the mine site. The modified scaled distance factor shall be determined such that the particle velocity of the predicted ground vibration does not exceed the prescribed maximum allowable peak particle velocity.

8.6.7.3 The maximum airblast and ground-vibration standards aforementioned shall not apply at the following locations:

a) At structures owned by the permittee and not leased to another person,
b) For structures owned by the permit holder and leased to another person, if a written waiver by the lessee is filed with the regulator prior to blasting

8.6.8 Records of blasts.

Records of each blast, including seismograph reports, shall be retained for a minimum of 5years and made available for inspection by the regulator and the public upon request. The log shall contain the following data:

a) Name of permittee, operator, or other person conducting the blast;
b) Location, date, and time of blast;
c) Name, signature, and license number of blaster-in-charge;
d) Direction and distance, in feet, to nearest dwelling, school, church, or commercial or institutional building neither owned or leased by the permittee;
e) Weather conditions;
f) Type of material blasted;
g) Number of holes, burden, and spacing;
h) Diameter and depth of holes;
i) Types of explosives used;
j) Total weight of explosives used;
k) Maximum weight of explosives detonated within any 8-millisecond period;

l) Maximum number of holes detonated within any 8-millisecond period;
m) Methods of firing and type of circuit;
n) Type and length of stemming;
o) If mats or other protections were used;
p) Type of delay detonator used, and delay periods used;
q) Seismograph records, where required, including:
    i) Seismograph reading, including exact location of seismograph and its distance from the blast;
    ii) Name of person taking the seismograph reading; and
    iii) Name of person and firm analysing the seismograph record.

9 Support of mining tunnels

9.1 Timber and mine support guidelines

9.1.1 Support systems shall be designed, selected, used, installed, maintained and removed taking into consideration of the various rock conditions that may prevail.

9.1.2 The Manager shall appoint a responsible person to ensure that particular attention is given to the support of the area in the vicinity of the working face. In this regard, the timing of the installation and removal of temporary and primary support is important and, together with examination and making safe procedures, shall be specifically dealt with.

9.1.3 In small scale mining, underground development support shall focus on the installation and maintenance of supports in the stressed areas, main haulages or tunnels and traveling ways.

9.1.4 Timber sets shall be used to support excavations that have been driven through poor to very poor ground conditions or temporary excavations. Timber sets can be installed in haulages, material cross cuts, service drifts and undercuts and any other excavations or openings where the limitations of span and height shall permit.

9.1.5 Square timber sets shall be used in main drives, three piece timber sets in smaller drives and undercuts, false cap and pony sets for various tunnel/excavations configurations to provide passive support of hanging and side walls.

9.2 Materials and tools requirements for timber support work.

9.2.1 Required tools for framing and installation of timber sets are:

a) nails (100mm – 150mm);

b) at least a 4 Kg Hammer;

c) bow saw;

d) shovel (also pick);

e) timber-mans' staff;

f) twine; and

g) pinch bar.

9.2.2 The framing of timber usually includes cutting it to size, notching, cutting daps, mortising for joints, removing slabs from round timber and any other applications.

9.2.3 As such, other timber framing tools are needed, e.g., small hand-held chainsaws, circular saws, drills and others. A swing-saw for end-cutting and a permanently mounted power-saw for making wedges are necessary at the timber shop.

9.2.4 Additional tools for squaring logs and cutting planks for lagging and blocking are usually necessary for the timber shop.

9.3 Timber type and size selection

9.3.1 Long-grained hardwood timber with sufficient elasticity and strength shall be used for mine roof support. Timber used and nominal loads shall be in accordance with ISO 23872 and RS 427.

NOTE This means that when a timber prop is subjected to pressure on its ends, it bows outwards considerably without breaking while still resisting the applied pressure. Long-grained timber such as eucalyptus are preferred because they shatter more slowly when their compressive strength is exceeded and give a cracking sound that warns miners. Soft woods such as cypress possess great elasticity but do not have the strength to resist great pressures. Hardwood timbers such as oak are strongly resistant to pressure but do not offer any elasticity and would break after very little bending.

9.3.2 It shall be strong enough to bend without breaking so that it gives miners warning of an approaching fall.

9.3.3 In selecting the size of timber, sizes shall be adjusted by taking into consideration the rock conditions, size and intended life of the opening and the type of timber to be used.

9.3.4 When blockings are used, they shall not be less than 30cm thick and shall consist of several pieces of blocks, planks, and wedges.

9.3.5 Footboards shall not be less than 50 mm thick, 250 mm wide and 900 mm long when stulls are installed in loose ground.

NOTE Timber is 4 to 5 times stronger when force is exerted parallel to the grain than when it is exerted perpendicular to the grain.

9.4 Timber preparation

9.4.1 After harvesting, timbers shall be stripped of the bark, seasoned, treated and allowed to dry. Timbers shall have a maximum moisture content of 19%.

9.4.2 Timber shall be treated to prevent decay.

NOTE Timber decay is usually accelerated by humid conditions in underground. Treatment is more effective if carried out on green timber and shall be carried out for 24 h – 56 h or longer (for dipping treatment).

9.4.3 Adequate ventilation shall be provided to improve drying effect and increase in strength of the installed pieces.

NOTE Ventilation is important to reduce timber decay.

9.4.4 When choosing timber members for underground support, the following shall be considered:

a) effective life of the opening and that of timber shall be coordinated, i.e., long life openings like adits/tunnels shall be supported by mature and well dried pieces;

b) installed timber members readily indicate an increasing load (from physical appearance), which provides ample time for installing additional support;and

c) settling or disturbance of supports due to failure of component parts, is usually local in character – confined to only a few sets at most.

9.5 Timber treatment

9.5.1 Humid conditions in a mine tend to promote timber decay; treatment of timber can slow down or even prevent decay.

9.5.2 Timbers shall be stripped of its bark and framed before treatment.

9.5.3 Treatment shall be carried out either by dipping or soaking the timbers in a tank or by using a pressure vacuum plant which is usually expensive to keep at the mine.

9.5.4 If available in the neighbourhood, treated timber can also be obtained from a commercial treatment plant.

9.5.5 Treatment by dipping or soaking shall follow the following procedure:

a) use a rectangular, welded steel tank (or equivalent): 1.2 m x 1.2 m x 4.8 m;

b) treat the timber while fresh and after stripping off its back and framing;

c) treatment time shall be between 24 – 56 h – the longer the better;

d) stark treated timber so that circulation of air is retarded to prevent rapid drying or seasoning;

9.5.6 If the treated surface shall be sawed of chopped when it is place underground, the freshly exposed wood shall be well painted with preserving solution.

9.5.7 Testing of treated timbers shall be performed in accordance with RS EAS 325.

9.5.8 Care shall be taken when handling and transporting treated timber to avoid excessive rupture of the treated surface.

9.5.9 The economic benefits of using treated timber are generally high especially when the installation is semi-permanent or permanent.

9.5.10 However, in many stopes and their accessories (drifts, crosscuts, raises) long life is not necessary and hence the use of treated timber might not be necessary.

9.5.11 The life of timber and the life of workings (excavations) shall be carefully coordinated.

9.6 Preparation for support

9.6.1 Support when required shall be done early and safe working procedures shall be followed. In areas with weak conditions, preparations shall be done to provide a safe working environment immediately.

9.6.2 Obtain information or a plan on the type of support and area to support the area shall be checked for preliminary requirements, such as slyping, installing of survey reference points, marking of grade and centre lines close to the area.

9.6.3 If required, prepare special foundation such as a concrete base for each timber set. Preparations of this nature shall be done in advance. The concrete base shall be in accordance with ISO 23872.

9.7 Installation of timber sets

The timber sets shall be installed centrally to the excavation on direction and grade.

9.7.1 Preliminary work

9.7.1.1 Lash and clean to footwall.

9.7.1.2 Transport materials and tools to work site.

9.7.1.3 Bar and wash down, install prop support and as head cover for protection.

9.7.1.4 Establish the centre and grade lines.

9.7.2 Erecting the timber set

9.7.2.1 Lash to solid rock footwall and/or level off where necessary, if foundation is not laid in advance. Where intervals between sets are pre-determined, the leg position can be made ready well in advance of installation.

9.7.2.2 **Set legs** - Cut the two legs from round poles, 225 mm x 225 mm or 200 mm x 100 mm timbers. For the square timber set, these shall be cut squarely at the top.; the three-piece drive set timbers shall be cut 5 degrees off square on both ends so that the legs shall lean in wards at 85 degrees on erection, in order to oppose the buckling effect.

9.7.2.3 Position the two legs on either side, measuring from the centre line. To maintain the legs in an upright position temporary, nail 200 mm x 50 mm timbers on the outer side, align them centrally and secure in the footwall.

9.7.2.4 **Cap** - Measure, cut and lift cap and fit into position on top of the legs squarely. Sprag on to the sidewalls using blocks with minimum wedges.

9.7.2.5 Spreader and studdle - With timber-mans` staff measure the distance between the legs at the top just below the cap. Cut 200 mm x 50 mm timber to required length and nail under the studdle (divider) timbers vertically across the joint between the legs and cap.

9.7.2.6 **Sill** - Measure the distance between the legs at footwall position. Cut 200 mm x 50 mm timber and nail across from one leg to another as sill timber [most applicable where there is no plinth foundation].

9.7.2.7 **Spacers** - Measure 1.8 m centre-to-centre for the next set. Erect second set in similar way as the first. Nail 200 mm x 50 mm timbers from one leg to the other on either side, at 0.6 m from footwall and 0.3 m from the cap as spacers. Spacers are to cover only half the width of the leg in order to leave space for the next spacer.

9.7.2.8 **Cribbing and top lagging** - On top of the cap, directly above each leg, run 200 mm x 100 mm timbers from cap to cap, and place similar timbers at 0.5 m intervals across the span. These form the first row of cribbing timbers. Between the cribbing timbers, place 200 mm x 50 mm timbers extended from cap to cap as top lagging. A gap of up to 100 mm can be maintained between timbers for bleeding purposes.

9.7.2.9 **Side lagging** - Install 200 mm x 50 mm side lagging timbers by nailing these onto the legs on the outer sides. Gaps of about 0.3 m shall be maintained between side laggings for bleeding purposes.

9.7.2.10 **Additional cribbing** - The next row of cribbing timbers are placed across the bottom row, ie running from one side wall to the other, maintained at similar intervals of 0.5 m.

9.7.2.11 **Pony set** - If the ground has peeled off upwards across the span of the excavation in excess of 1.2m above the timber set cap, a pony set is installed. Legs of 0.5m length are cut 5 degrees off square on both ends. These are installed on top of the cribbing timbers, with cap and further cribbing until the hanging wall is reached.

9.7.2.12 **False caps** - If the ground is peeled off asymmetrically upwards in excess of 0.5 m above the timber set cap, a false cap is installed.

9.7.2.13 Caps are installed over the first set in a normal way. On the side where ground is peeled to the highest point, with two or more blocks placed over the cap directly above the position of the leg.

9.7.2.14 The false cap is then installed to rest on the blocks on one side, and on top of the cap on the lower hanging wall side.

9.7.2.15 After two consolidated sets, sill timbers and temporary support timbers can be removed.

9.7.2.16 Only hardwood wedges shall be used and a minimum of two of them. All wedges shall be installed to last as long as the whole set lasts.

9.7.3 Timber pack support standard

9.7.3.1 Scope of timber packs supports offer passive support

The pack shall withstand compression from either elastic convergence or the dead weight of separated strata or fractured rock block.

9.7.3.2 Effectiveness of timber pack

Stiffness is required for a timber pack to give maximum support.

9.7.3.3 Purpose and application of timber packs

Timber packs shall be constructed as pillars in shallow dipping drives for the purpose of controlling strata separation, loosening of fractured rock and hanging wall surging.

9.7.3.4 Timber pack support requirements

9.7.3.4.1 Slab timbers, 225mm x 225mm, 200mm x 100mm timber, round poles, hardwood wedges and normal timbermans` hand tools.

9.7.3.4.2 Area shall be wide enough with a regular footwall. The wider the area the better as compared to height.

9.7.3.4.3 Water increases creep in timber, therefore, timber packs do better in dry conditions. Denser timbers are less susceptible to creep because of their strength and less moisture absorption

9.7.3.4.4 **Fill material** - Sorted competent waste rock shall be used.

9.7.3.5 Timber pack preparation

9.7.3.5.1 Lash to footwall and level off.

9.7.3.5.2 Bar and wash down and make safe.

9.7.3.5.3 Transport all materials to site.

9.7.3.5.4 For composite timber packs, concrete brick mats are to be made in advance.

9.7.3.5.5 For timber mat packs, the mats are threaded in advance with iron bars.

9.7.3.6 Construction of timber pack

9.7.3.6.1 Prop up and wedge two up right side lagging timbers on the down dip edge of the support area if the footwall has a gradient of more than 5 degrees. If the footwall is flat, no up right side lagging is required.

9.7.3.6.2 Lay first base timber against the up rights, to extend across the support area up to side wall. Lay second base timber 0.3 m away from first timber up dip.

9.7.3.6.3 Place first deck timber to rest on footwall at extreme up dip end and on top of the first two base timbers on the down dip side. More second base timber up and down dip until decking timber stabilises.

9.7.3.6.4 Place other decking timbers towards side wall, maintaining 0.3 m between them.

9.7.3.6.5 Fill up spaces between base and decking timbers to level of first decking with clean sorted waste rock as fill material.

9.7.3.6.6 Place next decking timbers across the first decking. Each timber shall be cut to extend from limiting edge of the timber pack to the rock face on the side wall, with 0.3 m intervals maintained.

9.7.3.6.7 Fill up second decking level with fill material.

9.7.3.6.8 Continue decking, positioning each decking timber in the same position as preceding decking timbers of similar direction.

9.7.3.6.9 Build timber pack to hanging wall. Block and wedge against hanging.

9.7.3.7 Other support – Steel archs

9.7.3.7.1 In hard rock mining, limited application since most support duties can be performed more effectively by rock bolts, dowels or shotcrete or by some combination of these systems.

9.7.3.7.2 Where used in mining through faults or in very badly broken ground associated with faults of shear zones. In such cases, it may be impossible to anchor the rock bolts or dowels in the rock mass and steel sets may be required.

9.7.3.7.3 Application in small scale mining is limited due to cost compared to timber.

9.7.3.8 Other support - Roof bolting

9.7.3.8.1 Rock conditions shall determine the type of rock bolting support The method shall be used where the ground condition requires the rock formation either to be reinforced and form part of the reinforced rock mass

9.7.3.8.2 Use of Grouted re-bars and wire dowels is the most common method of rock bolting support.

9.7.3.8.1 Minimum requirements for roof bolting installation

9.7.3.8.2.1 Drilling equipment, pedal pump for grouting and accessories.

9.7.3.8.2.2 200 mm x 100 mm timbers for prop support.

9.7.3.8.2.3 Safety goggles, nose/mouth cloth respirators, water proof suits.

9.7.3.8.2.4 Wire dowels or rebars of the appropriate sizes; 1.5 m, 1.8 m, 2.1 m or 2.4 m.

9.7.3.8.2.5 Pockets of cement, a 210 - litre drum cut into two portions, sieve (< 5 mm mesh), mixing puddle or stirring stick, cotton or waste paper, 5 - litre bucket.

9.7.3.8.2.6 Drilling pattern and method established.

9.7.3.9 Procedures on timber support inspections and maintenance

The Manager shall specifically appoint person who shall examine all haulages and traveling ways once a week and enters the results of the examination in a special log book. The examination shall include:

a) quality of the timber setts;

b) any noticeable movement on the sets; and

c) new areas requiring support.

9.7.3.10 Illustration of a square timber set

9.7.3.10.1 Figure 6 gives a typical illustration of a square timber set.

9.7.3.10.2 When concrete or steel structures are used, they shall meet requirements of ISO 23872.

Support illustration

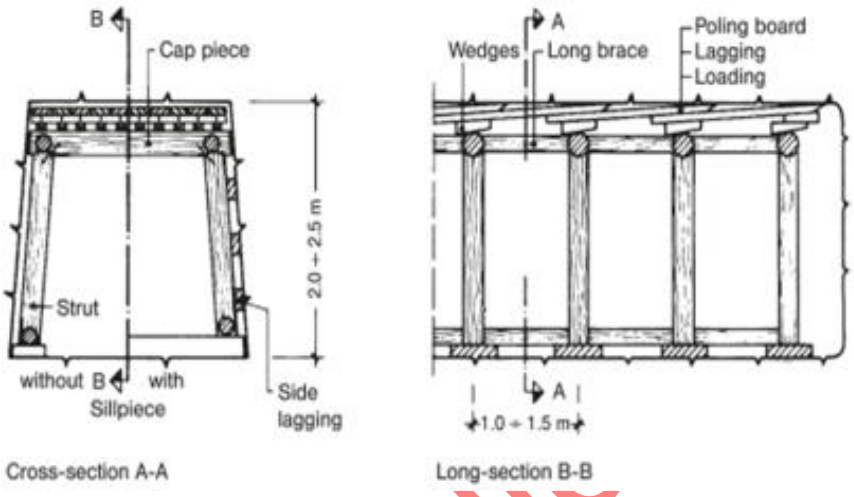


Figure 7— An example of timber set

10 Mine ventilation

10.1 General

10.1.1 The mine operator shall excavate secondary shafts or egress for the purpose of ventilation.

NOTE Secondary shafts allow air to naturally ventilate the working areas to facilitate an effective and sufficient natural pressure gradient.

10.1.2 Where more than one secondary shafts are excavated, they should be located on different elevations where applicable.

10.1.3 No mine worker shall enter any work place underground, in particular those places with poor air circulation, unless the air has been checked therein to ensure a safe breathable atmosphere free from levels of hazardous gases.

10.1.4 The Manager shall ensure that adequate and effective ventilation is supplied to all places in a mine where persons are working or travelling.

10.1.5 Consequences of poor ventilation may, among others, be:

d) heat exhaustion where temperatures are excessive;

e) exposure to blasting fumes, which can lead to unconsciousness and even death;

f) exposure to excessive levels of diesel particulates, which can lead to occupational health issues such as lung damage; and

g) increased exposure to risk when fatigue results from a poor working environment can lead to fatality due to lack of adequate oxygen.

10.2 Ventilation planning process

10.2.1 The process of planning for ventilation for an operating mine, as indicated in the figure below.

10.2.2 Ventilation system shall be able to supply a quantity of oxygen for breathing purposes at minimum of 19.5 % by volume.

10.2.3 The ventilation system shall remove heat and provide comfortable working conditions and hence improve production.

10.2.4 The ventilation system shall dilute and remove noxious and flammable gases that may be encountered during mining operations.

10.2.5 The ventilation system shall dilute and remove hazardous airborne pollutants created by various mining operations underground (e.g. dust, fumes, aerosols, vapours, etc.).

10.3 Quantity of oxygen required in mines

The air in areas where persons work or travel in mines shall contain at least 19.5 % oxygen and not more than 0.5 % carbon dioxide.

NOTE Table 3 indicates effects of reduced oxygen supply.

Table 4 — Effects of reduced oxygen supply

Oxygen in air (%)	Effects
19	Flame height on a lamp or candle reduced by 50%
17	Noticeable increase in rate and depth of breathing – this effect shall be further enhanced by an increased concentration of carbon dioxide
16	Flame on a lamp or candle extinguishes
15	Dizziness, increased heartbeat
13-9	Disorientation, fainting, nausea, headache, blue lips, coma

7	Coma, convulsion and probable death
Below 6	Fatal

10.4 Location of fans

10.4.1 A ventilation system for fan locations and airflow direction shall be one of the following:

a) exhaust (pull) system, mine fan shall be located on top of return airshaft;

b) blowing (push) system, mine fan shall be installed at the intake airshaft; and

c) combined system (push-pull), fans shall be installed on the intake and return airshafts.

NOTE Airflow direction is affected by the location of the main fan which, in turn, impacts the other mine operations.7.5 monitoring of ventilation fans.

10.4.2 In order to monitor ventilation fans, the following shall be performed:

a) in long underground excavations where there is poor ventilation, fans shall be installed underground to produce the required airflow to the working ends;

b) the fans shall be powered by means of a compressor or electricity;

c) to assure electrical and mechanical reliability of main mine fans, each of the compressors and the main mine fan and its associated components, shall be examined for proper operation by a trained person;

d) fans and compressor monitoring system shall be examined at every mine prior to anyone entering the mine. A log book shall be filled in accordance with Annex J;

e) assess fan capacity to deliver air to all working ends;

f) monitor and implement development of return air drives;

g) adhere to re-entry procedures in mines with blasting; and

h) make shift supervisors aware of the ventilation standards in their operating areas.

10.4.1 Prohibition of actions affecting ventilation in underground environments

10.4.1.1 The use of machinery, water pumps that would produce toxic gases shall not be allowed.

10.4.1.2 Unless in wide workings with adequate ventilation, monitoring of gases shall be periodic and documented. Annex D gives permissible limits of certain gases.

10.4.1.3 Machinery shall comply with emission requirements in accordance with RS 407-2.

10.4.1.4 Diesel fumes shall not be permitted in underground mines.

10.4.1.5 Use of candles shall not be permitted in underground mines

10.4.1.6 Use of substances producing toxic gases, fire, burning and any other flammable materials are not permitted in underground mines.

10.5 Monitoring of O_2 levels in mines

10.5.1 Each mine site shall monitor levels of air quality especially in underground mines using calibrated equipment.

10.5.2 The records of O_2 monitoring shall be documented.

11 Quarry and open pit excavations

11.1 Safety of open pit and quarry excavations

11.1.1 In open and quarry operations, where the vertical height of the face exceeds three metres and where explosives are used, bench drilling shall be carried out from the top of the bench.

11.1.2 A face shall not be drilled in a manner which shall create an overhang of the face, and where unconsolidated rock is mined; the face and sides shall be battered (that is, be at an appropriate angle) to prevent a collapse.

11.1.3 A face shall not be undercut by the excavation of a slot at the toe of the face apart from the purpose of driving a tunnel or adit being driven into the face.

11.1.4 Where a person is required to work manually at the bottom of the bench of a quarry face or on the face itself, the face shall be scaled of any loose rock which could fall on that person.

11.1.5 In an area close to population areas, the manager may need to fence against inadvertent access to the faces.

11.1.6 In open excavations, persons are not permitted to walk on the edge of excavations. They shall walk 2.5 m away from the edge of the excavation.

11.1.7 All loose material on the surface or on any bench shall be cleared to allow a clearance of at least 2 m from the edge.

11.1.8 In excavations mined manually, a face or sidewall shall not exceed a vertical height of 1.5 m unless the face or sidewall is sloping at an angle sufficient to ensure the safety of persons.

11.1.9 Where mechanical equipment is used for digging and loading, suitable precautions shall be taken to ensure that the operator of the equipment and any other person is not exposed to any danger from any face or sidewall.

11.2 Bench heights

11.2.1 In mechanical operations, the open pits shall be designed with the bench heights that take into consideration the strength and characteristics of rock mass. The heights in softer rock shall not exceed 5 m at the given slope angles.

11.2.2 The bench width shall be considered using the following formula:

$$Bench\ width\ (m) = (0.2\ \times bench\ height) + 4.5\ m$$

NOTE The formula above is recommended by the *SME Mine Engineering Handbook* (1992).

11.2.3 The guide to the Berm height and width can be derived from the following formula:

$$Berm\ height = 1\ m + 0.04\ H\ (H = 10\ m)\ (Kennedy)$$

11.2.4 In manual excavation, the mine operator shall ensure that the bench height in such operations do not exceed 3 m.

11.3 Waste dumps

11.3.1 Dumping shall be systematic and top soil materials that can be used for re-vegetation shall be dumped and stockpiled separately.

11.3.2 The waste dumps shall be designed taking into consideration the rock type. The soft rock type such as sandstones, clays and schists shall be dumped in such a way that the slope angle does not exceed the natural angle of repose. The broken or crushed rock dump shall have a slope angle not exceeding the natural angle of repose.

11.3.3 The dumps shall be designed in such a way that there is a berm on the edge of the dump and a retaining catchment berm at the foot of the dump. The berm height where dumping by vehicles shall be 50% of the dump vehicle tyre size.

11.3.4 The height of the dump shall not exceed 10 m. At such height, the slope angle shall not result in that greater than the natural angle of repose for the given materials.

11.4 Safety berms at pits

The dimensions (height and width) of the safety berm on the open pit haul roads and benches are determined using the following formulae:

a) $Berm\ height\ = 50\ \%\ of\ the\ tyre\ diameter$

b) $Berm\ width\ =\ 2\ \times berm\ height/tan\ 35°$

11.5 Open pit drilling and blasting

11.5.1 Mine site shall develop standard procedures on the safe operations of the excavating, loading and haulage equipment at the mine site.

11.5.2 blasting operations shall be carried out in accordance with applicable standards.

11.6 Procedures on safety operations of mining equipment

Mine site shall develop standard procedures on the safe operations of the excavating, loading and haulage equipment at the mine site to ensure safety of the operators, employees and equipment.

12 Air compressors and underground lighting

12.1 Air compressors underground

Any compressor which compresses air, used underground in a mine, shall be designed, constructed, operated, regularly tested and maintained for the following reasons:

a) air entering the compressor is not contaminated by pollutants and is as dry, clean and cool as practicable;

b) only high-quality mineral oil or suitable synthetic oil, having a specified flashpoint, shall be used for lubricating the compressor;

c) services shall be supported from properly secured fastenings, which shall not be used for any other purpose, and the number of fastenings shall be adequate;

d) services hung in haulage and travel ways (including ladder ways) shall be installed in such a manner to provide for adequate clearance for persons and equipment;

e) pipelines shall be connected by approved couplings; and

f) no repairs shall be carried out while any service is under pressure.

12.2 Underground lighting

12.2.1 Every mine shall provide suitable fixed lighting to employees involved in working in underground work with cap lamps or torch light. The serviceability of the lighting devices shall be verified by the mine operator.

12.2.2 The mine responsible person shall ensure personal lighting for underground use are in place.

12.2.3 Workers shall only take fully charged batteries.

12.2.4 Lamps shall be maintained regularly.

12.2.5 Cap lamps globes shall be checked for correct operation before proceeding underground.

12.2.6 Cap lamps shall not be taken into mines unless they are fully functional and secure.

12.2.7 The cap lamps or torch light shall be in a condition to illuminate the workings with a minimum luminous efficacy of 60 lm/w and the batteries shall have longevity to last a minimum of 8 h.

12.3 Safe use of electricity

12.3.1 Where electricity is used in mine workings, the mine operator shall ensure that a competent person is appointed to be responsible for all the electrical installations and operations.

12.3.2 All electrical operated equipment shall be selected, arranged, installed, protected, maintained and operated in such a manner as to prevent danger.

12.3.3 To every electrical circuit, effective means, suitably placed for isolating the supply of electricity from the circuit shall be provided to prevent danger.

12.3.4 Effective automatic means of preventing the energising of any electrical circuit or electrical apparatus shall be provided to prevent danger.

12.3.5 Every electricity generating plant and all substation equipment shall be adequately fenced or enclosed and notices prohibiting unauthorised persons from entering shall be placed.

12.3.6 No inflammable or explosive material shall be placed in dangerously near to any electrical apparatus.

12.3.7 All material used for the purpose of insulating any conductor shall be suitable and shall have required degree of insulation and mechanical strength required.

13 Personal protective equipment (PPEs)

13.1 General

13.1.1 The mine owner shall provide personal protective safety equipment to all employees, contractors and visitors at all time and shall ensure that all people required to use the PPEs do so correctly and are maintained in good conditions.

13.1.2 The basic PPEs shall include:

a) safety helmet or hard hat to protect personnel against hazards of falling objects;

b) protective gloves for work that might cause injury to the hands;

c) suitable protective footwear to protect against danger of slipping or injury to the feet;

d) safety goggles;

e) respirator mask;

f) ear muf; and

g) protective vest.

13.2 Safety footwear

13.2.1 Persons working and visiting mining operational areas that are marked as requiring safety footwear shall wear compliant safety footwear as per RS ISO 20347. the mine operators shall prescribe the operational areas where safety boots and shoes are compulsory.

13.2.2 All safety boots and/or safety shoes shall comply with the specification for safety footwear in mines. The standard safety shoe shall have a hard sole to prevent penetration and a steel capping to protect the toes.

13.3 High visibility attire

Employees working in an underground and/or open pit environment where the operations involve the use of motorized machinery shall wear suitable high visibility attire and the machinery shall comply with emission requirements in accordance with RS 407-2.

13.4 Eyewear

13.4.1 Persons working in or visiting mining operational areas that are marked as requiring the use of eye protection glasses shall wear compliant eye protection glasses and goggles.

13.4.2 The manager shall prescribe the operational areas where the use of safety eyewear is compulsory. All safety eyewear or glasses shall comply with ISO 16321-1.

13.5 Safety helmet

13.5.1 The use of safety helmets shall be compulsory where there is any risk of head injury. Mining operators shall clearly prescribe operational areas and shall clearly mark out the areas where the use of hard hats is compulsory.

13.5.2 No person shall enter or remain in the operational area in any of the following places unless that person wears a safety helmet:

a) underground;

b) any open pit susceptible to cause head injury;

c) any other place which the manager has designated as safety helmet area.

13.5.3 All safety helmets shall comply with ISO 3873 and shall allow a provision for use of earmuffs and have a provision for holding a lighting cap.

13.6 Clothing

The mine operator shall provide clothing for use at mining operations. Cotton overalls or work suits shall be the normal work wear in mines. Strips of reflective material shall be added to make the miner more visible to drivers in case of motorized operations involving underground vehicles or to any other employee working underground.

13.7 Ear protection

13.7.1 Where the noise exceeds permissible level as per RS 236 the manager shall provide persons working in or visiting mining operational areas with suitable protective hearing devices including muffles or ear plugs.

13.7.2 The manager shall prescribe the operational areas where the use of safety ear protection wear is compulsory.

13.8 Safety harness

13.8.1 Any person working in a place where he/she may fall more than two metres shall be provided with and wear a safety belt or harness which shall be securely attached to the wearer and to a safe anchorage.

13.8.2 Where the lanyard of the safety belt or harness is too short for use when attached to the safe anchorage, an anchor chain shall be attached to the safe anchorage and the lanyard shall be securely attached to the chain.

13.8.2 Where more than one person is attached to a safe anchorage, the strength of the anchorage shall be increased in proportion to the number of persons attached to it.

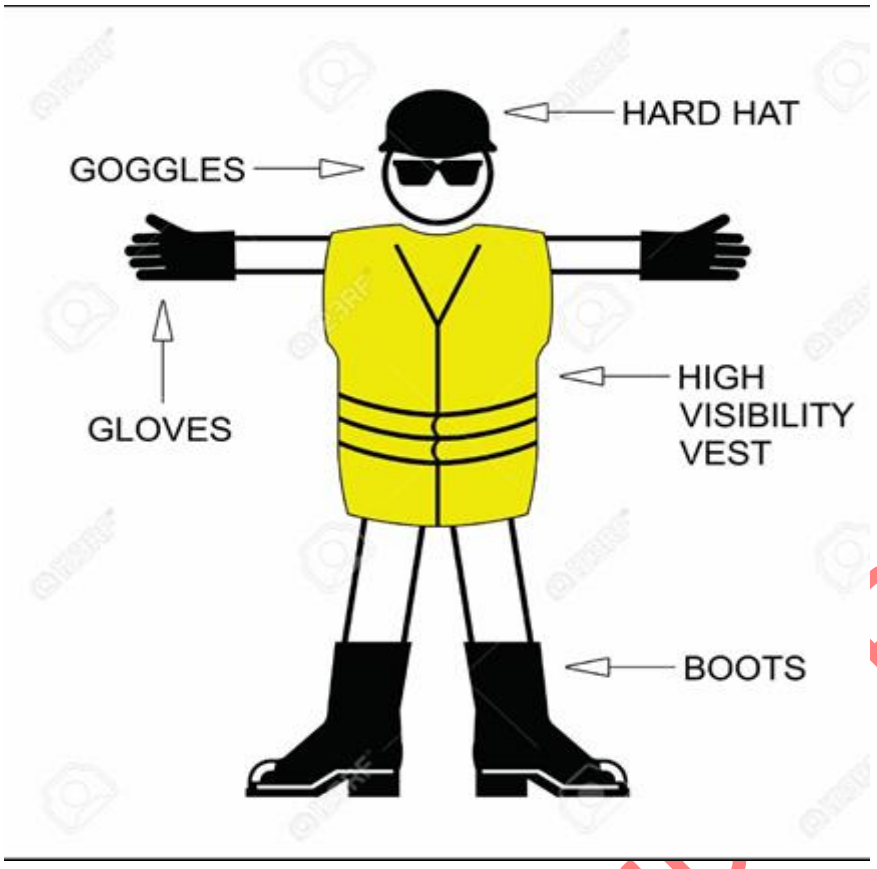


Figure 8 — Illustration of PPE

13.9 Display of mandatory signs of PPE

It shall be mandatory for the mine operator to display PPE wear signage as displayed in Figure 5 and 6.

Figure 9 — Mandatory requirements

14 Health of employees

14.1 Insurance of employees

Prior to the commencement of work, the owner shall ensure that each and every employee has insurance for health and accidents.

14.2 Noise level surveys

14.2.1 Noise surveys shall be conducted and the noise levels shall be measured in areas where noise exposure is likely to be hazardous throughout an entire plant or in workplaces underground to identify noisy areas.

14.2.2 The noise survey shall identify:

a) areas where employees are likely to be exposed to harmful levels of noise and PPE may be needed;

b) machines and equipment which generate harmful levels of noise;

c) employees who might be exposed to unacceptable noise levels.

14.3 Temperatures

14.3.1 Managers shall ensure that measures and precautions are implemented to protect employees from heat at mine sites.

14.3.2 Managers and supervisors shall ensure that the safety and occupational health needs of people working at the mine are appropriately monitored and workplace temperature hazards are detected.

14.3.3 Mine operators shall:

a) appoint trained staff to measure the appropriate heat stress index and monitor employees for heat illness;

b) establish cool rest areas that have cold drinking water and are close to “hot” work sites;

c) provide suitable canopies, cabins or clothing to protect staff from direct sunlight in above-ground mines.

14.4 Symptoms and treatment

14.4.1 Heat exhaustion

The symptoms of heat exhaustion are headaches, dizziness, light headedness, weakness, mood changes, (that is, feeling irritable or confused), vomiting, decreased and dark coloured urine, fainting and pale clammy skin. If heat exhaustion is not treated, the illness may advance to a heat stroke.

14.4.2 Heat stroke

The symptoms of heat stroke are dry pale skin (no sweating), hot red skin (looks like a sunburn), mood changes, (that is, feeling irritable or confused), seizures, fits, collapse and unconsciousness.

14.4.3 Treatment

All cases of heat illness shall be taken seriously as there is a high risk of death resulting from lack of treatment. Medical attention shall be sought as soon as possible. All cases of heat stroke shall be treated as an emergency and the patient taken to hospital.

14.5 Dust control

14.5.1 General

Appropriate Personal Protection Equipment shall be used where dust particles concentration of size ranging from 0.001 to 0.1 mm (1 to 100 µms) are encountered airborne to prevent reducing visibility, irritation of eyes, ears, nose, throat and skin and damage to the tissues of the lungs.

14.5.2 Dust control methods

14.5.2.1 The strategy to control dust shall include the establishment of a dust control programme for the purpose of:

a) monitoring and analyses of airborne dust;

NOTE Examples of matter to be monitored and analysed include particulate matter such as $PM_{2.5}$.

a) implementation of corrective action to control generation of dust;

b) limit employee exposure to dust, where required; and

c) personal exposure records.

14.5.2.2 The methods by which dust in working places is controlled include the following:

a) wet drilling and water mist drilling;

b) proper ventilation of working places, particularly dead ends (for example, by supplying dust-free air to the face);

c) wetting muck piles when moving broken rock, loading trucks or dumping into bins or stockpiles;

d) use of wetting agents with water in selected processes; and

e) use of total wet processes in crushing and screening plants.

14.5.3 Medical examination

14.5.3.1 Medical checkups shall be done in accordance with relevant instructions from the Competent Authority.

14.5.3.2 Employees working physically in diggings, underground transportation, blasting, drilling, processing shall present a medical certificate of fitness before the first day of work.

14.5.3.3 Medical examinations shall be conducted on all employees on the following tests:

a) hearing;

b) blood pressure;

c) vision;

d) lung (Breathing); and

e) communicable diseases (e.g.: tuberculosis, etc.).

14.5.3.4 other tests can be done depending on operations undertaken or as may be recommended by the Competent Authority

14.5.3.5 Regular check-ups shall be done once a year or whenever a competent authority deems it necessary.

14.5.3.6 Medical examinations shall be documented and presented to the competent authority when required.

NOTE Relevant instructions from the Competent Authority refers to Instructions on occupational safety issued by relevant authority such as listed in Bibliography (v).

14.6 Vibrations control

14.6.1 General

14.6.1.1 Workers operating handheld machinery, especially pneumatic rock drills and pick hammers, even for one hour a day, can suffer from the effects of vibration in their hands and arms.

14.6.1.2 Vibration White Finger (VWF) or “dead finger” starts when the fingers become numb.

14.6.1.3 VWF can lead to Gangrene, which is the death of tissues which often occurs in the extremities or skin from loss of blood supply.

14.6.1.4 Regular exposure to vibrating tools can cause damage to your hand’s nerves, joints and blood vessels, making it more difficult for blood to pump to your fingertips.

14.6.1.5 Symptoms include discoloured skin, severe pain followed by numbness and foul discharge.

14.6.1.6 There is no cure for Vibration White Finger.

14.6.1.7 Employees shall not be exposed to vibrations exceeding the tolerance limits specified in RS 237.

14.6.7.8 Safety procedures and instructions shall be documented and communicated to employees regularly.

14.6.2 Prevention and control of vibration

14.6.2.1 Avoid long periods using handheld vibrating equipment. Work in short bursts, e.g.:. Take regular breaks of at least 10 min every hour away from the tool.

14.6.2.2 Use modern, vibration-dampened equipment.

14.6.2.3 Repair or replace old equipment or fit anti-vibration handles.

14.6.2.4 Grip handles as lightly as possible.

14.6.2.5 Support heavy tools so that a lighter grip can be used.

14.6.2.6 Maintain vibrating tools to minimize vibration levels.

14.6.2.7 Store tools so that they do not have very cold handles when next used.

15 Mine facilities

15.1 Location of offices, first aid facilities and parking

15.1.1 All offices, first aid room and parking facilities shall be located outside the operational area and shall be easily accessible.

15.1.2 It shall be a requirement for a site manager to set up suitable facilities at the mine site.

15.2 Hygienic facilities

Hygienic facilities shall be provided to the mining site and shall take into consideration special needs for males and females. Hygienic facilities shall include but not limited to the following:

a) toilets (latrines);

b) washrooms;

c) handwashing facilities; and

d) changing rooms.

15.3 First aid room records

15.3.1 Every mine site shall have a first aid room and there shall be sufficient first aid kits.

15.3.2 Every mine site shall have trained personnel on the use of first aid kit.

15.3.3 Requirements for the first aid facility are laid out in Annex A.

15.3.4 The following book particulars shall be recorded in accordance with ISO 19434:

a) case treated, stating the name of the injured or sick person;

b) the nature of the injury or illness;

c) the treatment given;

d) the name of the person administering the treatment and the date; and

e) time of the treatment.

16 Reporting of incidents and accidents

16.1 Incident reporting

16.1.1 All injuries, no matter how slight, shall be reported immediately to the responsible mine official.

16.1.2 An incident report form shall be completed and taken, with the injured person to the health Centre/clinic/hospital and a copy of incident report kept.

16.1.3 The incident report form is as set out in Annex G.

16.1.4 A preliminary report form shall be completed within 24 h of the incident happening and communicated to the competent authority.

16.1.5 A final investigation report shall be conducted and report sent to the competent authority within 48 h.

16.2 Registration of incidents and accidents

16.2.1 The mine manager is required to maintain a register of any accident, dangerous occurrences (incidents) and diseases. The register shall avail to the inspector of the competent authority and its extracts shall form a report to the competent authority.

16.2.2 When any employee contracts a disease listed as notifiable by the relevant competent authority (e.g.:. Ministry of Health, Ministry of Labour, etc.), the manager shall immediately notify such cases to the competent authority.

16.3 Reportable accidents and incidents

16.3.1 The following accidents shall be immediately reported to the competent authority:

a) involving death of a person;

b) in which any person becomes unconscious or is admitted in a hospital; and

c) accident in which the injuries sustained by any person could lead to permanent disability.

16.3.2 The presumed cause of accident shall accompany the notification to form the basis of further investigation of the real cause of the accident.

16.3.3 The following types of incidents occurring at the mine site shall be notified immediately and reported to the competent authority within 24 h of occurrence:

a) any accident due to explosives including an accidental ignition or detonation of explosives;

b) the flooding of any considerable portion of the workings or the failure of any dam or reservoir used for conserving water or slimes;

c) any accidental explosion or large fire due to the ignition of dust, gas, oil or vapour;

d) any accidental fire underground or accidental large fire on the surface;

e) any electrical shock or burns to a person who consequently receives medical treatment;

f) the extensive caving of any underground working or any extensive subsidence of any ground which is not normal for the method of mining in practice;

g) any prolonged failure of the main ventilation system or part of it; and

h) the reports shall be made out in the reporting format set out in the Annex F.

16.4 Analysis and classification of incidents/accidents

Incidents and accidents shall be classified in accordance with ISO 19434.

17 Machinery isolation procedures

17.1 Isolation procedures

17.1.1 The isolation procedures shall be a systematic way of identifying the sources of energy that, if uncontrolled, could cause injury; and controlling the activation of that energy source by other people.

17.1.2 The procedure shall be done as follows:

Step 1 – Identify all equipment to be isolated confirm that the switches, valves, chains, locking pins and other devices to be used to isolate the system are the correct ones as per example in Figure 9.

Step 2 – Determine the correct point of isolation. Positive isolation can only be achieved by isolating the sources of energy from the equipment to be worked on. Use main switches, circuit breakers, de-contactors, valves, locking devices for isolation. Do not use push button, conveyor lanyard switches, control circuit devices.

Step 3 – Carry out the isolation.

Step 4 – Test the effectiveness of the isolation.

Step 5 – Place safety lock/tag(s) on isolating device(s).

Figure 10 — An example of isolation: isolated switch

18 Tailings Storage Facility (TSF)

18.1 Storage of tailings

The selection of the tailings storage facility (TSF) shall offer the safety, long term storage of tailings with minimal environmental impact.

18.2 Design and operating requirements of a TSF

18.2.1 The design and construction of a TSF shall be in accordance with applicable standards. It shall be undertaken and supervised by suitably experienced personnel.

18.2.2 In the operational phase, an inspection and audit by competent engineer shall be done every six months.

18.2.3 A plan for rehabilitation and decommissioning of TSF shall be made by a competent engineer and maintained at site by the Mine Manager.

18.2.4 The Mine Manager shall ensure that the mine has developed Emergency Response Action Plan on the TSF.

18.2.5 Records on periodic internal inspection of TSF shall be maintained at the mine site.

19 Emergency response preparedness (ERP)procedures

An ERP shall include:

a) engineering controls (such as containment, automatic alarms, and shutoff systems) proportionate to the nature and scale of the hazard;

b) identification and secure access to emergency equipment available on-site and nearby;

c) notification procedures for designated emergency responders;

d) diverse media channels for notification of the affected community and other stakeholders;

e) a training programme for emergency responders including drills at regular intervals;

f) public evacuation procedures;

g) designated coordinator for ERP implementation; and

h) measures for restoration and clean up of the environment following any major accident.

19.1 Emergency evacuation signage

Personnel shall look out for signs that shall be standard as per Figure 10. Other safety signs can be used as appropriate. RS ISO 7010 gives more examples of registered safety signs.

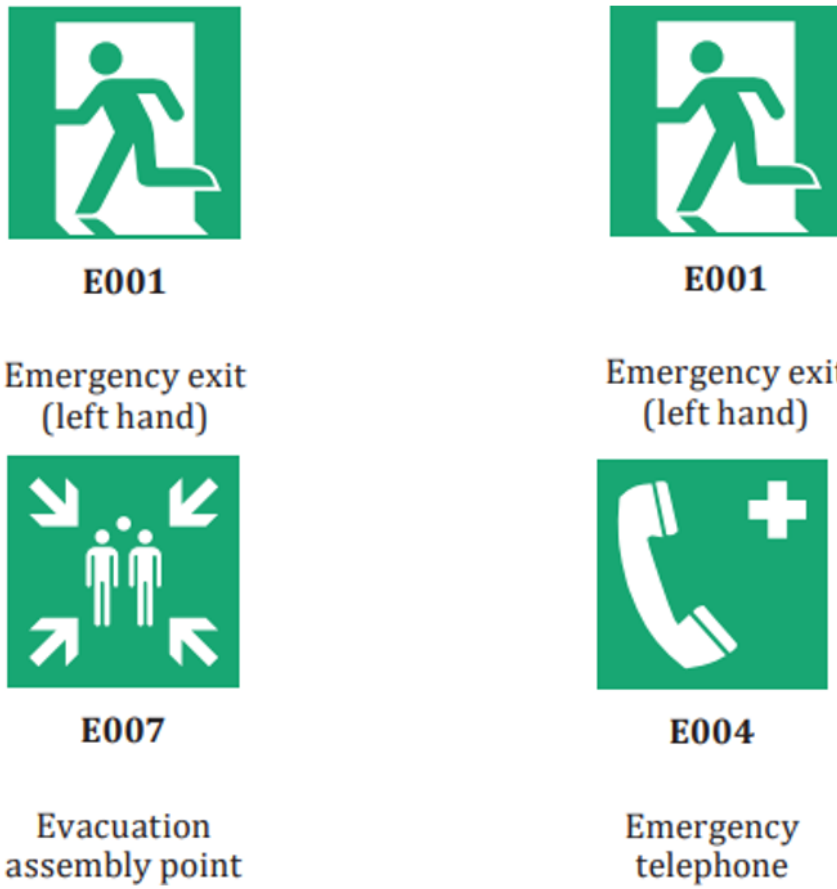
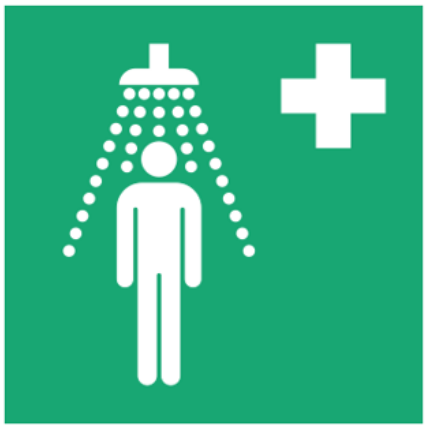


Figure 11 — Example safety signs for emergency evacuation

19.2 Workers exposed to chemicals

At site where workers are likely to be exposed to chemicals, clear signs shall be in place. Figure 11 gives example signs as per RS ISO 7010.

To signify that protective clothing must be worn



To indicate the location of a safety shower

To signify that protective gloves must be worn

To signify that safety footwear must be worn

Figure 11 — Example of safety signs for areas where workers are likely to be exposed to chemicals

19.3 Firefighting equipment

In case of fire, personnel shall look for fire extinguishing equipment. Annex B gives guidance on fire fighting and classification of fires.

Figure 12 — figure title?????

19.4 Medical emergency signs

The following sign shall be used for medical emergency. The CROSS indicates the First Aid Box and an arrow can be used to indicate the location of the FIRST AID box/station.

Figure 13 — Example safety sign for medical emergency location

20 Mine security and access control

20.1 All visitors and employees at mine site shall be recorded upon arrival.

20.2 Only authorized vehicles are allowed access to the mine.

20.3 All persons shall stay clear from “No-Entry Zones” unless entry is authorized.

20.4 Alcohol and drug are prohibited at mine site.

20.5 Any person present at mining site shall not be under influence of drugs and alcohol.

20.1 Mandatory signs to be observed

Signs shall be placed at visible places at the mines and shall be observed at all times by employees and visitors.

Figure 14 — figure title?????

20.2 Signs to prohibit alcohol and drugs at mines

20.3 Management of wastewater

20.3.1 Wastewater resulting from mining activities shall meet the requirements of RS 109 prior its disposal into the environment.

20.3.2 Records of quality of wastewater discharges shall be documented and availed during the inspection.

NOTE Whenever deemed necessary, competent authority has the right to require a third party verification of wastewater quality.

20.4 Artisanal traditional processing of minerals

20.4.1 A mine manager shall develop a plan of replacement of ground sluicing methods with appropriate technology to minimize loss of minerals and prevent damage to the environment.

20.4.2 The use of chemicals in mineral processing shall be prohibited.

20.4.3 The mine manager shall ensure that the environmental safety measures are in place for:

a) water conservation;

b) erosion prevention;

c) preventing contamination;

d) disposal of solid waste products; and

e) preventing siltation of streams.

20.4.4 The mine manager shall ensure that persons involved in ground sluicing operations are provided with appropriate PPEs.

20.4.5 Tailings from the processing shall be stored in a properly constructed embankment and tailings dam.

20.5 Standard Operating Procedures for mechanized minerals beneficiation

20.5.1 Manager shall develop equipment operating procedure based on the user and operational manuals of the original equipment manufacturer.

20.5.2 The procedure shall include use and safe operation of the processing equipment, movements, safety precautions around the operational areas, maintenance, lockout, hazard identification and responsibility. Environment safety measures shall be put in place considering requirements of Clause 24.4.3 of this Standard.

21 Community living in proximity of operations

21.1 Community relations

21.1.1 Before the start of operations, the owner shall meet applicable statutory and regulatory requirements.

21.1.2 The owner shall conduct environmental and social impact assessment (ESIA); where ESIA certificates and its conditions of approval require the land acquisition. The mining/quarrying operations shall start only if affected people have been expropriated/relocated.

21.1.3 In case the environmental and social audits of mining/quarrying operations reveal that ongoing mining operations have impact that requires relocation of affected local community, mining/quarrying activities shall resume only after relocating/expropriating affected community.

21.1.3 The owner shall develop and respect the provisions of Corporate Social Responsibilities (CSR) and keep records of its implementation.

21.2 Protection of people against mine health hazards

21.4.3 The owner shall take reasonable steps to protect persons living in the mining areas against health hazards including dust, water contamination anderosion, as a result of operations and noise pollution.

21.2.2 The mine shall put in place periodic monitoring of the environment through collection and analysis of samples.

21.3 Keeping mining operational areas secure

21.3.1 The Mine manager shall ensure that the operational areas of the mine are well secured to avoid entry by people living in the vicinity of the mines.

21.3.2 Warning signs shall be displayed to caution people.

21.3.3 Mine vehicles and equipment shall be operated in a safe manner ensuring the safety of persons living in mining areas.

21.3.4 Sites, that is, shafts and tunnels at the mine that for some reason are closed off and not in use shall be protected and barricaded with proper signage "**DANGER, NO ENTRY**".

21.3.5 Where an excavation into which a person may fall, is made, the material excavated shall be used to form a regular ridge around the boundary of the excavation.

21.4 Protection against subsidence and caving

21.4.1 Where any mining operation has caused or is likely to cause any crack, subsidence or cavity on the surface in any area, the whole of the area shall be kept fenced with appropriate sign to be placed warning people of possibility of subsidence.

21.4.2 The Mine manager shall take steps to ensure that there is a designed safety pillars to protect surface installations, dwellings on top of mine workings.

21.4.3 No mining operation shall take place when it is likely to cause any crack, subsidence or cavity on the surface within a horizontal distance of 50 m from any building, road, railway, lake, river, tailings dump or any other structure or feature on the surface requiring protection.

21.4.4 No person shall erect or construct a building, road or railway within 50 m from the caving areas.

21.5 Mine plans

21.5.1 At all mine sites, plans of the mine shall be prepared and held at the site office to facilitate emergency responses and prevent injury and damage to services.

21.5.2 The surface plans shall show the boundaries of the surface area, positions of the buildings, processing facilities, internal and access roads, geographical features and assembly points.

21.5.3 The positions of the mine, mine adits and shaft entries including the electricity and water reticulation lines and compressed air line shall be indicated on the plans.

21.5.4 The mine plans shall be identified by numbering and include the date they were finalized and the date they are to be reviewed and each plan shall be signed by a competent person.

21.5.5 The plan shall include location of tunnels, include ventilation, location of old workings, geological features, bore holes etc, where applicable.

21.6 Policies

21.6.1 An operating mine shall develop a policy on Environmental Management and Occupational Health and Safety.

21.6.2 Employees shall be trained on the above policies and shall be documented.

NOTE The competent authority may require the development of other policies on safety, health and environment and standard operation procedures in order to enhance the implementation of best mining practices.

Annex A
(normative)

Items to be kept in first-aid

A.1 The following items are to be kept and maintained in first-aid boxes whose standard dimensions shall be, length 63.5 cm, width 38 cm and height 12.5 cm, and are a minimum requirements:

A.1.1 Splints

Eight splints with metal junctions.

Two rectangular splints for injuries to elbow, forearm, wrist and hand (Recommended size 500 mm X 230 mm X 75 mm).

A.1.2 Tourniquets

Two rubber tourniquets, one for the upper limbs and one for the lower limbs.

Two tourniquet "twisting sticks", one 150 mm long, one 230 mm long.

A.1.3 Bandages

The following shall be available:

a) Eighteen triangular bandages.
b) Twelve sterilized small first aid packets "finger dressing" size.
c) Eight sterilized medium first aid packets "first field dressing" size.
d) Four sterilized large first aid packets "shell dressing" size.
e) Each packet of above dressing to be in waterproof cover with rolled bandage lightly stitched on at back of dressing of gauze and wool 500g tow.
f) 250g packet cotton wool.
g) Twelve assorted safety pins.
h) Four 30 g packets white lint.
i) One 60 ml bottle labelled "Antiseptic - Poison - For External Use Only".
j) Eye drops, one 30 ml dropper bottle sterile liquid paraffin.
k) One small pair of scissors.

The whole of the above splints, tourniquets, bandages and dressings shall be packed in a strong metal box fitted with leather straps and a handle.

Annex B
(normative)

Fire-fighting

B.1 General

B.1.1 Suitable fire-fighting equipment means a fully equipped fire-fighting unit capable of extinguishing every type of fire, or where this is not possible or unduly onerous, adequate provision of supplies of water, suitable fire-extinguishers or containers filled with sand or inert dust at places where they are adequate and suitable for the fire risk involved.

NOTE "Adequate supplies of water" means water sufficient in quantity, supplied at a pressure not less than 3.5 bars, at a rate of not less than 270 l/min through pipes, hoses and hydrants.

B.1.2 For the purposes of this Standard, fires are classified in accordance with RS ISO 3941 where:

Class "A"

These are fires involving solid materials normally of an organic nature (compounds of carbon), in which combustion generally occurs with the formation of glowing embers.

Water in the form of a jet or spray or such other agents as the Mine Manager may in writing approve, may be used as suitable fire-extinguishing agents.

Class "B"

These are fires involving liquids or liquefiable solids. For the purpose of choosing effective extinguishing agents inflammable liquids may be divided into two groups:

a) those that are miscible with water; and

b) those that are not miscible with water.

Where the fire falls under B a), the extinguishing agents include water spray, foam, and vaporising liquids; and where the fire falls under B b), the extinguishing agents are vaporising liquids, carbon dioxide and dry chemical powders and such other agents as the Mine Manager may approve in writing.

Class "C"

These are fires involving gases or liquefied gases in the form of a liquid or gas leak or liquid spillage and these include methane, propane, butane. Foam or dry chemical powder can be used to control fires involving liquid spills and gas leaks. Water, in the form of spray, may only be used to cool the containers.

Class "D"

These are fires involving metals. Extinguishing agents containing water are ineffective and even dangerous; carbon dioxide and the bicarbonate classes of dry chemical powders may also be hazardous if applied to most metal fires. Powdered graphite, powdered talc, soda ash, limestone and dry sand are normally suitable for Class `D' fires. Special fusing powders may also be used for fires involving some metals, especially those which are radioactive.

B.2 Electrical fires

B.2.1 It is not considered, according to present-day ideas, that electrical fires constitute a class, since any fire involving, or started by, electrical equipment shall in fact, be a fire of Class A, Class B or Class D. The normal procedure in such circumstances is to isolate the electricity and use an extinguishing method appropriate to the substance which is burning. Only when this cannot be done with certainty shall special extinguishing agents be required which are non-conductors of electricity and non-damaging to equipment; these are vaporising liquids, dry powders and carbon dioxide and such other agents as the Mine Manager may in writing approve, although the cooling and condensation effects of carbon dioxide may affect sensitive electronic equipment.

B.2.2 Suitable fire-extinguisher means, a fire-extinguisher designed for use on a fire in its earliest stage and not expected to be effective after a fire has reached large dimensions. Fire-extinguishers differ and each type is limited in application to certain kinds of fire. It is essential that the correct type of fire-extinguisher is used depending on the nature of the source of the fire, according to the international classification of fires quoted.

B.2.3 A competent person, fully trained and experienced in fire-fighting, shall decide upon the correct type and size of fire-extinguisher to be located at places where an extinguisher is required to be provided according to the relevant regulations.

B.2.4 Fire-extinguishers shall be carefully maintained to ensure instant readiness when required.

Annex C
(informative)

Competency testing

Competency testing may include the following:

a) harness;
b) blasting ticket;
c) Manager Competency ticket;
d) approval of safety helmets, PPE;
e) winders
f) rock breakers; and
g) self-propelled vehicles approval of type or class of self-propelled vehicle for use underground.

Annex D
(normative)

Maximum permitted quantities of certain gases

Description of gas	Maximum permitted quantity of gas in parts per million
1.Carbon dioxide	7 500
2.Carbon monoxide	100
3.Nitrous fumes	10
4.Sulphur dioxide	20
5.Hydrogen sulphide	20

Annex E
(normative)

Work shift logbook

E.1 A work shift logbook

A work shift shall bear the following minimum information:

Company name				
Company's address	District		Sector	
Site name:		Supervisor		
Total employees/shift				
Time in		Time out		
Handover time				
Handover details (Working comments)				
Handover to				
Time in		Time out		
Date/Closing shift signature		Date/Open shift signature		

E.2 List of shift workers

No	Names	ID Number	Gender

Annex F
(normative)

Preliminary report from preliminary incident report

Subject:

Incident Date:		Mine:	
Incident Time:		Manager:	

1. Description of Incident (with Photos if possible):

……

……

……

2. Immediate Causes Identified:

……

……

3. Key Learning's:

……

……

4. Corrective Actions:

……

……

Annex G
(normative)

Accident report form

This form shall be completed for reportable accidents in terms of regulations and dangerous occurrences

SECTION 1: EMPLOYER DETAILS

1. NAME OF OPERATOR: ……

2. NAME OF MINE SITE:

3, DISTRICT:

4. MINERAL(S) MINED:

SECTION B: ACCIDENT OR DANGEROUS OCCURRENCE DETAILS

1. Mine accident or number……

2. Number of persons killed……

3. Number of persons totally disabled……

4. Number of persons injured ……

5. Date of accident or dangerous occurrence

6. Time of accident or dangerous occurrence

7. Location of accident or dangerous occurrence

8. Name of working place

9. Depth below surface (in metres)

10. Description of accident or dangerous occurrence in words

……
……

11. Did accident or dangerous occurrence occur during normal working hours or overtime?

☐ Normal ☐ Overtime

12. Did accident or happen at normal workplace? ☐Yes ☐ No

Section C: Responsible persons

NAME	IDENTITY NUMBER	OCCUPATION
……..	……	……
Name of Manager/Technician	Signature	Date
……..	……	……

SECTION 2: FOR USE BY THE REGULATION AND INSPECTION UNIT

1. ACCIDENT OR DANGEROUS OCCURRENCE NUMBER……
2. DATE REPORTED ……
3. TYPE OF ACCIDENT OR DANGEROUS OCCURRENCE
4. PROBABLE CAUSE OF ACCIDENT OR DANGEROUS OCCURRENCE
5. CONTRAVENTION IN INSPECTOR'S OPINION
6 IF YES, ACT/STANDARD CONTRAVENED
7 ACTION RECOMMENDED
8. DATE EVALUATION FORM COMPLETED
9. INSPECTORATE DETAILS: NAME (IN BLOCK LETTERS)

   DATE SIGNATURE

10. MINE INSPECTOR:

11 DIRECTOR REGULATION AND INSPECTION:

12. ARE CRIMINAL PROCEEDINGS ENVISAGED? ☐YES ☐NO

Annex H
(normative)

Template with guidance on how to conduct hazard and risk assessment

Table H.1 — Risk Assessment — Hierarchy of controls

Elimination	The most satisfactory method of dealing with hazards is to get rid of them. Once a hazard has been eliminated, the potential for harm has gone.
Substitution	This involves substituting a dangerous process or substance with one that is not as dangerous.
Isolation	Separate or isolate the hazard from the people.
Engineering	Introduce or substitute an engineered device to eliminate or reduce the risk.
Administrative	Administrative solutions usually involve modification of the likelihood of an accident happening. This is done by reducing the number of people exposed to the hazard, and by ensuring that those who shall remain exposed know about the hazard and how best to manage it. Administrative solutions also include danger signs and written systems of work, such as those for working in confined spaces and lock-out procedures.
PPE	Provision of personal protective equipment shall only be considered when all other control methods are impractical. They provide a means to increase control and offer a last line of defence when used with another method higher up the hierarchy.

Table H.2 Classification of risk and rating

Step 1. Assess the Likelihood			Step 2. Assess the consequences			
L1	happens every time we operate	Almost Certain	Common or repeating occurrence	C1	Fatality	Catastrophic
L2	happens regularly (often)	Likely	known to have occurred “has happened”	C2	Permanent disability	Major
L3	has happened (occasionally)	Possible	could occur or “heard of it happening”	C3	Medical/hospital or lost time	Moderate
L4	happens irregularly (almost never)	unlikely	not likely to occur	C4	First aid or no lost time	minor
L5	improbable (never)	Rare	practically impossible	C5	No injury	insignificant

Once the likelihood L1 to L5 and consequence numbers C1 to C5 are selected, a single Risk Rating can be selected from Table H.4.

Table H.3 Risk matrix

Risk Rank Likelihood x Consequence	L1 Almost certain	L2 Likely	L3 Possible	L4 Unlikely	L5 Rare

C1 Catastrophic	A	B	C	G	H
C2 Major	D	E	I	J	P
C3 Minor	F	K	L	Q	R
C4 Minor	M	N	S	T	U
C5 Insignificant	O	V	W	X	Y

Table H.4 Risk rating

Risk rating	
Highy risk	A-F
Medium Risk	G-M
Low Risk	P-Y

Annex I
(normative)

Daily logbook for examinations to be carried out in underground mine working areas prior to access

Table I.1 — Daily logbook of underground mine access

Company Name:

Tunnel/Adit/Shaft Name: Mine site name:

Starting date…….. Ending date ……..

No		Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday	
		D/S	N/S	D/S	N/S	D/S	N/S	D/S	N/S	D/S	D/S	D/S	N/S	D/S	N/S
1.	All main entrances are in good condition?														
2	Do all employees wear PPE?														
3	Are there any hanging walls?														
4	Are gravitational sources such as roofs, backs, sides, floor and walls in good condition?														
5.	Are ventilation units in good condition?														
6.	Oxygen is sufficient in all underground														

	openings and no dust?														
7.	Is the lighting and supply system in good condition?														
8	Is the installed underground support system in good condition?														
9	Gases such as H2S, CO, CO2 NOx have been checked?														
10	Equipment and tools used today are in good condition?														
11	Ladders are in normal condition?														
11	Other findings														
	Is it permitted for workers to enter?														
	Day Team Leader (Name and Signature)														
	Evening shift Team Leader (name and Signature)														
	Day comments														
	Evening comments														
	Supervisor (name and Signature and comment.														

Table I.2 Action plan

date	Hazards obtained	Risk Rating	Actions for Eliminating or minimizing Risk	Action by Whom/position	Target date	Completion Date	Signature

D/S*: Day Shift, N/S*: Night shift

Annex J
(normative)

Daily logbook of ventilation fans

Table J.1 — Daily log book of ventilation fans

Company name				
Site name				
Date				
Tunnel Adit/Shaft Name				
Serial number				
Flow rate capacity (CFM)				
date	**Are the following symptoms observed during day work?**	**Tick DS* / NS***	**Suggested maintenance**	**Assessor name and signature**
	Too much noise			
	Fairly to start			
	fan operating too hot			
	Decreased discharge airflow rate.			
	Shootdown itself			
	Other symptoms			
	Is it permitted to use assessed equipment?			
	If no Suggested maintenance and any comment.			

DS: Day Shift, NS: Night Shift

Annex K
(normative)

Template for delegation of authority

K.1 General

The template below shall be used to delegate authority

Template K: Template for delegation of authority

Company name:	District & Sector:	
Names of Staff and Position: Tel:	Date	signature
Reason for absence:		
From:	To:	
Names of appointed person: Tel:	Date	signature
Approved by the in-charge of human resources Names:	Date	signature

Bibliography

[1] ISO 22932-2:2020, *Mining — Vocabulary — Part 2: Geology*

[2] ISO 14159:2002, *Safety of machinery — Hygiene requirements for the design of machinery*

[3] Law N° 66/2018 of 30/08/2018, *Law regulating labour in Rwanda*

[4] *Ministerial Order N° 013/MOJ/AG/19 of 16/07/2019 determining requirements for granting authorisation to import, manufacture, transport, trade in and use dynamites in mining and quarry operations (Article 24)*

[5] RS 413: 2020, *Furniture — Quality and grading of wooden furniture*

[6] N° 02/MIFOTRA/22 of 30/08/2022, *Ministerial Order on occupational safety*

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