



**RWANDA
STANDARD**

**DRS
117-5**

First edition

2023-mm-dd

**Mining and quarrying — Health and safety
requirements**

Part 5: Blasting

ICS 73.020; 13.100

Reference number

DRS 117-5: 2023

© RSB 2023

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

© RSB 2023

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without prior written permission from RSB.

Requests for permission to reproduce this document should be addressed to:

Rwanda Standards Board

P.O Box 7099 Kigali-Rwanda

KK 15 Rd, 49

Tel. +250 788303492

Toll Free: 3250

E-mail: info@rsb.gov.rw

Website: www.rsb.gov.rw

ePortal: www.portal.rsb.gov.rw

Contents		Page
1	Scope.....	1
2	Normative references.....	1
3	Terms and definitions	1
4	Underground blasting.....	7
4.1	General poor ground control measures.....	7
4.2	Preparation of a working face or end	7
4.3	Procedures on washing and cleaning at the tunnel face	8
4.4	Standard practices for barring down of hanging rocks	8
4.5	Procedure on washing or pumping out sockets.....	9
4.6	Standard practices for marking the heading/face for drilling.....	10
5	Blasting	14
5.1	Design requirements for open-pit mining/quarries and Underground Mining.	14
5.2	Safety and health requirements during blasting.....	17
5.3	Determination of the bounds of blast area	18
5.4	Pre-blasting survey.	18
5.5	Blasting procedures.....	18
5.6	Procedures on safety operations of mining equipment.....	21
	Annex A (normative) Blasting survey cover form.....	22
A.1	General	22
	Bibliography.....	25

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 117-5 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: General requirements*
- Part 3: Open pit mining
- Part 4: Underground mining
- Part 5: Blasting

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

Ngororero Mining Company (NMC) 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

Copy for public comments

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.

Copy for public comment

Mines and quarries — Health and safety requirements — Part 5: Blasting

1 Scope

This Draft Rwanda Standard provides health and safety requirements for blasting operations in open-pit, quarries and underground mining.

General health and safety requirements for mining and quarrying are covered in DRS 117-2.

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.

RS ISO 3941, *Classification of fires*

3 Terms and definitions

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

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.

3.3

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

3.7

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 authority

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

3.31**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

person having agreed to work for an employer under a contract concluded between them, and in return for remuneration

4 Underground blasting

4.1 General poor ground control measures

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

4.1.2 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.

4.1.3 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.

4.1.4 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.

4.1.5 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.

4.2 Preparation of a working face or end

4.2.1 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.

4.2.2 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.

4.2.3 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.

4.2.4 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.

4.3 Procedures on washing and cleaning at the tunnel face

4.3.1 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

4.3.2 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.

4.4 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).

4.4.1 Procedure

4.4.1.1 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.

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

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

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

4.4.1.5 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.

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

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

4.4.1.8 Avoid standing on unstable rock pile whilst barring down.

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

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

4.4.1.11 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.

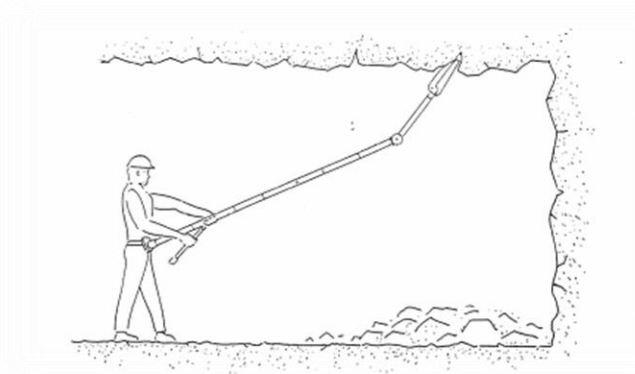


Figure 1 — Barring Down – making work safe using pinch bar



Figure 2 — Pinch bar (one Version)

4.5 Procedure on washing or pumping out sockets

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

4.5.2 Wash the drill face thoroughly well with water.

4.5.3 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 ninety - degree bend to allow the miner to stand clear from the direction of the hole being pumped.

4.6 Standard practices for marking the heading/face for drilling

4.6.1 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.

4.6.2 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.

4.6.3 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.

4.6.4 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.

4.6.5 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.

4.6.6 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.

4.6.1 Determining and marking of the centre line

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

4.6.1.2 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.

4.6.1.3 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.

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

4.6.2.1 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

4.6.2.2 Mark the machine man's jumper direction lines and mark the drill holes and pilot hole positions following the appropriate drill pattern.

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

Five-hole Burn-cut, mark a centre hole to the stub, relief or void hole. Mark four holes around the centre.

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.

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

Perimeter holes, top holes - marked 0.1m below the hanging wall 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.

Lifter holes, marked 0.1m above footwall limiting line at 0.6m intervals.

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

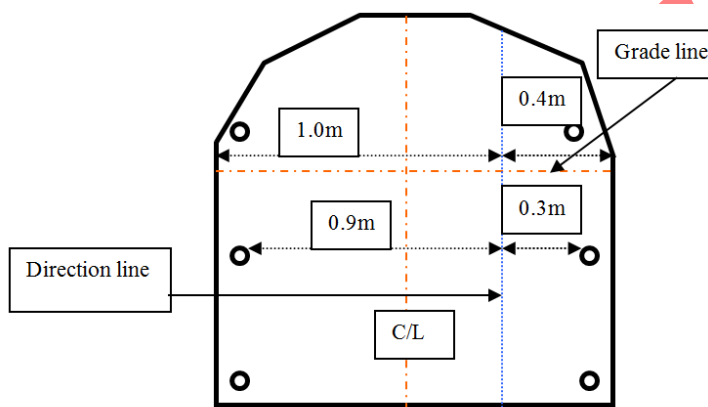


Figure 3 — Across section view of machine men direction lines in a straight end

4.6.3 Number of blast hole in hard rock mined underground

Table 1 gives an average number of blast holes common in underground hard rock mining.

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

4.6.4 Procedure on drilling activity of the ends

4.6.4.1 Rig up drilling equipment.

4.6.4.2 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.

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

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

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

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

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

4.6.4.7 Fix bits onto the drill rods.

4.6.5 Lashing of development ends or faces

4.6.5.1 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.

4.6.5.2 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.

4.6.5.3 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.

4.6.5.4 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.

4.6.6 Housekeeping during development of ends and end of shift procedure

- 4.6.6.1** Close water taps, coil hoses and store in crosscuts. Leave fans and air hoses ventilating ends at appropriate discharges.
- 4.6.6.2** Lash and clean around unit areas and leave drains open, water control in good condition.
- 4.6.6.3** Return tools to stores or areas borrowed.
- 4.6.6.4** Leave prop supports, timber packs or other support in place and orderly.
- 4.6.6.5** Clean all platforms of rock debris.
- 4.6.6.6** Defects in equipment are communicated and recorded.
- 4.6.6.7** Crew cards are marked and all work record sheets signed.

4.6.7 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.

4.6.8 Work in two development ends approaching water or gases

4.6.8.1 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.

4.6.8.2 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.

4.6.8.3 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.

5 Blasting

5.1 Design requirements for open-pit mining, quarries and underground mining.

5.1.1 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 blasting operations. The design for blasting operations shall include pre-blasting survey (conditions of neighbour infrastructure within at least 2 km radius).

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

5.1.3 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.

5.1.4 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.

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

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

5.1.1 Charging operations standard procedures

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

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

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

5.1.1.4 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'.

5.1.1.5 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.

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

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

5.1.1.8 Do not enter, permit or instruct anybody to enter a place where charges have been blasted until the fumes have been dispelled.

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

5.1.2 Blasting vibrations

5.1.2.1 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) and 10 mm/sec in open space far from residential areas and underground blasting.

5.1.2.2 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.

5.1.2.3 Vibrations measurements and equipment

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

5.1.2.3.1.1 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.

5.1.2.3.1.2 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.

5.1.2.3.1.3 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 4.



Figure 4 — 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

5.1.3 Determining safe distance from blasting

5.1.3.1 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.

5.1.3.2 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.

5.1.3.3 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.

5.1.3.4 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.

5.2 Safety and health requirements during blasting

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

5.2.2 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.

5.2.3 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.

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

5.2.5 Post blasting survey is also required.

5.2.6 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.

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

5.3 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.

5.4 Pre-blasting survey.

8.4.1 Prior to a permit to conduct a blast, the applicant shall submit to the Regulatory Authority a pre-blast survey, in accordance with Annex A, carried out on the dwelling and building located within 2 km of any part of the permit area. This survey shall be reviewed and authorized by a competent authority.

NOTE The competent authority may request pre-blasting survey to be conducted by a third-party organization when deemed necessary.

8.4.2 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.

8.4.3 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

5.5 Blasting procedures

5.5.1 General

5.5.1 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.

5.5.2 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

5.5.3 Warning and all-clear signals of various characters that are audible within a range of 2 km 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

5.5.4 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

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

5.5.6 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) surface blasting operation shall not be carried out within 150m of an underground mine not totally abandoned except with the concurrence of the Mining Enforcement and competent authority

5.5.2 Airblast

5.5.2.1 Airblast shall not exceed the limits set forth in accordance with relevant regulations.

5.5.2.2 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.

5.5.3 Monitoring.

5.5.3.1 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.

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

5.5.4 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.

5.5.5 Ground vibration

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

5.5.6 Maximum peak-particle velocity.

5.5.6.1 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.

5.5.6.2 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 seismic record shall be provided for each blast.

5.5.7 Scaled-distance

5.5.7.1 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.

5.5.7.2 The scaled distance may be derived by combining the distance between the source and measurement points, and the maximum charge per delay. This scaled distance shall be defined as follows:

$$S_d = \frac{D}{\sqrt{W_d}} \quad \text{equation (1)}$$

where

S_d is the scaled distance (m/\sqrt{Kg}),

D is the absolute distance between the shot and the station (m), and

W_d is the maximum explosive charge per delay (Kg)

The PPV is given by the equation (2).

$$PPV = K(S_d)^{-n} \quad \text{equation (2)}$$

where

K and n are the site and geological constant factors, respectively.

The site factors are determined by a logarithmic plot of PPV versus scaled distance. The straight-line best representing the data has a negative slope n , and an intercept, K .

5.5.7.3 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.

5.5.7.4 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; and
- 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.

5.5.8 Records of blasts

Records of each blast, including seismograph reports, shall be retained for a minimum of 5 years 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 metre, to the 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.

5.6 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.

Annex A
(normative)

Blasting survey cover form

A.1 General

The template below shall be used to conduct pre- and/or post-blasting survey.

Template L: Template for “blasting survey”

Company name: Mining blasting/quarry Blasting	
Information about blasting sites:	
District Name:	Sector Name: cell Name:
Village Name:	
TYPE OF SURVEY	
PRE-BLAST <input type="checkbox"/>	POST-BLAST <input type="checkbox"/>
SURVEY COMPLETED BY :	
Date:	
by signing below, you, the property owner or in charge, agree with all interior and exterior conditions of the indicated blast survey for all buildings upon your property including any supplemental notes and photos. You have initialed/ signed each of the forms contained herein indicating you have read and understand the conditions as described.	
Building/ Infrastructures TYPE:	
Residence :.....	Utility Building:.....
Barn:.....	

Other

Property Owner Names:

Property Address with GPS coordinate:.....

Property Owner Address:.....

CONDITION CODES: (E) – EXCELLENT (G) –GOOD (F) –FAIR

1. (Exterior)

Roofs: Types of materials:

Siding: Types of materials:

Gutters: Type of materials:

Driveway: Types of materials:

Walkways : Types of materials:

Porch(es): Types of materials:

Windows: Types of materials:

Patio(s): Types of materials:

Chimney(s) Types of materials:

Others:.....

1. (Interior)

Interior walls: Types of materials:

Floor: Types of materials:

Others:

Pictures showing cracks if visible

--	--	--	--

Remarks:

SURVEY COMPLETED BY:

Date and signature:

Official stamp.

Property owner names:

Signature:

Date:

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*

Copy for public comments

Copy for public comments

Price based on 24 pages