DEPARTMENT OF MINERAL RESOURCES AND ENERGY

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MINE HEALTH AND SAFETY ACT, 1996 (ACT NO. 29 OF 1996)

GUIDELINE FOR A MANDATORY CODE OF PRACTICE FOR MINIMUM STANDARDS ON GROUND VIBRATIONS, NOISE, AIR-BLAST AND FLYROCK NEAR SURFACE STRUCTURES AND COMMUNITIES TO BE PROTECTED

I **DAVID MSIZA**, the Chief Inspector of Mines, in terms of section 49 (6) read together with sections 9 (2) and 9 (3) of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) as amended, hereby issue the Guideline for a Mandatory Code of Practice for Minimum Standards on Ground Vibrations, Noise, Air-blast and Flyrock near Surface Structures and Communities to be Protected, as set out in the schedule below.

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CHIEF INSPECTOR OF MINES
DEPARTMENT OF MINERAL RESOURCES AND ENERGY

SCHEDULE

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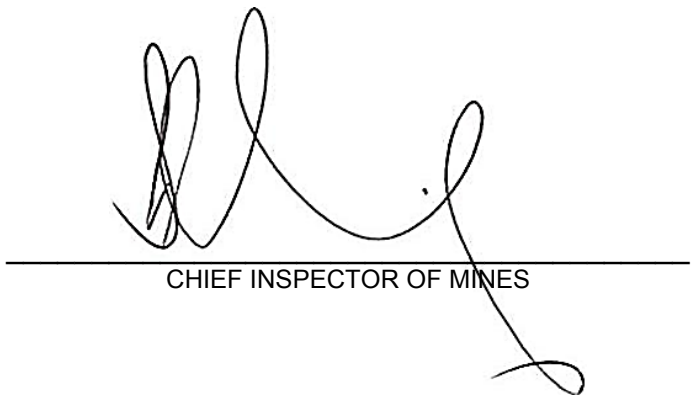
DEPARTMENT OF MINERAL RESOURCES AND ENERGY

MINE HEALTH AND SAFETY INSPECTORATE

GUIDELINE FOR THE COMPILATION OF A

MANDATORY CODE OF PRACTICE FOR

MINIMUM STANDARDS ON GROUND VIBRATIONS, NOISE, AIR-BLAST AND FLYROCK NEAR SURFACE STRUCTURES AND COMMUNITIES TO BE PROTECTED



CHIEF INSPECTOR OF MINES

mineral resources & energy
Department:
Mineral Resources and Energy
REPUBLIC OF SOUTH AFRICA

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PART A: THE GUIDELINE

1. INTRODUCTION

1.1. This guideline (for minimum standards) has been developed to provide a framework within which to manage the risk associated with **ground vibration**, **noise**, **air-blast** and **flyrock** during **blasting** in surface mines of South Africa.

1.2. Considering the absence of any local guidelines in the South African mining industry, the **USBM** standard (*Siskind, Stagg, Kopp & Dowding, 1989)* is generally used to assess whether **ground vibrations** exceed safe limits. Consequently, community members surrounding the mining areas are unhappy with the standards used by the mines as damage and/or deterioration of buildings is noticed, which many people of South Africa (communities included) attribute to **blasting operations** that South African surface mines conduct.

1.3. Following the outcomes of the completed work of the Safety in Mines Research Advisory Committee, the Mining Regulations Advisory Committee established a task team to facilitate the development of a guideline for the compilation of a mandatory **COP** for minimum standards on **ground vibrations**, **noise**, **air-blast** and **flyrock** near surface structures and communities to be protected.

1.4. The development of the foregoing guideline followed the (project) SIM14-09-01: Development of a South Africa minimum standards on **ground vibration**, **noise**, **air-blast** and **flyrock** near surface structures to be protected which was conducted by the Council for Scientific and Industrial Research under the auspices of the Mine Health and Safety Council (Brovko, Kgarume, Singh, Milev, Wekesa, Durrheim, Lumbwe, Pandelany & Mwila, 2016).

1.5. This guideline has been designed around the best practice principles and standards, using the latest operational expertise and application of technology for the measurement, management and monitoring of **ground vibration**, **noise**, **air-blast** and **flyrock**.

2. LEGAL STATUS OF THE GUIDELINE AND COP

2.1. In accordance with section 9(2) of the **MHSA**, an employer must prepare and implement a **COP** on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at a mine when the **CIOM** requires it.

2.2. The **COP** must comply with any relevant guidelines issued by the **CIOM** in accordance with section 9(3) of the **MHSA**.

2.3. Failure by the employer to prepare or implement a **COP** in compliance with this guideline is a breach of the **MHSA**.

3. OBJECTIVE OF THIS GUIDELINE

3.1. The objective of this guideline is to provide a framework with minimum standards for the employers at every mine to consider when compiling a **COP** to protect

surface structures against impacts of **ground vibration, noise, air-blast** and **flyrock** emanating **blasting operations**.

4. DEFINITIONS AND ACRONYMS

4.1. **Air-blast** means a transient change in air pressure arising from the detonation of an explosive that travels through the air at the local speed of sound.

4.2. **Blasting** means the process of reducing a solid body, such as rock, to fragments by using an explosive.

4.3. **Blasting operations** means and include:

- Drilling of charge holes at a mine/bench.
- Placing a charge and detonator in each hole.
- Detonating the charge.
- Clearing away the broken material from the bench.

4.4. **CIOM** means Chief Inspector of Mines.

4.5. **COP** means a Code of Practice.

4.6. **DMRE** means Department of Mineral Resources and Energy.

4.7. **Flyrock** means rock fragments that are propelled beyond the blast area by the force of an explosion.

4.8. **Ground vibration** means any vibration of the earth caused by confined explosions.

4.9. **MHSA** means the Mine Health and Safety Act, 1996 (Act 29 of 1996) as amended.

4.10. **Noise** means merely the audible part of the **air-blast** (> 20 Hertz).

4.11. **Qualified blasting expert** means a person with the relevant **blasting** engineering, in-depth knowledge and extensive relevant experience, who:

- Designs, organises, and supervises controlled blasts.
- Apply a scientific evaluation of the site and the desired outcome.
- Use explosives and initiating systems to achieve various outcomes in the field of mining, demolition or construction, in particular to limit **ground vibrations**, **noise**, **air-blast** and/or **flyrock**.

4.12. **Structure** means any public building, public thoroughfare, railway line, power line, any place where people congregate or any other structure, which may be necessary to protect to prevent any significant risk.

4.13. **USBM** means United States Bureau of Mines.

5. MEMBERS OF THE GUIDELINE REVIEW TASK TEAM

5.1. This document was prepared by members of the task team which comprised of:

CHAIRPERSON		
Mr Gibson Mthombeni		
STATE	**EMPLOYERS**	**ORGANISED LABOUR**
Mr Herbert Netshikweta	Mr Frikkie Fourie	Mr Johnny White
	Mr Corrie Rautenbach	Mr De Wet Blaauw
	Mr Pieter Nieman	Mr Taudi Mokgethi

PART B: AUTHOR'S GUIDE

1. The **COP** must, where possible, follow the sequence laid out in Part C: Format and Content of the **COP**.

2. The pages as well as the chapters and sections must be numbered, where possible, to facilitate cross-referencing.

3. The wording used in this guideline must be unambiguous and concise.

4. Unless otherwise indicated, for the purpose of crafting a **COP**, the meanings of the words mentioned in this guideline will also have the same meanings as those assigned to them in this document.

5. It must be stated in the **COP** whether:

5.1. The annexure forms part of the guideline and must be complied with or incorporated in the **COP**, or whether aspects thereof must be complied with or incorporated in the **COP**.

5.2. The annexure is merely attached as information for consideration in the preparation of the **COP** (i.e. compliance is discretionary).

6. When annexures are used, the numbering should be preceded by the letter allocated to that annexure, and the numbering should start at one again (e.g. A1, A2, A3, etc.).

7. Whenever possible, illustrations, tables, graphs and the like, should be used to avoid long descriptions and/or explanations.

8. When in-text referencing that relates to sources such as publications, and reports, have be done, these sources must be included in the text, as footnotes or side notes, as well as in a separate bibliography section.

PART C: FORMAT AND CONTENT OF THE MANDATORY COP

1. TITLE PAGE

1.1. The **COP** should have a title page reflecting at least the following:

1.1.1. The name of the mine.

1.1.2. The mine code number.

1.1.3. The heading: *Mandatory Code of Practice for the Minimum Standards on **Ground Vibrations**, **Noise**, **Air-blast** and **Flyrock** near Surface Structures and Communities to be Protected.*

1.1.4. A statement to the effect that the **COP** was drawn up in accordance with the guideline with reference number **DMRE 16/3/2/1-A8** issued by the **CIOM**.

1.1.5. The mine reference number for the **COP**.

1.1.6. The effective date of the mine's **COP**.

1.1.7. The revision dates of the mine's **COP** (previous and next revision dates if applicable).

2. TABLE OF CONTENTS

2.1. The **COP** must have a comprehensive table of contents.

3. STATUS OF THE MANDATORY COP

3.1. Under this heading the **COP** must contain statements to the effect that:

3.1.1. The **COP** was drawn up in accordance with the guideline with reference number **DMRE 16/3/2/1-A8** issued by the **CIOM**.

3.1.2. This is a mandatory **COP** in terms of sections 9(2) and 9(3) of the **MHSA**.

3.1.3. The **COP** supersedes all previous relevant **COPs**.

3.1.4. All managerial instructions or recommended procedures and standards on the relevant topics must comply with the **COP** and must be reviewed to assure compliance.

3.1.5. The **COP** may be used in investigations or inquiries in terms of the **MHSA** to ascertain compliance and to establish whether the **COP** is effective and fit for purpose.

4. MEMBERS OF THE DRAFTING COMMITTEE PREPARING THE COP

4.1. In terms of section 9(4) of the **MHSA** the employer must consult with the health and safety committee on the preparation, implementation or revision of any **COP**. If there

is no health and safety committee, the employer must consult with the employee representative referred to in section 3 of this document.

4.2. It is recommended that the employer should, after consultation with the employees in terms of the **MHSA**, appoint a committee responsible for the drafting of the **COP**.

4.3. The members of the drafting committee assisting the employer in drafting the **COP** should be listed giving their full names, designations, affiliations and experience.

4.4. This committee must include competent persons sufficient in number to effectively draft the **COP**.

5. GENERAL INFORMATION

5.1. The general and relevant information relating to the mine must be stated in this section of the **COP**, which must include at least the following:

5.1.1. A brief description of the mine and its geographical location.

5.1.2. The commodities produced at the mine.

5.1.3. The mining methods or mineral excavation processes.

5.1.4. A description of the systems in use at the mine relating to the management of hazards and risks associated with **blasting** related **ground vibration**, **noise**, **air-blast** and **flyrock**.

5.1.5. Other related **COPs**.

6. TERMS AND DEFINITIONS

6.1. Any word, phrase or term of with a meaning is not clear, or which will have a specific meaning assigned to it in the **COP**, must be clearly defined.

6.2. Existing and/or known definitions should be used as far as possible.

6.3. The drafting or reviewing committee should avoid jargon and abbreviations that are not in common use or that have not been defined.

6.4. The definitions section should also include acronyms and technical terms used.

7. RISK MANAGEMENT

7.1. Section 5(2) of the **MHSA** provides that, as far as reasonably practicable, every employer must:

7.1.1. Identify the relevant hazards and assess the related risks to which persons who are not employees are exposed.

7.1.2. Ensure that persons who are not employees, but who may be directly affected by the activities at the mine, are not exposed to any hazard to their health and safety.

7.2. Section 11 of the **MHSA** requires the employer to identify hazards, assess the health and safety risks to which employees may be exposed to while at work and to record the significant hazard(s) identified and risk(s) assessed.

7.3. The **COP** must address how the significant risks identified in the risk assessment process must be dealt with, having regard to the requirements of sections 11(2) and 11(3) of the **MHSA**, which states that as far as reasonably practicable, attempts should first be made to eliminate the risk, thereafter, to control the risk at source, thereafter, to minimize the risk and thereafter, insofar as the risk remains, provide personal protective equipment and to institute a programme to monitor the risk.

7.4. To assist the employer with the hazard identification and risk assessment processes, all possible relevant information such as routine inspections, accident statistics, research reports, geotechnical parameters, rock excavation processes as well as information on geology, hydrology and seismology must be considered.

7.5. In addition to the periodic review required in terms of section 11(4) of the **MHSA**, the **COP** must be reviewed and updated, if necessary.

7.5.1. After every reportable incident or accident relating to the topic(s) covered in the **COP**.

7.5.2. If significant, changes are introduced to procedures relating to the implementation of the **COP**.

8. ASPECTS TO BE ADDRESSED IN THE MANDATORY COP

8.1. The **COP** must address the management of risks and hazards on **ground vibration**, **noise**, **air-blast** and **flyrock** incidents emanating from **blasting** practices at mines.

8.2. The **COP** may be used in conjunction with the standard operating procedures employed at a mine.

8.3. Identification of all relevant structures to be protected (pre-survey to be conducted)

8.3.1. The purpose of the pre-survey

8.3.1.1. Identify the specific type of structure(s), for example a public building, public thoroughfare, a railway line, a power line, any place where people congregate or any other structure that may be necessary to protect.

8.3.1.2. Determine the condition and structural integrity of the structure(s).

8.3.1.3. Measure the distance from where **blasting** is to be conducted to the specific structure and consult with the Principal Inspector of Mines.

8.3.2. A pre-survey must be done, before any **blasting** commences, for structures that is within the affected area. Where no pre-survey was done before **blasting operations** commenced, for example at existing mines, a survey must be done as a matter of urgency and relevant requisite information collected.

8.3.3. This information must be used to determine the site-specific baseline limits, restrictions, and conditions to be complied with for **ground vibrations**, **noise, air-blast** and **flyrock** to ensure that there is no significant risk to the specific structures and the health or safety of persons in the determined area.

8.3.4. The principle of "*who came first*" must be applied. This, therefore, means that:

8.3.4.1. Measures must be put in place to ensure that structures which existed prior to the commencement of **blasting operations** are protected against the risks emanating from **blasting operations**.

8.3.4.2. When new structures are built close to the mine boundary and after mining operations have commenced, these structures should be of a design that enables the structures to withstand the prescribed safety limits without sustaining undue damage. It is the duty of the employer to communicate with the community of the prescribed safety limits.

8.3.4.3. During this process, the need for and frequency of the follow-up surveys of the identified structures exposed to risk must be determined by the relevant appointed committee.

8.4. Drill and blast design

8.4.1. When significant risk to structures due to **ground vibration**, **noise, air-blast** and **flyrock** is determined, site specific drill and blast designs must be developed by a dedicated multi-disciplinary team consisting of, but not necessarily limited to:

8.4.1.1. A **qualified blasting expert**.

8.4.1.2. The relevant explosive manufacturer or supplier.

8.4.1.3. The geologist.

8.4.1.4. The rock engineer or geotechnical expert with appropriate Chamber of Mines (now Minerals Council of South Africa) Certificate in Rock Mechanics.

8.4.1.5. Employee representative.

8.4.1.6. Affected community representative.

8.4.2. This team must determine the drill and blast design to limit **ground vibration**, **noise**, **air-blast** and **flyrock** to below the recommended South African standard as stated in table 1 and 2 below, and as determined by Milestone 5: Scoping of guidelines to ameliorate the effects of **blasting** on people, domestic and wild animals, dwellings, buildings, and other civil structures *(*Brovko *et al 2016)*.

***TABLE 1**: Recommended safe **ground vibration** levels at the **structure** that needs to be protected*

STRUCTURE DESCRIPTION	PEAK PARTICLE VELOCITY (mm/s)
National roads / tar roads	150
Electrical lines (pylons)	75
Railway	150
Transformers	25
Waters wells	50
Telecoms tower	50
General houses of proper construction	**USBM** criteria or 25 mm/s
Houses of lesser proper construction	12.5
Rural building – mud houses	6

***TABLE 2**: Recommended **air-blast** levels at the **structure** that needs to be protected*

DECIBELS (dB)	EFFECT
100	Barely noticeable
110	Readily noticeable
120	Currently accepted by the South African authorities as being a reasonable level for public concern (not more than 10% of the measurement should exceed this value)
134	Currently accepted by the South African authorities that damage will not occur below this level (no measurement should exceed this value outside of the mine boundaries)
164	Window break
176	Plaster cracks
180	Structural damage

8.4.3. No acceptable levels of **flyrock** have been suggested, other than to avoid it altogether outside the mine site and/or exclusion radius set by the operation as part of the risk assessment.

8.4.4. If the assessment of the danger zone suggests it may extend beyond the site boundary, then a controlled space or exclusion radius must be created where the public are either excluded or evacuated, and therefore not endangered by the blast.

8.4.5. The predicted values for **ground vibration**, **air-blast** and **flyrock** must be calculated as part of the drill and blast design implemented.

8.5. Quality assurance and quality control

8.5.1. The employer must develop and implement measures and procedures to attain practical and reasonable quality assurance and quality control systems, to ensure that every blast is executed as designed.

8.6. Monitoring and recording of actual blast results

8.6.1. The employer must implement an effective system, such as Vibrometers, to monitor the intensity of every blast, and record the actual **ground vibration**, **noise, air-blast** and **flyrock** measured.

8.6.2. The specific location of monitoring equipment will be determined during the risk assessment and captured on a plan with reference to the specific blast.

8.6.3. Design predicted values and the actual blast results must be compared. Site exceedances or deviations must be investigated and the impact thereof must be evaluated to prevent reoccurrences.

8.7. Management of complaints

8.7.1. The employer must develop and implement effective measures to register and handle complaints emanating from the surrounding communities and any other affected parties.

8.7.2. These measures may include, but are not limited to:

8.7.2.1. Increasing awareness amongst community members through posters, consultations with the community committees, etc.

8.7.2.2. Implementing an effective warning system at the mine to notify and alert the surrounding communities of every planned **blasting** activity. Such warning system may include measures such as audible alarms or sirens, posters, blast notification boards and WhatsApp-messages for notifying the members of the community and other affected parties of such planned **blasting operations**.

PART D: IMPLEMENTATION

1. IMPLEMENTATION PLAN

1.1. The employer must prepare an implementation plan for a **COP** that makes provision for issues such as organisational structures, responsibilities of functionaries and programmes and schedules for the **COP**, which will enable proper implementation of the **COP** (a summary of and a reference to, a comprehensive implementation plan may be included).

1.2. Information may be graphically represented to facilitate easy interpretation of the data and to highlight trends for the purposes of risk assessment.

2. COMPLIANCE WITH THE COP

2.1. The employer must institute measures for monitoring and ensuring compliance with the **COP**.

3. ACCESS TO THE COP AND RELATED DOCUMENTS

3.1. The employer must ensure that a complete **COP** and related documents are kept readily available at the mine for examination by any affected person.

3.2. A registered trade union with members at the mine, or where there is no such union, a health and safety representative on the mine, or if there is no health and safety representative, an employee representing the employees on the mine, must be provided with a copy. A register must be kept of such persons or institutions with copies to facilitate the updating of such copies.

3.3. The employer must ensure that all employees are fully conversant with those sections of the **COP** relevant to their respective areas of responsibilities.

ANNEXURE A: REFERENCES
(For information purposes only)

1. Brovko, F., Kgarume, T., Singh, N., Milev, B., Wekesa, R., Durrheim, T., Lumbwe, T., Pandelany, T. & Mwila, M. 2016. *Development of a South African Minimum Standard on **Ground Vibration**, **Noise**, **Air-blast** and **Flyrock** near Surface Structures to be Protected*. SIM 14-09-01: Council for Scientific and Industrial Research final project report. Available at: https://mhsc.org.za/sites/default/files/public/research_documents/SIM140901%20Final%20Report.pdf (Accessed: 6 June 2024).

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4. Szendrei, T & Tose, S. 2024. *Flyrock in surface mining – Limitations of current predictive models and a better alterative through modelling the aerodynamics of flyrock trajectory.* Available at: https://mhsc.org.za/wp-content/uploads/2024/06/SAIMM-Flyrock-P1-v122n12p725-1.pdf (Accessed: 6 June 2024).

5. Szendrei, T & Tose, S. 2024. *Flyrock in surface mining Part II — Causes, sources, and mechanisms of rock projection.* Available at: https://mhsc.org.za/wp-content/uploads/2024/06/NIXT-2023-Blasting-and-Ground-Vibrations-1.pdf (Accessed: 6 June 2024).

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