



DEPARTMENT OF MINERALS AND ENERGY
REPUBLIC OF SOUTH AFRICA

MINE HEALTH AND SAFETY INSPECTORATE

Guideline for the Compilation of
a Mandatory Code of Practice
for

The Prevention of Flammable
Gas Explosions in Mines
Other than Coal Mines

REFERENCE NUMBER: DME 16/3/2/1 - A2

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OTHER THAN COAL MINES

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CHIEF INSPECTOR OF MINES

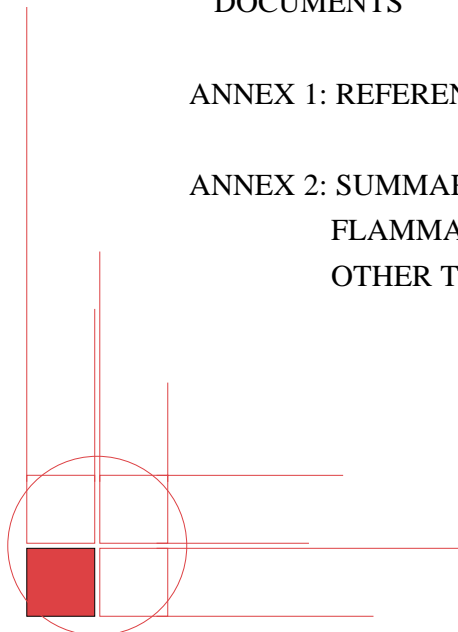
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PART A: THE GUIDELINE

1. FOREWORD

- 1.1 Flammable gas may be present in the strata of all mines. The erratic occurrences of flammable gas, which are often of short duration, lead to a tendency to underestimate the potential dangers associated with the liberation of flammable gasses into the workings of a mine. This has led to an increase in the number of people fatally injured in flammable gas explosions in recent years.
- 1.2 Annex 2 summarises the findings of a study into the occurrence flammable gas explosions in mines other than coal mines. Annex 2 is attached as information for consideration in the preparation of a COP.

2. LEGAL STATUS OF THE GUIDELINE AND COPs

- 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 the mines if the Chief Inspector of Mines requires it. These COPs must comply with any relevant guideline issued by the Chief Inspector of Mines (section 9(3)).
- 2.2. Failure by the employer to prepare or implement a COP in compliance with this guideline is a breach of the MHSA. Any contravention of, or failure to comply with, a COP is not, in itself, a breach of the MHSA, except a contravention or failure by an employer that also constitutes a failure to implement the COP. Since the DME does not approve COPs, its focus is not to enforce them either. The focus of the DME is to ensure that employers provide healthy and safe working environments at mines, i.e. focusing on system failures and compliance with the MHSA, rather than enforcing compliance with the COP.
- 2.3 The fact that a contravention of, or failure to comply with a COP is not a breach of the MHSA does not mean that such breaches will have no legal implications. As far the employer is concerned, there are numerous specific and general obligations on the employer in the MHSA aimed at ensuring the health and safety of all employees and all persons who are not employees but who may be directly affected by the activities at

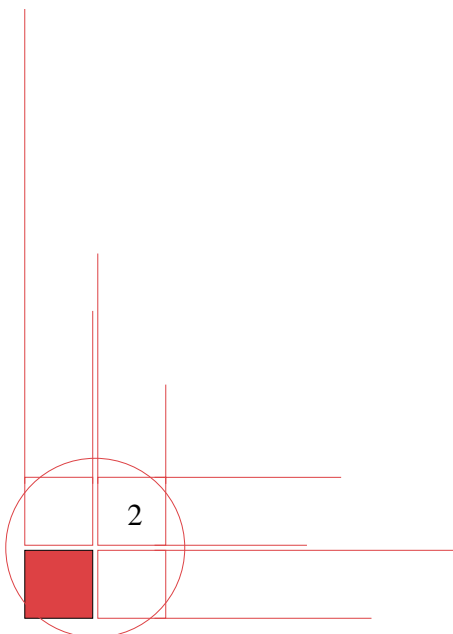
the mine. Where any failure to comply with a COP also constitutes a breach of any of the employer's obligations under the MHSA, the employer could be liable to an administrative fine for such breach. An inspector could also issue various instructions to the employer and employees in terms of section 54 to protect the health or safety of persons at the mine. Failure by an employer to comply with such an instruction could render the employer liable to an administrative fine.

2.4 As far as employees are concerned, section 22 places a number of obligations on employees, including that they must take reasonable care to protect their own health and safety and the health and safety of other persons who may be affected by their conduct. Where a failure by an employee to comply with a COP would also constitute a breach of the employee's duties in terms of section 22 (or a breach of section 84, 86(1) or 88), the employee could be criminally charged for such breach. As is the case with employers, the inspectorate could issue instructions to employees in terms of section 54 and failure to comply with such an instruction constitutes a criminal offence.

2.5 Employers should deal with breaches by employees of COP in terms of the mine's standard instructions and the employer's disciplinary procedures. This is not the responsibility of the State.

3. THE OBJECTIVE OF THIS GUIDELINE

The objective of this guideline is to assist the employer of every mine, other than a coal mine, to compile a code of practice, which, if properly implemented and complied with, would considerably reduce the risk of an ignition of flammable gas.



4. DEFINITIONS AND ACRONYMS

In this guideline for a COP or any amendment thereof, unless the context otherwise indicates -

“containment wall” means a seal which is designed to withstand a static pressure of 140 kPa;

“controlled recirculation” means air from a working face or place which returns to the same working place or face under pre-determined conditions;

“explosion protected apparatus” means any apparatus designed for the use in a hazardous location selected in accordance with the guidelines as defined in the South African Bureau of Standards Code of Practice SABS 0108. “The classification of hazardous locations and the selection of apparatus for use in such locations”, as amended; and

“hazardous location” means any location on surface or underground at any mine, other than a coal mine, where there may be a risk of igniting gas, dust, vapour or any other explosive substance.

5. SCOPE

This Guideline covers issues which need to be dealt with in the COP in order to significantly reduce the risk of a flammable gas explosion in mines other than coal mines. The issues to be addressed include at least the following: -

5.1 Identify sources of flammable gas.

5.2 Methods to control emissions.

5.3 Detection of flammable gas.

5.4 Dilution, Removal and Dispersion of Flammable Gas.

5.5 Development Ends and Accessible Tunnels.

5.6 Stopes.

5.7 Abandoned Areas.

5.8 Clearing of Flammable Gas.

5.9 Abandoned Areas.

5.10 Ventilation Controls.

5.11 Classification of Hazardous Areas.

5.12 Control of Ignition Sources.

6. TASK GROUP MEMBERSHIP

This document was prepared by the MRAC Flammable Gas Task Group.

6.1 The members originally appointed were the following:

Messrs.:	K Hewitson	-	State
	MA Mosia	-	State
	D Brown	-	State
	DJ Stanton	-	Employers
	DE Wrigley	-	Employers.

6.2 The task group proceeded with the following members and alternates who attended until the completion of the guideline for the COP.

Messrs.:	GF du Toit	-	State
	HG Nourse	-	Employers.

PART B: AUTHORS GUIDE

1. The COP must, where possible, follow the sequence laid out in Part C “Format and Content of the COP”. The pages as well as the chapters and sections must be numbered to facilitate cross-reference. Wording must be unambiguous and concise.
2. It should be indicated in the COP and on each annex to the COP whether-
 - 2.1 The annex forms part of the COP and must be complied with or incorporated in the COP or whether aspects thereof must be complied with or incorporated in the COP, or
 - 2.2 The annex is merely attached as information for consideration in the preparation of the COP (i.e. compliance is discretionary).
3. When annexes are used the numbering should be preceded by the letter allocated to that particular annex and the numbering should start at one (1) again. (e.g. 1,2 3, ...A1, A2, A3...).
4. Whenever possible illustrations, tables, graphs and the like, should be used to avoid long descriptions and/or explanations.
5. When reference has been made in the text to publications or reports, references to these sources must be included in the text as footnotes or sidenotes as well as in a separate bibliography.

PART C: FORMAT AND CONTENT OF THE MANDATORY COP

1. TITLE PAGE

The COP should have a title page reflecting at least the following -

- 1.1 name of mine;
- 1.2 the Heading : “Mandatory Code of Practice for the Prevention of Flammable Gas Explosions in Mines Other than Coal Mines”;
- 1.3 a statement to the effect that the COP was drawn up in accordance with Guideline DME Reference Number DME 16/3/2/1 - A2 issued by the Chief Inspector of Mines;
- 1.4 the mine’s reference number for the COP;
- 1.5 the effective date; and
- 1.6 revision dates.

2. TABLE OF CONTENTS

The COP must have a comprehensive table of contents.

3. STATUS OF MANDATORY COP

Under this heading the COP must contain statements to the effect that -

- 3.1 the mandatory COP was drawn up in accordance with Guideline DME Reference Number 16/3/2/1 - A2 issued by the Chief Inspector of Mines;
- 3.2 this is a mandatory COP in terms of sections 9(2) and (3) of the MHSA;
- 3.3 the COP may be used in an accident investigation/inquiry to ascertain compliance and also to establish whether the COP is effective and fit for purpose;

3.4 the COP supersedes all previous relevant COPs; and

3.5 all managerial instructions or recommended procedures (Voluntary COPs) and standards on the prevention of flammable gas explosions must comply with the COP and must be reviewed to ensure compliance.

4. MEMBERS OF DRAFTING COMMITTEE

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.

4.2 It is recommended that the employers 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. This committee should include competent persons sufficient in number effectively to draft the COP.

5. GENERAL INFORMATION

Relevant information relating to the mine must be stated in this paragraph. The following minimum information must be provided -

5.1 a brief description of the mine and its location;

5.2 the commodities produced;

5.3 the mining methods/mineral excavation processes;

5.4 a description of the systems used at the mine to prevent the flammable gas explosions;
and

5.5 other relevant COPs.

6. TERMS AND DEFINITIONS

Any word, phrase or term of which the meaning is not absolutely clear or which will have a specific meaning assigned to it in the COP, must be clearly defined. Existing and/or known definitions should be used as far as possible. The drafting committee should avoid jargon and abbreviations that are not in common use or that have not been defined. The definitions section should also include acronyms and technical terms used.

7. RISK MANAGEMENT

7.1 Section 11 of the MHSa requires the employer to identify hazards, assess the health and safety risks to which employees may be exposed while they are at work, record the significant hazards identified and risks assessed. The COP must address how the significant risks identified in the risk assessment process must be dealt with, having regard to the requirements of section 11(2) and (3) 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, to provide personal protective equipment and to institute a programme to monitor the risk.

7.2 To assist the employer with the risk assessment, all possible relevant information such as accident statistics, ergonomic studies, research reports, manufacturers specifications, approvals, design criteria and performance figures for all relevant equipment should be obtained and considered.

7.3 In addition to the periodic review required by section 11(4) of the MHSa, the COP should be reviewed and updated after every serious incident relating to flammable gas, or if significant changes are introduced to the procedures, mining and ventilation layouts, mining methods, plant or equipment and material.

8. ASPECTS TO BE ADDRESSED IN THE MANDATORY COP

The COP must set out how the significant risks identified in terms of the risk assessment process referred to in paragraph 7.1 above will be addressed. The COP must cover at least the aspects set out below unless there is no significant risk associated with that aspect at the mine.

8.1 Identification of Flammable Gas Sources, Occurrences and Composition

The COP must set out procedures for the identification of flammable gas sources, occurrences and compositions. Such procedures must cover at least the following:

8.1.1 A description of the sources of flammable gas, the way that flammable gas is encountered or likely to be encountered and how it enters the workings of the mine, for example:

- (a) ingress through faults, dykes, fissures and potholes;
- (b) high pressure pockets;
- (c) from worked out and or abandoned areas, through seals;
- (d) cover drilling;
- (e) pilot hole drilling;
- (f) normal shot hole drilling;
- (g) blast and Seismic induced fracture planes;
- (h) occurrence of flammable gas with water;
- (i) change in barometric pressure;
- (j) change in season; and
- (k) long term emitters.

8.1.2 A procedure for recording flammable gas intersections.

8.1.3 A procedure to deal with increases in flammable gas intersections, sampling procedures and allocation of responsibilities to competent persons.

8.2 Control of Gas Emissions

8.2.1 The COP must set out precautionary measures to be taken to control the release of flammable gas, inclusive of when sealing of an area or bleeding of gas from an area should be done.

8.3 Detection of Flammable Gas

8.3.1 The COP must set out a procedure to detect flammable gas, which must deal with the following aspects:

- (a) selection of appropriate flammable gas detection instruments for the typical operational conditions;
- (b) availability for allocations, at any time, of a sufficient number of the flammable gas detection instruments referred to in (a);
- (c) issuing of flammable gas detection instruments to employees on the mine;
- (d) testing for and dealing with the presence of flammable gas;
- (e) maintenance and calibration of flammable gas instruments; and
- (f) training and presence of competent persons for performing flammable gas detection measurements, inclusive of the correct selection, use and care of flammable gas detection instruments.

8.4 Dilution, Removal and Dispersion of Flammable Gas

The COP must set out how the dilution, removal and dispersion of flammable gas must be done. A ventilation layout plan that indicates the positions of the ventilation appliances mentioned hereunder must be drawn up:

8.4.1 Main Surface and Underground Booster Fans;

8.4.2 Downcast Shafts; and

8.4.3 Fixed Installations, e.g.

- (a) pump stations;
- (b) dams, sumps, silos and settlers;
- (c) shaft bottoms;
- (d) belts;
- (e) workshops;
- (f) battery bays;
- (g) repair bays;
- (h) sub stations;
- (i) mini sub stations;
- (j) electrical switchgear;
- (k) stores;

- (l) hoist rooms; and
- (m) ventilation tunnels where people work or travel.

8.4.4 Development Ends and Accessible Tunnels not in Through Ventilation

The COP must set out procedures to prevent the build up of flammable gas in development ends and accessible tunnels not in through ventilation. The COP must cover at least the following issues: -

- (a) minimum air quantity;
- (b) minimum air velocity;
- (c) ventilation column sizes for the different applications;
- (d) fan types and sizes;
- (e) ventilation methods;
- (f) restrictions on ventilation column size and distance;
- (g) maximum distance of a ventilation column discharge from the face in tunnels, raises, winzes and boxholes;
- (h) minimum and maximum overlap distances of ventilation systems;
- (i) methods of ensuring that the force volume is always directed to the working face;
- (j) blasting frequency;
- (k) blasting method and re-entry period;
- (l) how ends in series should be ventilated and restrictions on the maximum number of ends that may be ventilated in series;
- (m) methods to ensure uncontrolled recirculation does not take place;
- (n) methods of breaking away a new end from an existing end or tunnel; and
- (o) the installation of electrical equipment beyond the last point of through ventilation and applicable safety precautions.

8.4.5 Stopes

The COP must set out procedures to prevent the build up of flammable gas in stopes and must cover at least the following: -

- (a) the minimum air quantity per stope;
- (b) minimum air velocity in a stope;

- (c) the installation of electrical equipment and safety precautions applicable thereto; and
- (d) special detailed precautions for back stopes and inverted “U” tubes.

8.4.6 Abandoned areas

The COP must set out procedures to prevent the build up of flammable gas in abandoned areas and must cover at least the following: -

- (a) circumstances under which areas can be abandoned;
- (b) method of removing the ventilation system; and
- (c) monitoring procedures for sealed off areas.

8.4.7 Clearing Accumulation of Flammable Gas, Including from Roof Layers

The COP must set out procedures to be taken to ensure the clearing of gas accumulations, including from roof layers. These procedures should cover at least the following: -

- (a) isolating electricity; and
- (b) withdrawing of people from the return.

8.4.8 Approaching and Holing into Abandoned Ends

The COP must set out the safety precautions to be taken when approaching or holing into abandoned ends, covering at least the following: -

- (a) warning notes from the surveyor;
- (b) stopping distances of workings approaching abandoned areas;
- (c) maximum excavation sizes;
- (d) methods to probe for water and gas accumulations; and
- (e) ways of re-establishing ventilation before and after holing.

8.4.9 Ventilation Controls

The COP must cover operating and maintenance procedures for ventilation controls.

8.4.10 Stoppage, Change or Reversal in Ventilation

The COP must describe the procedures to be followed in the event of a stoppage, noticeable change or reversal in the ventilation.

8.5 Identification of Hazardous Locations

The COP must set out a procedure for identification of hazardous locations and the measures to be taken to prevent flammable gas explosions in those locations.

8.6 Preventing Ignition of Flammable Gas

The COP must set out procedures for controlling the following potential ignition sources.

8.6.1 Contraband

The COP should cover at least the following: -

- (a) orientation of employees in regard to the risks of taking contraband into underground mines;
- (b) methods of warning employees of the dangers of taking contraband into the workings of a mine; and
- (c) the random searching of persons about to proceed into or while in the workings of a mine;

8.6.2 Open flame

The COP must set out safe procedures for welding, flame cutting, flame heating, and similar work such as friction cutting, grinding, vulcanizing, soldering, photography, video, and audiotaping. These procedures should cover at least the following:

- (a) the training of competent persons to perform such work;
- (b) issuing and control of flint lighters;
- (c) the construction, ventilation, physical characteristics and orderly main-

- tenance of the workshop and cutting bays so that work can be performed in a safe and healthy manner;
- (d) precautions to be taken when working outside approved workshops or cutting bays;
 - (e) the ventilation, inertisation, fire prevention and the gas testing procedure before, during and on completion of such work;
 - (f) the precautions and devices utilized to quench flashback and to prevent backfeeding of gas;
 - (g) the proper transport, storage and use of gas cylinders; and
 - (h) the issuing, safekeeping and examination of both equipment and devices used.

8.6.3 Electrical Equipment

The COP must describe the procedures to be followed:

- (a) where explosion protected apparatus are used;
- (b) where the use of electrical equipment requires special precautions;
- (c) for interlocking of fans ventilating in series and other electrical equipment used within relevant areas;
- (d) for the positioning of fans in series;
- (e) for the positioning of switchgear in development ends;
- (f) for flammable gas tests before starting or stopping electrical equipment;
- (g) for identification of electrical equipment that poses a significant risk and the measures to deal with that risk; and
- (h) no automatic re-starting of auxiliary (development end) fans.

8.6.4 Re-Establishing Electrical Power After a Power Failure

The COP must set out a procedure to re-establish power after a power failure.

The procedure must detail all the safety precautions necessary to prevent a flammable gas ignition. The procedure should specify the level of supervision for each operation.

8.6.5 Frictional Ignitions

The COP must set out measures to be taken to identify potential sources of frictional ignition and detail the relevant prevention and control measures.

8.6.6 Static Electricity

The COP must set out measures to be taken to identify the potential sources of static electricity and detail relevant prevention and control measures.

PART D: IMPLEMENTATION

1. Implementation Plan

- 1.1 The employer must prepare an implementation plan for the COP that makes provision for issues such as organisational structures, responsibilities of functionaries and programmes and schedules for this COP that 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 purpose of risk assessment.

2. Compliance with the COP

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

3. Access to the Code and Related Documents

- 3.1 The employer must ensure that a complete COP with 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 on written request to the employer. A register must be kept of such persons or institutions with copies to facilitate 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 responsibility

ANNEX 1

(Attached for information only)

REFERENCES

Cook AP - "GAP 504". - The Occurrence, Emission and Ignition of Combustible Strata Gases in Witwatersrand Gold Mines and Bushveld Platinum Mines, and Means of Ameliorating Related Ignition and Explosion Hazards, 1999.

Chamber of Mines of South Africa - "Flammable Gas in Metal Mines". - A Guide to Managers.

The Mine Ventilation Society of South Africa - "Environmental Engineering in South African Mines".

"Mine Health and Safety Act" - Act No. 29 of 1996.

DME "Code of Practice for Lamprooms".

DME "Guidelines for the Prevention of a Flammable Gas Explosion in Collieries"

ANNEX 2

(For information purposes only)

BACKGROUND

A study into the occurrence of flammable gas on mines other than coal mines has revealed the following six points to prevent a flammable gas explosion.

1. Always expect gas

2. Be Aware

There is a general lack of awareness of the presence and hazards associated with flammable gas. Only four mines in the country considered flammable gas to be a significant problem. This is reflected in the fact that although the fatality trend in the industry is down the trend on flammable gas fatalities is up.

3. Know what gas you are dealing with.

4. Determine the combustible properties of the gas mixture.

5. Are your flammable gas detectors reading correctly?

6. Know your probable gas sources.

Methane and hydrogen are not the only flammable gases present in mines. The employer must know the gases it is dealing with in order to institute proper calibration and testing procedures.

Gas Samples must be analyzed because it is the only way to determine the composition of gases the mine is dealing with.

All employees must know the circumstances in which gas is likely to occur.

This Guideline and the Code of Practice to which it refers will deal with identifying possible gas emissions, controlling the emissions where possible, early detection of flammable gas and good ventilation practice. Combined, these interventions should ensure that flammable gas explosions should not occur.

