

**GUIDELINE FOR THE COMPILATION OF A MANDATORY CODE OF PRACTICE FOR  
PREVENTION OF FIRES AT MINES**

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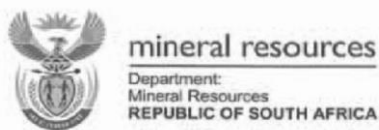
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DEPARTMENT OF MINERAL RESOURCES  
MINE HEALTH AND SAFETY INSPECTORATE  
GUIDELINE FOR THE COMPILATION OF A MANDATORY CODE OF PRACTICE FOR  
**PREVENTION OF FIRES AT MINES**

(Signed)

CHIEF INSPECTOR OF MINES



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## **PART A: THE GUIDELINE**

### **1 Foreword**

- 1.1 **Fire** in a mine or excavation, such as a transportation tunnel, is a serious **fire hazard** that could result in loss of life and revenue for the enterprise concerned. Mines contain significant amounts of fuel sources such as flammable material, fuels, lubricants, timber, rubber, plastics, paint and packaging materials. Coupled with these are numerous ignition sources such as self-heating of coal, **flame** from oxy-acetylene cutting and welding equipment, sparks, electrical short-circuits, machinery hot surfaces and friction that can initiate a **fire**.
- 1.2 Basic **fire** theory suggests that **fires** occur when three constituents are present simultaneously: a fuel source, an ignition (heat) source and oxygen (air). At **mines**, oxygen will normally be present in the air as it is required to sustain human life and enable the operation of combustion engines. The identification of **fire hazards** should focus on the following key considerations:
- 1.2.1 the presence of fuel sources such as combustible materials, flammable substances, volatile chemicals, etc;
  - 1.2.2 the presence of ignition or heat sources such as hot surfaces on equipment, electrical sparks, naked **flames**, explosives, exothermic chemical reactions, etc;
  - 1.2.3 chemical chain reaction in metallic **fires** known as class D **fires**.
- 1.3 The **fire** risk in any mine has to be managed properly. This is achieved by an assessment of the **risks** involved, monitoring of **fire risk** controls, good **mine** and ventilation system design, equipment and material selection, the preparation, implementation and enforcement of formal appropriate **mine**-specific standards.
- 1.4 The South African mining industry has in the past experienced several underground **fire** incidents. Underground fires are particularly dangerous due to the confined nature of excavations, the quantity of smoke and noxious fumes produced in relation to the limited quantity of fresh air present and the restricted ability to escape quickly from the mine. Since 2004, the industry accounted for 19 fatalities; 149 **fire** related injuries and a total of 71 dangerous occurrences directly related to **fires**. Surface operations encountered conveyer belt, plant structure and trackless mobile machinery **fires** during the same period.
- 1.5 **MHSA** regulations pertinent to the prevention of underground **fires** include:
- 1.5.1 Regulation 5.1(1)(a) requires an employer to ensure that a competent person reports to the employer, at appropriate intervals determined in accordance with the mine's **risk** assessment, on the adequacy of measures in place to prevent, detect and combat the start and spread of **mine fires**.
  - 1.5.2 Regulation 8.9(3) requires an employer to take reasonably practicable measures to prevent persons from being exposed to **flames**, fumes or smoke arising from a conveyor belt installation catching **fire**, including instituting measures to prevent, detect and combat such **fires**.
  - 1.5.3 Regulation 9.1(2) requires an employer, where the **risk** assessment indicates a significant **risk** of a **fire** and/or explosion and/or toxic release, that could lead to an irrespirable atmosphere or an atmosphere immediately dangerous to life or health, to provide an early warning system or systems at all working places.

- 1.5.4 Regulation 16.1(1) requires an employer to ensure that a competent person reports to the employer, at appropriate intervals determined in accordance with the **mine's risk** assessment, on the adequacy of escape and rescue procedures at the **mine** relating to explosions, **fires** and flooding.
- 1.6 The **MHSA** regulations do not set out any other detail about the measures required to prevent, detect and combat the start and spread of **mine fires**. The main aim of this guideline is therefore to provide employers with a framework to assist in the preparation of a **COP** on the **fire prevention measures** at a **mine** in order to reduce significant **risks** associated with **fires**.

## 2 Legal status of guidelines and COPs

- 2.1 In accordance with section 9(2) of the **MHSA**, the employer must prepare and implement a **COP** on any matter affecting the health and safety of employees and any other persons who may be directly affected by the 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 as per section 9.3. Failure by the employer to prepare and implement a **COP** in compliance with this guideline is a breach of the **MHSA**.

## 3 Objective of the guideline

- 3.1 The main objective of this guideline is to enable the employer at every **mine** where a **fire** could pose a significant **risk** to the health or safety of persons, to prepare a **COP** which, if properly implemented and complied with, would improve control measures aimed at preventing **fire** incidents.
- 3.2 The guideline provides guidance of a general nature on the required format and content for the **COP** and details sufficient technical background to enable the drafting committee at the **mine** to prepare a comprehensive and practical **COP** for their **mine**.

## 4 Definitions and acronyms

- (a) '**COP**' means Code of Practice;
- (b) '**DMR**' means the Department of Mineral Resources;
- (c) '**FIRE**' means a rapid oxidation process in which a chemical reaction results in the evolution of light, gases, and heat energy varying in intensity;
- (d) '**FIRE DETECTION SYSTEM**' means the combination of Fire Alarm Systems and Fire detectors;
- (e) '**FIRE ALARM SYSTEM**' means a system or portion of a combination system that consists of components and circuits arranged to monitor and announce the status of a fire condition or of supervisory signal-initiating devices in order to initiate the appropriate response to those signals;
- (f) '**FIRE DETECTOR**' means an automatic device designed to detect the presence of a **fire** and initiate action;
- (g) '**SMOKE DETECTOR**' means an automatic device designed to detect the presence of smoke and initiate action;
- (h) '**FIRE PREVENTION MEASURES**' means actions deemed necessary and suitable to inhibit the initiation of a fire or stop the evolution of a developing fire;
- (i) '**FIRE PROTECTION MEASURES**' means actions deemed necessary and suitable to safe guard the life and health of individuals and/or the integrity of equipment, machinery and infrastructure that may be exposed to a fire;

- (j) **'FIRE SUPPRESSION SYSTEM'** means a system designed to enable total flooding by or for the localised application of extinguishing agents;
- (k) **'FLAME'** means the visible portion of the fire;
- (l) **'FLAME RETARDANT'** means a self-extinguishing substance or material that will inhibit the formation or the spread of a flame on a surface to which it is applied;
- (m) **'FIRE HAZARD'** means a condition that presents the potential for harm to people and damage to property, or the environment as a result of fire;
- (n) **'HOT WORK'** means work involving burning, heating, welding, grinding or a similar operation that is capable of initiating fires or explosions;
- (o) **'IFSTA'** means International Fire Service Training Association;
- (p) **'MHSA'** means Mine Health and Safety Act, 1996 (Act 29 of 1996) as amended;
- (q) **'MINE'** as defined in the Mine Health and Safety Act, 1996 (Act 29 of 1996) as amended;
- (r) **'NFPA GOT'** means National Fire Protection Association Glossary of Terms, published in 2013;
- (s) **'RISK'** means a measure of the probability and severity of adverse effects that result from exposure to a fire hazard;
- (t) **'SABS'** means South African Bureau of Standards;
- (u) **'SANS'** means South African National Standard; and
- (v) **'SDS'** means (Material) Safety Data Sheet (solids, liquids and gases).

## 5 Scope

The scope of this guideline relates to measures or procedures that should be established to prevent the occurrence of **fires** at a **mine**, which is the preferred way of managing the **risks** associated with **fires** in underground and surface operations at a **mine**.

This guideline does not replace existing guidelines dealing with related topics, eg the guidelines on *Prevention of Flammable Gas and Coal Dust Explosions in Collieries* and on *Prevention of Flammable Gas Explosions in Mines Other Than Coal Mines*. The **COP** to be drawn up by the employer in compliance with this guideline should take account of all other **COPs** drawn up by the employer and all the **COPs** and other related **mine** standards should be reviewed concurrently in order to avoid any conflict of requirements as laid down by the **mine**. The objective would be to have an integrated system.

## 6 Members of the task group

6.1 The members of the task group were as follows:

STATE	EMPLOYEES	EMPLOYERS
J Legadima	H van Vuuren	M Biffi
N Mokhonoana		A Thomson
CT Kekana		J Maass
A Coutinho		P Sefudi
K Hewitson		I Labuschagne

### **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**.' The pages as well as the chapters and sections must be numbered to facilitate cross-reference and wording must be unambiguous and concise.
- 2** It should be indicated in the **COP** and on each annexure to the **COP** whether:
  - 2.1 the annexure 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 annexure is merely attached as information for consideration in the preparation of the **COP** (ie compliance is discretionary).
- 3** When annexures are used the numbering should be preceded by the letter allocated to that particular annexure and the numbering should start at one (1) again. (eg 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 side notes 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 the name of the **mine**;
- 1.2 the Heading: 'Mandatory Code of Practice on the Prevention of Fires at Mines';
- 1.3 the statement to the effect that the **COP** was drawn up in accordance with the Guideline with the **DMR** reference number **DMR 16/3/2/4-B3** issued by the Chief Inspector of Mines;
- 1.4 the **mine's** reference number for the **COP**;
- 1.5 the effective date of the **COP**; and
- 1.6 the revision dates of the **COP**.

#### **2 Table of contents**

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

#### **3 Status of COP**

Under this heading the **COP** must contain statements to the effect that—

- 3.1 the mandatory **COP** was drawn up in accordance with the Guideline with the **DMR** reference number **DMR 16/3/2/4-B3** 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 the 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 relevant topics 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 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. This committee should include competent persons sufficient in number to effectively draft the **COP**.

#### 5 General information

General relevant information relating to the **mine** must be stated in this section of the **COP**.

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 in use on the **mine** relating to **fire prevention measures**;
- 5.5 the unique features or special conditions of the **mine** that have a bearing on this **COP**; and
- 5.6 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.

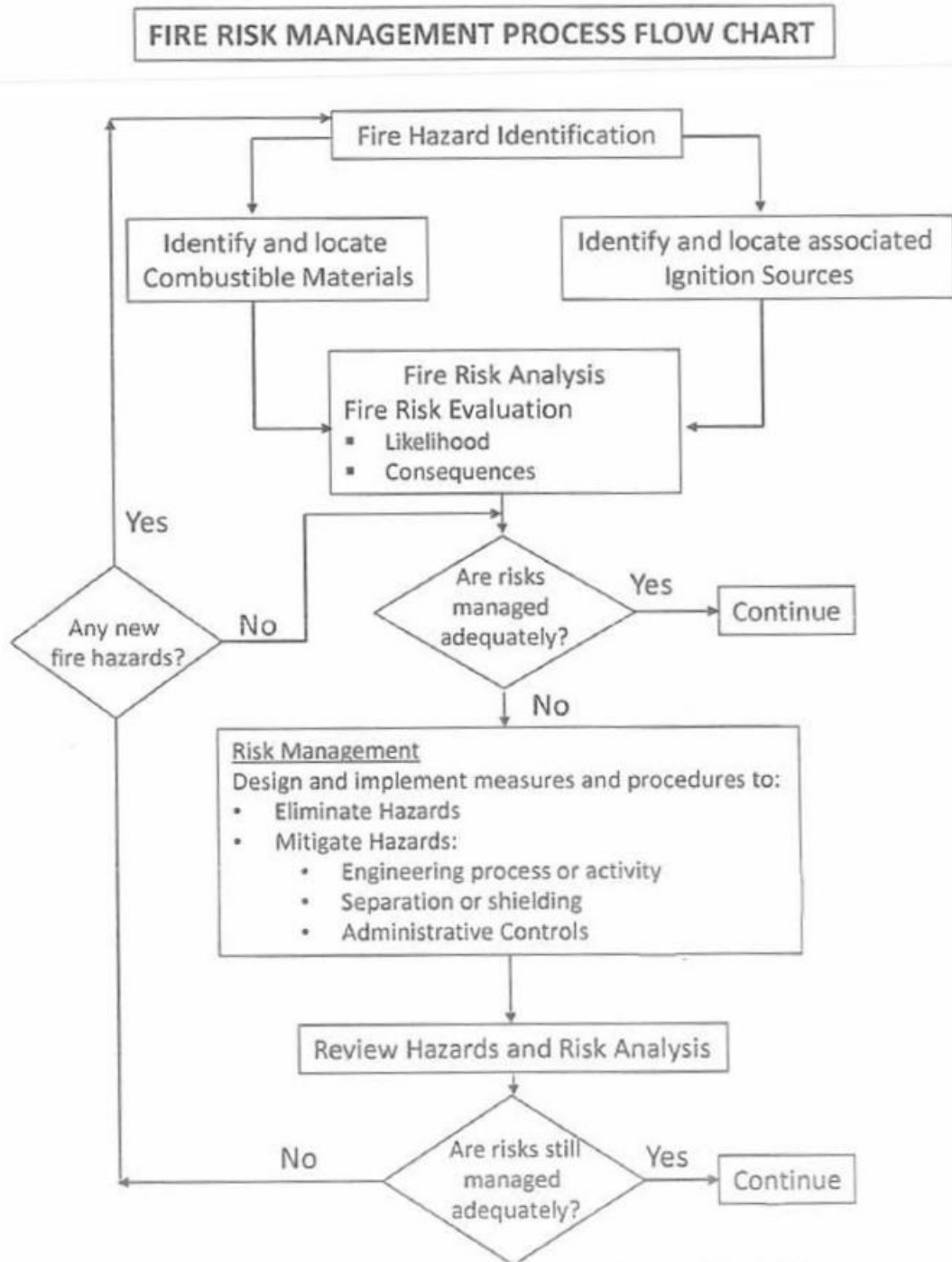
#### 7 Risk management

- 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 **risk** assessed. The employer must determine how the significant **risks** identified in the **risk** assessment process must be dealt with, having regard to the requirement 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 minimise 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 **fire** incidents, 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 if relevant after every serious incident relating to a topic covered in the **COP** or if significant changes are introduced to procedures, processes, process layout, process methods, ventilation layouts, plant or equipment and material.

### 8 Aspects to be addressed in the COP

In order to manage the risks associated with fires at a mine, the **COP** should set out a structured Fire Risk Management Program covering at least the steps and measures envisaged in this guideline. Figure 1 below shows diagrammatically the Fire Risk Management Program covered in this guideline.



**Figure 1: Diagrammatic Representation of Fire Risk Management**



## 8.1 Fire and risk management

The **COP** should set out as the first element of a Fire Risk Management Program the requirement to identify **fire hazards** and then **fire risks**. The **COP** should require these to be continuous activities covering the following:

### 8.1.1 Identification of fire hazards

The **COP** should identify each possible **fire** hazard and classify *each* as either a fuel source or an ignition source (under certain circumstances, timber, coal and other organic materials may be both). The location of all possible ignition sources, at fixed sites at a **mine** or on mobile or semi-mobile equipment operating at a **mine** should be established.

**Fires** will occur if these two sources are present simultaneously in time and space. Preventative measures may be put in place to prevent such interactions and, under certain conditions, suitable physical barriers may be introduced to prevent the two sources from interacting. These are classified as protective measures against **fires**. Other actions and procedures, such as emergency evacuation procedures and the use of refuge bays, for example, are seen as measures needed to mitigate the impact following from the ignition of combustible material to protect workers. This **COP** shall concentrate predominantly on preventative measures and on some protective measures aimed particularly at separating effectively the two sources.

**Annexure 1** Generic notes on **fires** provides more information on the stages of **fire**, covering the nature and development thereof.

#### 8.1.1.1 **Fire hazards:** Fuel sources

The **COP** should classify the identified fuel sources in terms of the **fire** classes defined by the combustion process associated with them:

(a) Class A: Materials (ordinary combustibles)

These are solid materials, usually of an organic nature, in which combustion normally results in the formation of glowing embers. These include combustibles such as wood, paper, fabric, plastics, and most kinds of solid waste materials.

(b) Class B: Materials (flammable liquids and gases)

These are non-solid fuels consisting of flammable or combustible liquids or gases such as petrol or propane gas.

(c) Class C: Energised electrical equipment

Electrical **fires** involve potentially energised electrical equipment. This sort of **fire** may be caused by short-circuiting or overloaded electrical networks.

(d) Class D: Combustible metals

Combustible metals mostly encountered are magnesium, potassium, titanium, and zirconium. With the exception of the metals that burn in contact with air or water (for example potassium and sodium), combustible metals on their own do

not represent unusual **fire risks** because they have the ability to conduct heat away from hot spots efficiently. However, when combustion is induced, the **fire** is self-sustaining: rapid combustion (oxidation) of magnesium induced by an external source may result in a fiercely exothermic process.

(e) Class F: Cooking oils and fats (kitchen **fires**)

These include unsaturated cooking oils in well-insulated cooking appliances located in commercial kitchens. Though such **fires** are technically a subclass of the flammable liquid/gas category, the special characteristics of these types of **fires**, namely the lower flash point, are considered important enough to re-classify these separately. Water mist can be used to extinguish such **fires**.

8.1.1.2 **Fire hazards**: Ignition sources

The **COP** should identify potential sources of ignition at a **mine** including but not limited to the following energy sources:

(a) Heat energy

The presence of heat energy is often characterised by high temperature surfaces (eg exhaust systems of internal combustion engines, pumps, turbochargers, electric motors, gearboxes, heat exchangers, bearings, rubbing surfaces such as brakes, cigarette butts, naked **flames** from use of welding equipment and matches or cigarette lighters).

(b) Electrical energy

Switch gear, motors, retarders, transformers, lights and cables; short-circuit arcs, earth-faults, static electricity discharge, induction heating, thyrist or drives.

(c) Mechanical energy

Friction (conveyor belts drives, winch ropes), mechanical impact (coal picks) or grinding.

(d) Chemical energy

Self-heating, auto-ignition, exothermic reactions, spontaneous combustion of coal and induced pyrolysis of vehicle tyres (lightning).

8.1.1.3 Fire hazard identification process

The **COP** should set out the **fire** hazard identification process that requires a physical inspection of all working places, of travelling ways, hoisting and conveying infrastructures and of equipment and machinery used at a **mine** to identify and list all recognisable fuel and ignition sources. In addition, the **fire hazard** identification process shall include a review of processes employed at a **mine** to assess the probability of a **fire** being caused as the result of operational malfunctions or of process design failures.

The outcomes of the **fire** hazard identification process should be recorded in a **fire hazard** register that identifies the hazard together with its classification (fuel source, ignition source or both) and location of the hazard at the **mine**. The latter should distinguish whether the **fire** hazard is fixed or mobile, as might be the case for vehicles. The location of fixed hazards should be deemed to be particularly hazardous where these are located in or in close proximity to intake airways, at sites containing other **fire hazards** (eg transformer station adjacent to fuel storage areas) or sites that might be adversely affected directly or indirectly by a **fire** (eg major oil-filled transformers adjacent to sub-vertical shafts or sub-declines or other fresh air intakes). The latter is of particular importance where mobile equipment is operated.

A series of different **fire hazard** identification processes may be undertaken at different stages in the life of any mining project. These should be appropriate in terms of and aligned with the maturity of the operation and of changes that take place from time to time due to process or system design modifications, introduction of new technologies and/or equipment and as a result of changes in accepted practices.

(i) Baseline and issue-based fire hazard surveys

The **COP** should set out baseline and issue based procedures that are summarised in the **fire hazard** register and to include the following information:

- (a) the date of the survey;
- (b) the name of the person responsible for the respective assessments;
- (c) a list of operational procedures and standards that were affected (added, amended or deleted) as the result of such assessments; and
- (d) the details of where the official **risk** assessment documentation is kept at the **mine**.

These surveys should be completed as soon as any type of mining operation is undertaken (eg shaft sinking, primary development, plant construction, production ramp-up, etc) and whenever a major change or addition to the operation or process is undertaken (eg sinking of another shaft or sub-vertical structure, extension of the mineral treatment plant, etc).

Additionally, a review of the baseline **risk** survey should be conducted with the occurrence of changes in conditions and/or processes or resulting from an incident. The information from the **risk** survey can then be used as a basis for the assessment and

control of **fire risk** (refer to section 8.1.2: Assessment of fire risks).

(ii) Continuous fire hazard identification

The **COP** should set out measures ensuring that in the event of any changes in the equipment operated, systems or processes employed as recorded in section (i) above, additional surveys should be performed to supplement the baseline **fire hazard** survey. In the absence of these changes, the baseline **fire hazard** surveys should be reviewed at intervals not exceeding 12 months. These reviews could include, but are not limited to, items identified during:

- (a) employee **fire** hazard identification and reporting procedures;
- (b) workplace inspections and observations; and
- (c) equipment and plant inspections.

The **COP** should include a record of any instances where operational standards and procedures have been amended following such reviews.

Refer to **Annexure 2: Examples of fire hazards at mines**.

8.1.2 Assessment of fire risks

8.1.2.1 Fire risk assessment method

The **COP** should ensure that all identified **fire hazards** are analysed to assess their contribution to the overall **fire risk**. In the assessment of **fire risks**, the following should be included:

- (a) the identified fuel and potential ignition sources and other factors that can have an impact on the type and magnitude of the **risk**;
- (b) the evaluation of the **fire risk** based on the assessed consequence and likelihood of a particular **fire** event; and
- (c) the input from a number of specialist areas, including occupational hygiene/**mine** ventilation and emergency response as part of the **risk** mitigation process.

Where appropriate, similar **fire hazards** or classes of **fire hazards** may be analysed in logical groupings as might be determined by the mine's infrastructure, process or design.

8.1.2.2 Fire risk assessment tools

The **COP** should outline measures to ensure that the selected **risk** assessment tools should be applicable for the intended function and should provide effective indication of:

- (a) the actual **risk** as understood at the time;

- (b) any intervention deemed to be feasibly effective in reducing such **risk** (preventative measures);
- (c) the effect of any corrective interventions (preventative measures) being considered;
- (d) the impact of any residual **risk** after the application of the preventative measures;
- (e) any (further) protective measures that might be considered to manage any residual **risk**, (eg including **fire** detection and fire-fighting measures); and
- (f) monitoring criteria that will determine the effectiveness of anticipated or implemented **risk** reduction controls.

The assessment of the **fire risks** should take into consideration impacts and consequences of any **fire** incident on the health and safety of workers, on neighbouring communities, on the environment and on the future viability of operations (eg material and reputational damage).

Any mitigating preventative and/or protective measures proposed for identified **fire risks**, should be recorded formally to an adequate level of detail, should be approved by management and be assigned to competent persons for completion within a specified period of time consistent with the level of the identified **risk** rating assigned to the corresponding **fire hazard**.

#### 8.1.2.3 Risk analysis

The **COP** should ensure that the **risk** analysis section includes information on the type and nature of **fire hazards** and any contributing operational and environmental factors for consideration in the structuring of adequate preventative and protective measures. **Risk** analyses should focus on the following but should not be limited to:

- (i) Potential for fires

The **COP** should ensure that the potential for **fires** at a mine is determined using the **fire hazard** identification process described in section 8.1.2 above. Where specialised processes are undertaken, the assistance of recognised experts in the field of **fire** engineering should be sought.

- (ii) Characterising potential fires

Once the fuel and ignition sources have been identified, the **fire risk** should be characterised for each using information such as:

- (a) the quantity of fuel available for combustion;
- (b) 'fuel loading' or the relative mass of the fuel (or potential calorific energy) per unit volume of the occupied space (high, moderate or low fuel loading);

- (c) the chemical composition and intensity of smoke and fumes or gases likely to be generated by a **fire** (this information should be used for the selection of a suitable emergency evacuation procedure);
  - (d) the location of fuel and combustible material storage areas, relative to other areas;
  - (e) the route that will be followed by any smoke generated by a **fire** (to define possible escape routes); and
  - (f) the presence of further fuel sources that might participate in an extended **fire** scenario.
- (iii) Fire hazard location
- The location of a **fire hazard** could have a significant impact on the level of **risk**:
- (a) **fires** located in a main intake airway (eg main decline) are likely to pose a higher **risk** than if located in a return airway;
  - (b) **fires** located close to the main working areas are likely to provide less time for affected personnel to respond timely and adequately (ie there will be limited time for employees to evacuate to a place of safety such as fresh air bases and refuge bays);
  - (c) **fires** on surface close to fresh air or compressed air intakes to underground workings or to offices on surface can pose a significant **risk**; and
  - (d) **fires** located close to or within, hazardous material and combustible liquids storage enclosures have the potential to pose a **risk** to other neighbouring areas.
- (iv) Ventilation

Ventilation systems, natural or induced, serving underground working places or buildings, will be affected by **fires** and may contribute to the spread of smoke, gases, and hot air. Factors that should be considered when deciding how to manage ventilation systems during a **fire** include: the prevailing air flow, oxygen feed to the **fire**, rate of contamination downstream and fire spread beyond the source particularly in situations where employees may still be trapped by the fire.

The impact of ventilation system operation on the behaviour of **fires** is likely to differ for each location and for each application. It is essential that persons competent in the design and operation of ventilation systems (eg **mine** ventilation engineer or ventilation officer) be involved in the assessment of **fire risks** at **mines**.

#### 8.1.2.4 Risk assessment output

The **COP** should ensure that the **fire risk** assessments shall yield the following information that shall not be limited to:

- (a) locations throughout the **mine** where fuel and ignition sources exist;
- (b) types and extent of **fire** events considered;
- (c) consequence and likelihood of each **fire** event;
- (d) the resulting **fire risk** (eg based on a consequence and likelihood **risk** matrix);
- (e) controls and associated monitoring criteria currently in use to minimise the **risk**;
- (f) any additional actions to further reduce **risk** by either improving existing controls or by providing additional controls or actions (included in authorised work programs and assigned to a competent person for completion); and
- (g) any additional actions aimed at mitigating or reducing the impact of the outcome.

**Note:** The composition and quantity of smoke and fumes generated in a **fire** are likely to have a significant impact on the consequence of the **fire** and hence the level of **risk**. The impact of heat generated by an incipient **fire** should also be considered as a small **fire** in a 'critical' location may provide sufficient heat to initiate a much larger conflagration.

## 8.2 Fire prevention controls

In this section of the **COP**, the application of adequate controls for **fire** prevention at **mines** is described by considering the systems, processes and equipment employed at the **mine**. A control is an action aimed primarily at preventing the occurrence of a **fire** incident or an intervention intended to limit the impact of any incipient **fire**. These can take the form of a process or equipment re-design, implementation of different material selection criteria or of adequate operational standards.

Controls shall be assigned to each **fire** hazard and corresponding **risks** identified and defined in the **fire risk** management section. The number and degree of coverage of controls shall be commensurate with the level of anticipated **risk**.

All **fire** prevention controls should be listed in the **COP** and must be aligned with the findings of the various **fire risk** assessments. To this end, the **COP** should include a register listing all **fire** prevention controls (in place or planned) including **risk** based monitoring criteria together with the reference **risk** assessment document to which they are linked.

Critical controls are actions or interventions whose integrity will ensure that the hazard will not cause harm and should be recognised as such in the controls register. Monitoring criteria for the effectiveness of critical controls should be employed. Regular monitoring and recording of the performance of defined critical controls should take place.

The following section provides broad parameters applicable to relevant **fire** prevention controls. The **COP** should provide the objectives of each major

control under the headings provided below. To provide the necessary guidance, reference should be made to the support notes provided at the end of this guideline.

#### 8.2.1 Design, construction and operation

The **COP** should ensure that the design, construction and operation of any process or system employed at any **mine** conforms to regulated standards and design codes in compliance with the **MHSA**. In addition, the design, construction and installation of any equipment and machinery in use at **mines** must comply with national standards, applicable design codes and section 21 of the **MHSA**.

Inherent with this, is the requirement that systems, processes and equipment shall be designed, constructed and installed, so as to prevent or avoid contribution to the occurrence of **fires** under normal operations.

**Annexure 4** General Design Requirements Mobile Equipment and **Annexure 5** General Design Requirements for Fuel Storage Areas, Fuel Transfer Equipment and Refuelling Bays provides principles against which design, construction and operational parameters may be assessed in relation to **fire hazards** for inclusion in the **COP**.

#### 8.2.2 Mine infrastructure

The **COP** should identify **fire hazards** and record in the **fire** hazard register all infrastructure and installations that could pose a significant **fire risk** such as, but not limited to:

- (a) fuel storage and associated transfer equipment;
- (b) refuelling bays;
- (c) main substations and switchgear installations;
- (d) underground hoisting stations;
- (e) workshops;
- (f) densely timbered areas in intake airways;
- (g) diesel fuel lines in main shafts and declines - where these are used for transport;
- (h) any **fire hazardous** areas as classifiable by **SANS 10108: Fire hazardous area classification**;
- (i) high density surface storage area, eg **fire hazardous** material and combustible liquid storage areas, timber yards, fuel storage tanks, liquid oxygen tanks, ammonia refrigeration plants, etc; and
- (j) waste disposal containers.

To minimise **fire risk** at critical installations and infrastructures, the following requirements should be considered at the design stage:

- (a) the installation of infrastructure that could pose a heightened high **fire risk** should only be undertaken following a formal assessment and consideration of the controls necessary to minimise **risk**; and
- (b) wherever possible, such high **risk** infrastructures should be located in the return airways or near these, to facilitate exhausting of smoke and gases directly to return in the event



of a **fire** and/or be equipped with suitably designed **fire** doors that would shut-off in the event of a **fire** thereby limiting or reducing smoke contamination of fresh air streams.

### 8.2.3 Fixed plants

The **COP** should address the following list of fixed plant components that should be assessed as part of **fire hazard** identification audits. This list provides some guidance which is neither complete nor exhaustive:

- (a) air, gas or refrigerant compressors;
- (b) major electrical installations;
- (c) crushers (surface and underground);
- (d) mineral processing plants, inclusive of smelting and refinement processes;
- (e) conveyor belt installation (underground and surface);
- (f) hoist rooms and winding plant installations (surface and underground);
- (g) pump stations;
- (h) raise borers;
- (i) shaft sinking equipment;
- (j) materials handling equipment; and
- (k) **fire hazardous** material and combustible liquid storage areas.

**Annexure 3:** Mine infrastructure and fixed plant provides examples of preventative controls that should be considered underground and on surface for fixed plant components as classified in **SANS 10108: Fire hazardous** area classification.

The location of fixed plant equipment in underground and confined spaces should consider the normal flow of fresh air so as to guide the type, size and location of any **fire** detection and fire-fighting equipment.

All fixed electrical and related equipment such as sub-stations, switch-rooms and main distribution boards should be in accordance with applicable **SANS** standards (such as, but not limited to, **SANS 60076** (2011): Power transformers, **SANS 1029** (2008): Mini substations, **SANS 62135** (2013): Resistance welding equipment and **SANS 10280** (2013)—Overhead power lines for conditions prevailing in South Africa and:

- (a) be designed constructed and installed in accordance with the manufacturer's standard;
- (b) be equipped with at least over-current, earth leakage and short circuit protection;
- (c) be designed and constructed so that oil leaking from transformers and switchgear installations is contained; and
- (d) consider the use of 'dry', 'inert gas' or emulsified (low flammability) coolant options for transformer and switchgear equipment.

**Fire prevention measures** and protection equipment considered for these installations shall be designed to address adequately and reasonably the level of **fire risk**.

Where flammable oil is used, fixed electrical equipment should:

- (a) be provided with automatic **fire suppression systems**;
- (b) be located so that the air current that flows over them passes direct to return; and
- (c) have aggregate bund walls capable of containing the total oil volume with a plus 10% excess to capture any oil spillage.

The **COP** shall include details of any **fire detection systems** installed following the respective **fire risk** assessment action plan as well as of any **fire**-fighting equipment provided as a further protective measure. This specialised equipment should be designed, installed and maintained in association with competent **fire** engineering experts.

#### 8.2.4 Workshops

The **COP** should reference the design and operation of workshops both on surface and underground. The following aspects should be included in workshop standards and operating procedures:

- (a) Workshops should contain a minimum storage of combustible liquids (oils, lubricants, fuel, etc). Storage quantities shall not exceed consumption for one week's work;
- (b) Any combustible liquids should be stored in segregated locations; and
- (c) Appropriate signs as per **SANS** 1186-1 (2011): Symbolic safety signs—Part 1: standard signs and general requirement, and notification should be installed at all entrances to workshops indicating:
  - type and volume of combustible liquids stored;
  - no smoking or naked lights near flammables;
  - **hot work** in designated areas only;
  - housekeeping requirements; and
  - emergency procedure in case of **fire**.
- (d) The maximum mass of combustible materials stored or in use in a workshop in different subdivisions shall not exceed one week consumption (eg fuel, lubricants, grease, rubber or polyurethane filled tyres, paints, welding gas cylinders, etc). This information should be used to determine the appropriate type and quantity of **fire**-fighting equipment as well as the location of any **fire** detection sensors.
- (e) The design of the ventilation system serving workshops must follow a **risk**-based approach that caters for:
  - position of machinery, equipment, temporarily stored material (consumables) vehicles being serviced at any one time (eg diesel emissions, hydrogen liberated during battery charging, etc) and the workshop volume taken-up by these under normal and exceptional circumstances. These will all affect air-flow patterns in the workshop,

- response of any smoke sensing equipment and effectiveness of any fixed **fire** suppression equipment;
- positioning of the workshop in relation to intake and return airways. This is important to determine the strategy to be adopted in the event of a **fire** and the type of **fire** detection and **fire**-fighting tactic; and
  - contingency arrangements may be required in the event of power failures.
- (f) Where part of a workshop is earmarked for **hot work** (welding, grinding, cutting or heating or burning using oxy-acetylene or electric welding), separate locations (cutting bays or welding bays or grinding bays) should be provided and supplied with adequate flow of fresh air to dilute any smoke or fumes generated by such work. Standard operating procedures should reflect a blanket permission to allow **hot work** whenever this is performed in these locations.
- (g) **Hot work** permit systems must be implemented for **hot work** in any other area of the mine.
- (h) Chemicals in stores that can generate heat or release fumes should be appropriately separated from workshops working areas.
- (i) Sealed waste oil disposal system and suitable containers for the disposal of other flammable waste should be used to minimise spillage.
- (j) Space heaters should not be used in workshops unless they have a surface temperature less than 300° C and are kept clear of rags, paper and other flammable material.
- (k) Welding gases such as acetylene and oxygen should be stored and used in accordance with OEM requirements.
- (l) Workshops should be provided with adequate spillage containment facilities (eg water hose, absorbent material) to contain or clean-up any fuel spills quickly and effectively.
- (m) Any waste (eg soiled absorbent material) should be placed immediately in clearly marked receptacles and be kept well away from any potential ignition source. These receptacles should be emptied at least weekly.
- (n) **Fire** extinguishers and **fire**-fighting equipment should be installed as required.
- (o) Suitable barriers or designated parking areas should be installed to provide for adequate separation of mobile equipment from flammable materials.
- (p) The following **SANS** standards should be considered during workshop design: **SANS** 10400(2009): National building regulations, **SANS** 10263(2009): The warehousing of dangerous goods and **SANS** 10232(2007): The transport of dangerous goods.

#### 8.2.5 Mobile equipment

The **COP** should address the **risk** posed by the operation of self-propelled mobile equipment at a **mine** or in a confined environment

(eg a surface coal bunker) as determined by a number of factors such as:

- (a) The mass of flammable material on the vehicle. This may include, but is not limited to:
  - fuel;
  - hydraulic oil;
  - tyres; and
  - the nature of the payload (more fuel, oil, timber, etc).
- (b) The routing (mobility) of the vehicles particularly in main intake airways—as a vehicle **fire** is likely to contaminate the air downstream of the event.
- (c) Propensity of a vehicle **fire** to involve other parts of the **mine** (eg coal seam in coal **mines**, plastic piping in roadways, timber support in drives, etc).
- (d) The location of refuelling bays or places where (temporary) maintenance is done.
- (e) The air quantity flowing past a potential **fire** site and sites through which is coursed downstream.

The general design of vehicles should conform to minimum **SANS 868**: Compression (ignitions engine system and machines powered by such engine system, for use in **mines** with explosive gas) and plants as applicable or manufacturer's specification. The routing of electrical (power) cables, fuel and hydraulic lines, particularly in engine bays, near brakes and pinch-points should be such that incidental damage and contact with hot surfaces is avoided. Pipes and hoses should be manufactured from high quality; durable materials and the piping layout should consider abrasive action and allow for adequate mobility.

The integrity of the original manufacturer's design as accepted by the mine and in line with this **COP**, amongst others, should be maintained for the life of the equipment.

**Annexure 4** General Design Requirements Mobile Equipment provides series technical solutions **risks** posed by the operation of self-propelled mobile equipment.

**Annexure 6** Safe Use, Transport and Handling of Explosives provides examples of preventative controls that should be considered underground and on surface for the transport of explosives (Referencing to the explosive procedure in terms of **MHSA** regulation 4.2(b)).

#### 8.2.6 Managing fire potential

The **COP** must indicate measures to address the storage and use of such substances or materials that have a flash point below 60° C, including compressed gases such as acetylene and propane. The use and presence of flammable substances at a **mine** is inevitable and therefore the **risk** posed by these must be managed adequately. The relevant **SDSs** in accordance with **SANS 10234 (2008)**: List of global harmonised classification and labelling of chemicals must be consulted to determine the type of any precautionary measures that require implementation.

#### 8.2.6.1 General requirements

The **COP** should set out measures to minimise **fire risk** associated with the storage or use of flammable substances at the design or selection stage. The following should be considered:

- (a) wherever possible and reasonable, **flame retardant** materials should be used in preference to flammable materials;
- (b) all combustible materials should be stored in dedicated, clearly-marked storage areas;
- (c) the use and location of flammable substance storage areas should only be undertaken following a formal assessment and consideration of the controls necessary to minimise **risk**;
- (d) wherever possible and reasonable, flammable substance storage areas should be ventilated into the return airways or have suitable **fire** doors installed to limit smoke ingress into working areas and intake airways. Flammable substance storage equipment should be constructed of non-flammable materials;
- (e) 'No Smoking' and 'No Naked **Flame**' signs should be displayed at all flammable materials storage locations;
- (f) flammable materials should not be stored on or near heat or ignition sources;
- (g) the routing of electrical cable clusters, particularly high tension lines, should not be allowed within close proximity from flammable materials. Each application shall be considered on merits dictated by **risk** considerations, good practice and the use, where necessary, of adequate protective (shielding or separating) measures;
- (h) electrical switchboards should not be placed in flammable material stores;
- (i) wherever possible and reasonable, light fittings should be mounted clear of flammable materials;
- (j) all electrical equipment should meet relevant electrical standards for design and installation and should be used as intended by the manufacturer;
- (k) where necessary and as indicated by an assessment of the **risk**, smoke alarms and earth leakage protection should be installed on electrical equipment that is left to operate unattended;
- (l) the quantity of flammable materials stored in any location, should be kept to a minimum as per mine **risk** assessment;
- (m) flammable material storage equipment should be located away from high traffic or collision-prone

areas or be otherwise protected against vehicle collisions;

- (n) wherever possible and reasonable, **hot work** should not be done in or near flammable materials, in the presence of flammable gases or other such fluids. A permit system for **hot work** (inclusive of adequate preventative and protective measures) should be in place for any such work outside workshops; and
- (o) wherever possible and reasonable, vehicle access to combustible stores should only be for the purpose of loading and unloading. Vehicles should not be parked in tyre stores.

#### 8.2.6.2 Combustible substances

The **COP** should address measures for the storage and use of combustible substances or materials at **mines** that generally have a flash point below 60° C. This includes Class 3 flammable liquids.

Foams and resins may be particularly volatile in their component form (ie prior to mixing). Where foams are used they must comply with **SANS 1867 (2003)**: Sprayed plastic foams for use in mines.

##### (a) Flammable solids

The **COP** should address the following requirements related to the use and storage of flammable solid materials:

- (i) Where the large-scale use of timber support is necessary, the **COP** should make reference to a programme to identify densely timbered areas, particularly in intake airways and storage areas. The choice of any specific mitigating measure such as, for example, impregnating timber with **fire** retardant chemicals or coating of exposed timber with inert (intumescent) material, should be **risk**-based and specified accordingly in operating procedures.
- (ii) The **COP** should outline any special measures for the prevention of **fires** in waste storage facilities. These could include, but not limited to:
  - adequate ventilation measures for some waste storage facilities;
  - displaying 'No Smoking' signs in the waste storage facilities and near refuse containers;
  - the regular removal of waste materials from refuse containers and waste storage facilities at adequate intervals to prevent the accumulation or overflow of waste materials.

The use, transport and handling of explosives in **mines** may be considered to be an additional **fire hazard**. This **COP** should make reference to the relevant standards procedures and precautionary measures intended for the safe use, transport and handling of explosives used at a mine.

(b) Flammable liquids

The **COP** should reflect the following requirements related to the use and storage of flammable liquids:

- (i) all vessels containing flammable liquids should be provided with clear and easily understood labels and respective **SDSs**;
- (ii) only purpose-built containers, designed to prevent spillage, should be used to transport flammable liquids. Diesel fuel should only be transported in purpose-designed bowers or jerry-cans, adequately secured to the vehicle's loading tub;
- (iii) where large quantities of flammable fuels are stored, eg diesel fuel storage tanks, oil cooled transformers, etc, and where justified by **risk**-based considerations, storage vessels should be enclosed in a containment area (bund wall) where any spillage following the rupture of the containment vessel. The containment area should be large enough to accommodate 110 % of the maximum flammable liquid volume in storage at any time. In addition, if this area should be filled with inert material such as gravel consideration must be taken into the volume of flammable liquid in the storage vessel. If any drainage system is used it must be fitted with a device that is normally closed; and
- (iv) the vehicles used for the transport of flammable liquids should be appropriately designed for the task.

**Annexure 5:** General design requirements fuel storage areas, fuel transfer equipment and refuelling bays below includes reference to a number of items relating to fuel storage areas, fuel transfer equipment and refuelling bays for possible consideration in structuring standards supporting the management of **fire risks** associated with these.

**Annexure 6:** Safe use, transport and handling of explosives below provides suggestions that might be included in procedures for the safe transport handling and use of explosives. These are provided for possible reference and inclusion in operating procedures.

## (c) Flammable gases

The management of **risks** associated with the natural occurrence of flammable gases in underground operations, ie resulting from mining operations, is not included in this **COP**. Reference should be made, however, to the respective **COPs** for the prevention of flammable gas explosions. This **COP** is to address the use of industrially manufactured flammable gases that may be used in various processes at a mine, mainly welding.

The **COP** should reflect the following requirements related to the use and storage of flammable gases used in '**hot work**':

- (i) flammable gas cylinders should be stored in a well-ventilated area;
- (ii) flammable gas cylinders should be transported and stored in accordance with the relevant manufacturer's specification;
- (iii) gas cylinders should be secured so that they cannot fall over. In particular, cylinders containing acetylene should always be stored in an upright position;
- (iv) when transporting cylinders, they should not protrude over the vehicle's loading bed extremities;
- (v) flash-back arresters should be installed on all oxy-acetylene equipment;
- (vi) the contents of flammable gas cylinders should not be decanted; and
- (vii) oxy-acetylene equipment should only be used in accordance with accepted operational standards and only in designated '**hot work** areas' or when approved through the use of a '**hot work** permit'.

## 8.2.6.3 Operating and maintenance procedures

The **COP** should reflect the following:

- (a) Operating procedures should be developed from the action plans drawn from the various **fire risk** assessments.
- (b) Maintenance systems should be in place to ensure that all equipment, both mobile and fixed plant, is maintained properly and according to the manufacturers' recommendations and that any defects are recorded and promptly repaired.
- (c) Oversight procedures are in place to ensure that:
  - ✓ regular maintenance of equipment for the prevention of **fires**, used for **fire** detection and **fire**-fighting is essential in the implementation of the various protection measures;



- ✓ all repair and maintenance activities for machinery, systems and equipment associated with **fire risks** and employed for **fire** prevention and protective measures should be carried out at specified intervals, by suitably qualified individuals and in accordance with original equipment manufacturer specification;
- ✓ repair and maintenance activities must restore equipment to the intended design and operational functionality; and
- ✓ employees training programmes for **fire** prevention procedures and awareness should be aligned with requirements and findings of the various **fire risk** assessments to ensure adequate levels of proficiency and effectiveness and acceptable workmanship.

**Annexure 7:** Generic operational and maintenance procedures below provides suggestions that might be included in procedures for generic operational and maintenance procedures. These are provided for possible reference and inclusion in operating procedures.

### 8.3 Purchasing procedures

The **COP** should include the requirement that the mine's purchasing procedures be developed and implemented to ensure that any machinery, equipment or materials purchased for use at the mine comply with site standards. This procedure should:

- (a) require manufacturers or suppliers to provide evidence that **fire risks** associated with such machinery, equipment or materials have been considered and addressed (refer section 21 of the **MHSA**) and in compliance with applicable at least national standards;
- (b) require manufacturers or suppliers to make mine management aware of any residual **fire risk**, either patent or potential that might be associated with the use of such machinery, equipment or materials;
- (c) require manufacturers or suppliers of machinery to advise mine management of any **fire**-fighting equipment or additional fire protection requirements associated with the use of such machinery at a mine;
- (d) ensure that **SDSs** are provided for any combustible or flammable materials supplied to the mine;
- (e) require that manufacturers or suppliers of machinery or equipment provide adequate information on the operational procedures and maintenance requirements, particularly relating to any specific **fire**-detection or **fire**-fighting equipment custom built into the machinery. Alternatively, requirements and specifications for such **fire**-detection or **fire**-fighting equipment that might have to be provided separately by a third party need to be communicated adequately;
- (f) require that manufacturers or suppliers of machinery or equipment provide adequate training and/or training material to ensure the proficiency of machinery or equipment operators; and

- (g) ensure that machinery and equipment specifications and maintenance and operational manuals are included in tender documents for any new contracts.

#### 8.4 Inspections

The COP should reflect the requirements stated in regulation 5.1 of the **MHSA**, in particular that:

'The employer must ensure that a competent person reports to the employer, at appropriate intervals determined in accordance with the mine's **risk** assessment, on—

- (a) the effectiveness of the precautionary measures taken to prevent or suppress explosions of coal dust or flammable gas; and
- (b) the adequacy of measures in place to prevent, detect and combat the start and spread of mine fires.'

The COP should include the requirement that a series of inspections relating directly to **fire hazards** be performed as follows:

- (a) **fire hazard** audits: Intervals are to be stipulated in accordance with section 8.1.1 of this guideline;
- (b) regular inspections of working areas to monitor compliance with fire controls, including preventative procedures and **fire** protection equipment; and
- (c) inspections aimed at identifying either substandard acts or work practices (behaviour) and substandard conditions (**fire hazards**). There are usually two types of inspections:
  - formal inspections of all workplaces that are undertaken on a regular (ie. weekly or monthly) basis, depending on the level of **risk** (eg weekly explosives magazine inspections). Formal inspections generally involve the use of area-specific or task specific check-lists to record any defects; and
  - informal inspections that are undertaken by employees, supervisors and managers on a daily basis.

Formal inspections must be recorded in adequately structured, fit-for-purpose reports. Any observed defects or deviations or irregularities are to be reported immediately verbally and then in writing to the legally appointed person - irrespective of the type or level of inspection being carried-out.

**Annexure 8:** Inspections provides guidance for consideration during inspections.

#### 8.5 Awareness training for fire prevention

In all documents relating to training in elementary **fire**-fighting procedures, caution should be exercised so as to prevent employees from being exposed to danger during **fire**-fighting operations. It is recognised that the dousing of an incipient **fire** is an effective measure to limit the impact of any such incident. However, employees must be warned of the dangers of going beyond their level of knowledge and proficiency in using **fire**-fighting equipment.

The **COP** should set out measures to address awareness training under the following sub-headings:

##### 8.5.1 General fire prevention awareness

Basic **fire** prevention awareness training should be provided as part of the mine induction.

Refresher training should then be conducted every 12 months as part of regular safety/tool-box meetings.

All personnel who work at the mine should have a basic understanding of **fire prevention measures** and be trained and assessed for competency in:

- (a) basic **fire** theory;
- (b) basic **fire** prevention methods;
- (c) understanding of **fire** potential **risks**;
- (d) use of the first response of basic **fire**-fighting equipment, including portable extinguishers, installed on-board vehicle **fire suppression systems**, etc;
- (e) behaviour of **fire** in enclosed environments, including the role played by ventilation systems;
- (f) emergency procedures, including use of self-rescuers, refuge chambers and emergency assembly points;
- (g) reporting procedures during **fire** emergencies; and
- (h) distinguishing and identifying audio and visual **fire** alarms where provided.

#### 8.5.2 Mobile equipment operators training

In addition to the general **fire** awareness training, all operators of mobile equipment at the mine should be trained and assessed for competency, with the assistance of equipment manufacturers or suppliers where necessary, in the following preventative and precautionary measures:

- (a) the basics of conducting proper inspections;
- (b) identification of overheating surfaces;
- (c) requirements for minimising engine and equipment temperatures through correct operating technique;
- (d) procedures to isolate on-board electrical power sources safely;
- (e) electrical **fire hazards**;
- (f) use of refuelling equipment and refuelling procedures;
- (g) **fire prevention measures** of tyre **fires**; and
- (h) response to any **fire** that may occur on a vehicle based on the equipment available.

#### 8.5.3 Fixed plant operators training

All personnel who operate fixed plant at the mine should be trained and assessed for competency, with the assistance of equipment manufacturers or suppliers where necessary, in the following preventative and precautionary measures;

- (a) identification of overheating surfaces;
- (b) requirements of machinery or equipment electrical isolation also in accordance with regulatory provisions;
- (c) equipment operational condition monitoring (eg normal operating temperatures, pressures and response to changing conditions);

- (d) recognising mechanical and electrical **fire hazards**; and
- (e) where appropriate, safe emergency stopping of machinery using brakes in terms of regulatory provisions.

#### 8.5.4 Mobile equipment maintenance awareness

All personnel involved in the maintenance of mobile equipment at the mine should be trained and assessed for competency, with the assistance of equipment manufacturers or suppliers where necessary, in the following preventative and precautionary measures:

- (a) use of the maintenance system check sheets;
- (b) equipment pre- and post-maintenance inspections;
- (c) equipment operational condition monitoring (eg normal operating temperatures, pressures and response to changing conditions);
- (d) inspecting and checking of 'V' belts, rigid and flexible guards and hoses;
- (e) installation and replacement of hydraulic and pneumatic hoses for specific equipment; this should also include the correct use of hose crimping, where required;
- (f) use of **hot work** permits and welding equipment, where required;
- (g) maintenance of **fire suppression systems**, where provided and necessary; and
- (h) importance of completing pre-use checklist items pertaining to **fire prevention measures**.

#### 8.5.5 Electrical maintenance personnel

Personnel involved in the maintenance of electrical equipment or installations at the mine should be trained and assessed for competency with the assistance of equipment manufacturers or suppliers where necessary, in the following preventative and precautionary measures:

- (a) conducting thermal imaging and electrical tests;
- (b) **hot work** permits system requirements; and
- (c) live testing of equipment in line with procedures and legislated regulations.

All personnel who undertake such work should also be appointed electricians qualified to work on the type of equipment (eg low voltage, high voltage, instrumentation, etc).

#### 8.5.6 Fuel storage operational personnel

Personnel involved in the transport, storage or handling of fuel, combustible materials and explosives at the mine should be trained and assessed for competency in at least but not limited to the following:

- (a) transport and storage procedures relating to fuel, combustible materials or explosives;
- (b) use of specialised distribution or unloading equipment;

- (c) procedures for the refuelling of vehicles conveying these materials;
- (d) access procedures to combustible material stores or explosives magazines;
- (e) isolation of equipment prior to maintenance;
- (f) emergency procedures specific to fuel facilities, combustible materials or explosives storage area; and
- (g) personnel responsible for the receipt of bulk diesel, shall be specifically trained in the receipt of dangerous goods, and be 'nominated' as the 'qualified person', referred to in **SANS 10231 (2010): Transport and dangerous goods.**

## 8.6 Fire protection and emergency response

The **COP** should reference broadly the mine's **fire**-protection and emergency response tactics for major **fire hazards**. In particular, this **COP** should describe the principles used in the selection of each tactic, the alignment of this with the respective **fire risk** assessment and any specialist input made in devising the protective measures and responses (eg **fire** engineering criteria to determine **fire**-fighting equipment specifications where deemed necessary, etc).

Under this section, the **COP** should list and describe briefly the measures implemented for early detection of **fires** at different locations on the mine based list of **fire** hazard locations referenced in section 8.1.

**Fire prevention measures** as intended in this **COP** is a proactive endeavour aimed at eliminating the hazard of **fire** and should therefore be considered as the primary form of control. **Fire** protection is a secondary control aimed at reducing the consequences of a **fire** by limiting the severity and impact of a **fire**. Therefore, this guideline should be used in conjunction with the Guideline for emergency preparedness and response to provide a comprehensive and coordinated approach in addressing the **fire prevention measures** and control of **fires**.

**Note:** Under no circumstances should **fire** braziers (mbaula), ie any fixed or portable solid fuel or gas fired equipment or appliance designed for heating and used outdoors, be used at the **mines**.

## 8.7 Effective means of monitoring and communicating the possible presence of a fire

The **COP** should set out measures to monitor and communicate the possible presence of **fire**. This system should include the following:

- 8.7.1 a brief description of the method(s) employed to detect the occurrence of a **fire**, presence of noxious gases or flammable gases underground;
- 8.7.2 a brief description of the approach used to position the sensors to monitor the air flow in the underground workings effectively for detecting the presence of a **fire** and facilitate its location in the mine;
- 8.7.3 a description of the channels of communication that are to be used after a **fire** has been detected, including communication with neighbouring **mines** where secondary outlets/escape routes are shared;
- 8.7.4 the process for monitoring of underground environmental conditions during a **fire**; and
- 8.7.5 a **list** of evacuation plans available in the control room that would include the following amongst others:
  - location of various sensors;

- location of refuge bays (inclusive of telephone numbers); and
- identification of escape routes.

## **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, 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 The **COP** must specify the source of information pertaining to the **risk** assessment and action plans and where these are to be found at a mine. In addition, the person or persons responsible for drafting, authorising, following-up and safe keeping of these documents and information shall be identified in the **COP**.
- 1.3 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 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 of the **COP** on written request to the manager. 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.

## ANNEXURE 1: Generic notes on fires

*(For information purposes)*

'**FIRE TRIANGLE**' (Oxygen, Heat, Fuel plus Chain Reaction) **fires** start when a flammable material or liquid, in combination with a sufficient quality of an oxidiser such as oxygen gas or oxygen-**risk** air is exposed to a source of heat or ambient temperature above the flash point for the fuel/oxidiser mix, and is able to sustain a rate of rapid oxidation that produces a chain reaction.

'**Four (4) stages of a fire**' By most standards including **IFSTA**, there are 4 stages of a **fire**. These stages are incipient, growth, fully developed, and decay. The following is a brief overview of each stage.

**Incipient**—This first stage begins when heat, oxygen and a fuel source combine and have a chemical reaction resulting in **fire**. This is also known as 'ignition' and is usually represented by a very small **fire** which often goes out on its own, before the following stages are reached. Recognising a **fire** at this stage provides the best chance at suppression or escape.

**Growth**—The growth stage is where the structures, **fire** load and oxygen are used as fuel for the **fire**. There are numerous factors affecting the growth stage including where the **fire** started, what combustibles are near it, ceiling height and the potential for 'thermal layering'. It is during this shortest of the 4 stages when a deadly 'flashover' can occur; potentially trapping, injuring or killing **fire**-fighters.

**Fully Developed**—When the growth stage has reached its maximum and all combustible materials have been ignited, a **fire** is considered fully developed. This is the hottest phase of a **fire** and the most dangerous for anyone trapped within.

**Decay**—Usually the longest stage of a **fire**, the decay stage is characterised a significant decrease in oxygen or fuel, putting an end to the **fire**. Two common dangers during this stage are firstly—the existence of non-flaming combustibles, which can potentially start a new **fire** if not fully extinguished. Secondly, there is the danger of a back draft when oxygen is reintroduced to a volatile, confined space.

Flammable liquids are classified in terms of the latest version of **SANS** 10089-1:

- 1.1.1 Class 0: liquefied petroleum gases (LPG);
- 1.1.2 Class 1A/B: liquids with a closed-cup flash point below 23° C;
- 1.1.3 Class 1C: liquids with a closed-cup flash point between 23 and 38° C;
- 1.1.4 Class 2: liquids with a closed-cup flash point between 38 and 60.5° C;
- 1.1.5 Class 3A: liquids with a closed-cup flash point between 60.5 and 93° C; and
- 1.1.6 Class 3B: liquids with a closed-cup flash point of 93° C or above.

Physical and chemical properties of fuel sources can impact the level of a **fire risk**. These properties include flammability, ignitability, combustibility (**fire** spread capacity or **fire** retardant effect), self-extinguishing properties, toxicity of paralysis products and other unique characteristics. Safety Data Sheets (**SDSs**) from suppliers in compliance with **SANS** 10234 (2008): Global harmonised system of classification and labelling of chemicals and system or process design specifications from designers should be consulted to identify and categorise fuel sources.

## ANNEXURE 2: Examples of fire hazards at mines

(For information purposes)

The following is a list of typical **fire hazards** that could be considered for addition in the **COP's** list of **fire hazards**. The list is intended as an *aide-memoire* and it is not exhaustive.

### Underground

- (a) Fixed mechanical equipment or plant using mechanical friction such as mono-winches and associated winch rope systems, conveyor belt drives and pulleys.
- (b) Fixed electrical equipment: electrical short circuits or over heating of oil-filled transformers or switch-gear; (particularly where these are located in main intake airway systems).
- (c) Mobile equipment: fuel or oil leaks on hot exhaust manifolds or the surface of a turbocharger.
- (d) Re-fuelling bays and battery charging bays.
- (e) Underground workshop areas (storage of fuels, grease, oils, paint, tyres, hoses) in the presence of mobile equipment and also where extensive **hot work** is performed.
- (f) Combustible and flammable liquid stores.
- (g) Explosives storage areas.
- (h) Locations where combustible or flammable dust or gases can accumulate.
- (i) **Flame** cutting and welding operations, particularly near combustible material.
- (j) Abandoned panels or work-places: spontaneous ignition of support timber or coal.

### Surface

- (a) Major transformer stations and electrical switchgear installations in or next to hoist rooms.
- (b) Storage installations for fuel or other flammable chemicals.
- (c) Overland conveyor belts.
- (d) Coal stockpiles or spoil piles (induced **fires** or self-ignition).
- (e) Explosives magazines.
- (f) Smelter granulation or casting process areas.
- (g) Ammonia refrigeration plants.
- (h) Waste storage or disposal areas.
- (i) Natural or agricultural areas near, plant/surface infrastructure, intake shafts or declines (plant material **fires**).



### ANNEXURE 3: Mine infrastructure and fixed plant

*(For mandatory purposes)*

The following notes are provided for general guidance and possible consideration for addition in the structuring of action plans or of associated preventative measures.

#### Fixed plant

- (a) Electrical cables and electrical equipment should be located so that they cannot be damaged by impact from vehicle collision or blasting in accordance with **MHSA** regulation 3.22 and 3.23.
- (b) Fixed electrical installations should be designed to minimise the need for maintenance personnel to work on live apparatus in accordance with **MHSA** regulation 3.13.
- (c) Oil-cooled transformers' sites be built on a bonded floor, impervious to fuel and provided with drainage facilities for handling spillage of cooling oil.
- (d) These sites should be adequately protected from incidental damage caused by vehicle movement in the vicinity. This implies that sites should be adequately selected in relation to vehicle traffic flow and that the erection of bollards or barriers should be considered.
- (e) Reflectors should be attached to fixed electrical installations and cables to make them clearly visible to operators.
- (f) Thermostats should be provided on electrical motors to stop the motor being governed automatically if pre-set temperature requirements are exceeded.
- (g) A minimum of two **fire** extinguishers rated for the classification of **fire** for which it is to be used must be provided for substations and transformers. For substations one should be located on the inside of the sub and the other on the outside of the substation in an upwind position. Transformers should have a **fire** extinguisher on either side located as close as practical to the entry. Newly designed **mines** should make provision for underground substations with oil filled equipment should be ventilated to the return airway when a fire occurs and have automatic **fire** extinguishing equipment.
- (h) Electrical protection against earth leakage and overload should be provided for all fixed mechanical equipment and electrical Trackless Mobile Machines. These installations should be designed in such a manner so as to prevent a temperature rise in the cables that could lead to a **fire**.
- (i) Critical items of plant that are associated with potential fuel sources should have thermal monitoring installed.
- (j) All materials used in the construction of fixed mechanical equipment should be **flame retardant**.
- (k) As a reference, a number of **SABS** publications may be considered:
  - (i) **SANS** 484-1 (2009): Conveyor belting—step splicing for multi-ply textile-reinforced rubber covered conveyor belting:
    - Part 1: Hot-splicing method
    - Part 2: Cold-splicing method
  - (ii) **SANS** 486-2 (2009): Conveyor belting—finger splicing of solid woven construction conveyor belting;
  - (iii) **SANS** 340 (2006): Conveyor belts—laboratory scale flammability characteristics—requirement and test method;

- (iv) **SANS** 968 (2013): Conveyor belting—textile reinforced solid woven carcass Ed 1 construction;
  - (v) **SANS** 971 (2013): Conveyor belting—methods of testing fire retardant properties of all conveyor belt construction; and
  - (vi) **SANS** 54 (2009): Rubber, vulcanised or thermoplastic—accelerated aging and heat resistance tests.
- (l) **MHSA** regulation 8.9(3): The employer must take reasonably practicable measures to prevent persons from being exposed to flames, fumes or smoke arising from a conveyor belt installation catching fire, including instituting measures to prevent, detect and combat such fires.
  - (m) Conveyor belts should be provided with a slip monitoring system that should stop the belt if a slip of 5% or greater is detected.
  - (n) Consider the installation of automatic **fire suppression systems** on the drives, tail and transfer points of conveyor systems. This does not apply where **flame retardant** belt and drum frictional surface is used and regularly (based on **risk** assessment) maintained.
  - (o) Equipment should be designed to minimise the need for welding and **flame** cutting underground or in confined spaces.
  - (p) Hydraulic and lubrication systems should use steel piping wherever possible. Where hoses are used they should be.
  - (q) Belt drift switches should be provided to stop the belt if excessive drift is detected.
  - (r) Fluid couplings if used should not be source of ignition.
  - (s) Idler bearings should be sealed.
  - (t) Temperature monitoring devices and alarms should be installed, in readily identifiable locations, on main bearings of conveyor drives.
  - (u) Where possible, compressors should be located on the surface rather than underground.
  - (v) Compressors should be designed so that in the event of a compressor fire, the amount of smoke entering the main intake is minimised.
  - (w) Where compressors are operated underground, consider the following:
    - (i) thermal monitoring devices should be installed on the output of the compressor screws that alarm and stop the compressor in the event of a temperature or oil pressure overload or high discharge air temperature being detected; and
    - (ii) compressors should be installed so that the ventilating air flows over them directly to return.
  - (x) Flow switches should be provided to stop pumps in the event of low flow conditions.

## **ANNEXURE 4: General design requirements: Mobile equipment**

*(For mandatory purposes)*

The following is a series of technical solutions that might be considered for addition in the **mine's** action plans and/or as part of the **COP**. This includes but not limited to the following:

### **Vehicles**

- (a) An adequate number of **fire** extinguishers adequate for the classification of **fire** for which it is to be used must be provided for each vehicle.
- (b) In addition to the above, large mining vehicles used for ore loading and transport should be provided with custom-designed on-board **fire** suppression equipment.
- (c) Where a vehicle has to pass under a power line, the line should be raised to provide clearance in accordance with **MHSA** regulation 3.29.
- (d) In relation to the layout of equipment in engine bays, the following should be considered in relation to hydraulic hoses:
  - (i) hydraulic hoses should be **flame retardant** and meet the requirements of **SANS** Hydraulic hoses parts 10a and 10b and **SANS** 347 (2009): Categorisation and conformity of all pressure equipment;
  - (ii) securely clamped away from hot surfaces;
  - (iii) located so that impact damage is minimised; and
  - (iv) provided with bulkhead fittings where they pass through bulkheads.
- (e) Flammable fluid containers should be located such that any overflow should not contact a potentially hot surface.
- (f) Secure filler caps should be provided that include tie straps.

### **Engine systems**

- (a) Consider the use of powering-down systems to stop engines safely in the event of an emergency.
- (b) Engine control systems should be designed so that the fuel system would be shut-off automatically if a fault occurs that requires the engine to stop.
- (c) Adequate protection must be provided where this equipment is operated in explosive gas dust atmospheres (**SANS** 868-1-1: Compression-ignition engine systems and machines powered by such engine systems, for use in **mines** and plants with explosive gas).
- (d) The introduction of operational or automatic means for shutting-down engines when working pressures exceed recommended maximum values should be considered.
- (e) Bulk heads should be **fire**-proof.
- (f) Ideally all equipment surfaces onto which flammable liquids could spray should operate at temperatures less than the lowest flash-point of oil being used.
- (g) Consider installing **fire** monitoring sensor sat points where the temperature of the hottest part of a diesel engine exhaust system and retarders can be measured as per **SANS** 868-1-1 (2005): Compression-ignition engine systems and machines powered by such engine systems, for use at **mines** and plants with explosive gas atmospheres or explosive dust atmospheres or

both Part 1-1: **Fire** hazardous locations in underground **mines**—basic explosion protected engines.

- (i) Part 1-2: **Fire** hazardous locations in underground **mines**—explosion protected engine systems.
- (ii) Part 1-3: **Fire** hazardous locations in underground mines—machines.
- (iii) Part 3-1: **Fire** hazardous locations on surface—basic explosion—protected engines.
- (iv) Part 3-2: **Fire** hazardous locations on surface—explosion—protected engine systems.
- (v) Part 3-3: **Fire** hazardous locations on surface—machines.
- (vi) Part 4: Non-fire hazardous locations in underground coal **mines**.

### Vehicle electrical systems

- (a) Protection should be provided against short circuiting and over current.
- (b) Electrical cables should be installed at safe distances from fuel lines.
- (c) Electrical systems should be designed to prevent the occurrence of electrical sparks following a system malfunction or accident.
- (d) Consider the use of electrical systems that derive power from diesel engine alternators or batteries designed to AS 4242: Earth-moving machinery and ancillary equipment for use in **mines**—electrical wiring systems at extra-low voltage standard. All other electrical systems should be designed to AS3000 Electrical Installations standard.
- (e) Where jump-starting systems are used, they should be purpose-designed for all electrical start equipment and meet the requirements as specified by the mine's engineer.
- (f) Where electrical cables and hoses are to pass through bulkheads, they should have rubber **flame retardant** connections (ie proper bulkhead connections) to which the cables and hoses are attached.
- (g) Protection against over current in low voltage (a nominal voltage level that are used for the distribution of electricity, the upper limit of which is an AC voltage of 1 000 V or a DC voltage of 1 500 V) circuits should be considered, where practical, by using circuit breakers or encapsulated fuses.
- (h) Consider protecting all circuits, except starter motors, against short circuit and over current.

### Vehicle fuel and hydraulic systems

- (a) Consider using steel lines for fuels, hydraulic and exposed lubrication systems.
- (b) Where flexible hoses are used they should limit the spread of **fires (SANS 10177-9: Fire testing of materials, components and elements used in buildings—Part 9: small-scale burning characteristics of flexible hoses)**.
- (c) Vent outlets or overflow points should be directed away from hot surfaces.
- (d) Hoses, oil, fuel and hydraulics lines, and fittings should be installed as per OEM specifications, ie positioning of clamps, routing and length of hoses, replacement fittings and components.
- (e) Fuel or oil lines or hoses should be kept separate from electrical cables.
- (f) Fuel or oil lines or hoses should be routed away from moving parts.

- (g) Fuel, oil and hydraulic systems and associated distribution lines should be free of leakages and protected from hot surfaces.
- (h) The flash points of liquids used by mobile equipment should be below the maximum ambient temperature likely to be experienced.
- (i) Hoses should be routed so that in the event of a burst or leaking hose, flammable liquid cannot come into contact with hot surfaces. Where routing away from hot surfaces is not possible, all hoses should be securely clamped and shielded so that in the event of a burst or leaking hose, flammable liquid cannot come into contact with a hot surface.
- (j) Hoses to be:
  - securely clamped away from hot surfaces;
  - located so that impact damage is minimised; and
  - provided with bulkhead fittings where they pass through bulkheads.
- (k) **Consider** providing dry break filling connections where fuel tanks on vehicles are replenished in production areas or for vehicles that transport explosives.
- (l) Containers for combustible fluids should be located so that any overflow cannot come into contact with hot surfaces. Where they are not provided with a dry break filler they should be provided with secured filler caps that are permanently connected to the container.

#### **Tyres and power transmission**

- (a) Tyres should be selected to suit their intended application in accordance with the OEM design and specifications.
- (b) Consider fitting **flame retardant** 'V' belts on mobile equipment.

#### **Other mobile equipment requirements**

- (a) Vehicle brake systems for mining equipment other than light vehicles (utility vehicles, small SUVs, small personnel carriers, etc) should be equipped with enclosed brake systems; or, where open discs are installed, residual pressure monitoring, brake drag or temperature monitoring and **flame retardant** brake hoses should be considered.
- (b) Ideally, all equipment functions, including the retarder function should be monitored.
- (c) A system that monitors engine oil pressure and stops the engine if pre-determined values are not maintained could be considered.
- (d) Turbocharger lubrication lines should be made of steel. Flexible connections may be used provided they are **fire retardant** and located away from hot surfaces (**SANS** 868-1-2).
- (e) The operators cab should be provided with a **fire**-wall to inhibit the passage of fire into the cab.
- (f) Covers on engine compartments should be **flame retardant**.
- (g) Vehicles transporting dangerous goods (define) should comply with **SANS** tanker standard.
- (h) Vehicles transporting combustible liquids should comply with **SANS** tanker standard.
- (i) Explosives should only be transported in separate enclosed compartments that meet the requirements of SAP Standard (Part 1: Explosives—storage and transport).

- (j) Further information regarding **fire prevention measures** for mobile equipment can be found in the TMM and Rail Bound guidelines.

The **COP** should set measures for the operation of all classes of mobile equipment. These procedures should include provisions for the following:

- (a) Testing of brake functionality by the operator.
- (b) Correct brake use by the operator.
- (c) Safe parking of the vehicle when a brake fault is detected.
- (d) A vehicle with a flat tyre to be parked in the nearest safe and accessible place.
- (e) Safe parking of equipment when 'V' belt fault detected.
- (f) Safe parking of equipment when tyre overheating or tyre fire is suspected.
- (g) The correct operation of retarder and equipment braking systems.
- (h) The provision of self-contained self-rescuers.
- (i) Housekeeping standards for operator cabs.
- (j) Checking equipment before use for the presence of oil or fuel leaks, combustible materials (eg rags, paper) and tyre condition.

## **ANNEXURE 5: General design requirements: Fuel storage areas, fuel transfer equipment and refuelling bays**

*(For information purposes)*

The following is a series of technical solutions that might be considered for addition in the mine's action plans and/or as part of the **COP**. The inclusion of these suggestions in the **COP** is not mandatory. These suggestions are not intended to be complete or exhaustive:

- (a) Electrical control systems associated with fuel transfer and storage should comply with the above mentioned standard.
- (b) High voltage reticulation should not pass through a fuel storage area; **SANS** standard such as but not limited to **SANS** 10228: Identification and classification of **fire** hazardous substances, **SANS** 10229: Transportation of dangerous goods, and **SANS** 60079: Electrical apparatus for explosive gas atmospheres for a safe distance.
- (c) Diesel storage tanks (fixed or mobile) should comply with the above mentioned **SANS** standard as appropriate and should be regularly inspected and maintained to ensure continuing compliance.
- (d) Where a mine uses a surface to underground fuel delivery pipe, it should be:
  - custom-designed;
  - where possible, installed in an accurately drilled and surveyed borehole;
  - where installed in a working shaft or material decline, it should be protected from incidental damage through contact with vehicles or moving conveyances;
  - contained in a free draining borehole; and - Subjected to inspection and non-destructive testing at regular intervals; and
  - provided with a system preventing 'runaway' flow of fuel into the mine.
- (e) Containers such as 'Jerry cans' used for transporting fuel should be secured to the load-carrying area away from any potential impact damage.
- (f) The storage of flammable gas cylinders should be separated from oxygen cylinders by a distance of at least 3m or have steel plate barrier at least the height of the flammable gas cylinders next to the oxygen cylinders.
- (g) Appropriate signage should be installed at all entrances to fuel storage areas indicating:
  - type and volume of fuel stored;
  - prohibition of unauthorised persons;
  - prohibition of smoking or naked lights;
  - prohibition of any **hot work**;
  - requiring the shutting down engines before refuelling; and
  - emergency procedures in case of **fire**.
- (h) All refuelling points should be separated from any connected supply points by the use of a physical barrier or adequate distances.
- (i) Any fuel supply or permanent refuelling location should be capable of being effectively and safely isolated from the mine's ventilation system in the event of a **fire** or situated in a manner that smoke can be effectively directed into the return airway.

- (j) Permanent storage, supply and refuelling stations should have an automatic **fire** detection and suppression system that complies with relevant parts of **MHSA** regulation 8.10.11.
- (k) Automatic **fire suppression systems** should include a **fire** alarm or other system to alert mine personnel in case of **fire** and be capable of being manually activated at a safe distance from the refuelling bay. Relevant part of **MHSA** regulation 8.10.11.
- (l) A minimum of two portable **fire** extinguishers with a suitable rating for the class of **fire** should be provided on the upstream side of all temporary fuelling areas.
- (m) Permanent fuel storage locations should be built on a bonded floor, impervious to fuel and provided with drainage facilities for handling fuel spillage. **SANS** 10089-3 (2010): The petroleum industry—Part 3: The installation, modification and decommissioning of underground storage tanks, pumps/dispensers and pipe work at service stations and consumer installations, could be used as reference.
- (n) These sites should be adequately protected from incidental damage caused by vehicle movement in the vicinity. This implies that sites should be adequately selected in relation to vehicle traffic flow and that the erection of bollards or barriers should be considered.
- (o) Where a fuel storage location is temporary, a **risk** assessment that deals with fuel spillage should be conducted and control measures as identified by the **risk** assessment is implemented.
- (p) All equipment used to store, transfer or distribute fuel should meet all the relevant sections of **SABS** Standards, **SANS** 10089-3:2010. The petroleum industry Part 3: The installation, modification and decommissioning of underground storage tanks, pumps/dispensers and pipe work at service stations and consumer installations.
- (q) Storage tanks, pipe work and fuel transport vehicles entering refuelling bays should be earthed in accordance with **SANS** 10089-3 (2010): The petroleum industry—Part 3: The installation, modification and decommissioning of underground storage tanks, pumps/dispensers and pipe work at service stations and consumer installations to dissipate static electrical charge.
- (r) All fuel transfer systems should be constructed with non-flammable materials and brass or non-metallic components and automatically shut off to stop flow.
- (s) Where practical, in underground applications, steel **fire** doors should be constructed to seal off the refuelling bay area to prevent smoke entering intake airways in the event of a **fire**.
- (t) No vehicle should park in a refuelling bay except for the purposes of refuelling or unloading of fuel.
- (u) Refuelling bays should be provided with adequate facilities (eg water hose, absorbent material) to quickly contain or clean-up any fuel spillage.
- (v) Any waste (eg soiled absorbent material) should be placed immediately in clearly marked receptacles and well away from any potential ignition source. These receptacles should be emptied at least weekly.
- (w) Electrical equipment, including lights, should meet the wiring requirements of **SABS** 10142: Wiring of premises—Part 1: Low voltage systems.



## **ANNEXURE 6: Safe use, transport and handling of explosives**

*(For mandatory purposes)*

The following is a series of technical solutions that might be considered for addition in the mine's action plans and/or as part of the **COP**. This includes but not limited to the following:

### **Explosives storage containers**

- (a) Explosive storage containers should be located away from main travelling ways to minimise the potential impact of explosion due to **fire** (regulation 4.2).
- (b) A water hose and proper drainage should be installed to allow for hosing down of spilt product or combustible liquids (eg oil leaking from explosives vehicles).
- (c) Appropriate signs should be installed on all explosive storage containers indicating:
  - no smoking, naked lights or equipment within 8 meters of explosives; and
  - the emergency procedure in case of **fire**.
- (d) Formal housekeeping requirements should be implemented to ensure that no waste material is allowed to accumulate in the area where explosive storage containers are located.
- (e) Operating procedures should be developed for the safe storage and transport of explosives to reduce the **risk** of **fire** involving explosives. These procedures should include provisions for the following:
  - safe refuelling of vehicles carrying explosives (consideration should be given to removing explosives from the vehicle before refuelling);
  - only purpose-designed and constructed explosives-carrying equipment entering magazines;
  - access to explosive storage facilities including loading and unloading of vehicles carrying explosives, at the explosive storage facilities or elsewhere;
  - vehicles carrying explosives being parked in designated areas that prevent uncontrolled access while left unattended;
  - non-bulk explosives (eg detonators, primer plugs, boosters etc) to be transported in;
  - separate enclosed compartments that meet the requirements of the Explosive Act (Act 15 of 1973) (Part 1: Explosives—Storage and Transport); and
  - all procedures relating to the storage and transport of explosives should meet the SAPS' Standard.

### **Prohibition requirements**

Procedures should prohibit:

- (a) Access to explosive storage facilities except by purposely designed vehicles and only for the purpose of loading and unloading:
  - the presence of ignition sources including mobile and satellite phones, smoking, cigarette lighters and matches on or around explosives carrying machines, or in or around explosive storage facilities, explosives carrying machines and service equipment;

- diesel engines running whilst loading or unloading in an explosive facilities;
- the presence of flammable goods in operators' cabins of vehicles conveying explosives;
- explosives carrying vehicles into maintenance areas prior to their having been washed down;
- **hot work** on or around vehicles carrying explosives and detonator until these have been removed, washed down;
- the transport or storage of diesel around or into an explosive storage facility;
- the transport or storage of flammable gases around or in explosive storage facilities;
- vehicles parked at a safe distance from explosive or other combustible materials (eg empty cartons) when inside explosive storage facilities; and
- persons attempting to fight an explosives **fire** with portable extinguishers except to extinguish a small equipment or waste **fire** not involving explosives.

### Other requirements

- (a) In addition to training requirements provided for Mobile Equipment Operators, personnel who transport explosives or handle explosives inside explosive storage facilities should also be trained and assessed for competency in at least the following:
- procedures for transport and handling of explosives;
  - explosive **fire prevention measures** and response;
  - refuelling of explosives carrying vehicles;
  - access requirements for explosive storage facilities; and
  - compliance with fuel unloading and refuelling procedures.
- (b) The following supervisory activities are recommended:
- checks for the presence of correct signage (eg 'Flammable materials', 'No Smoking', 'Explosives' etc);
  - compliance with maintenance procedures;
  - pre-handover inspection on machine cleanliness;
  - checks for adequate **fire** protection (eg sufficient number and correct type of **fire** extinguishers);
  - checks of emergency equipment such as refuge chambers and the status of escape ways;
  - layout of the explosive storage facilities (segregation of the explosives, detonators and bulk explosives);
  - safe parking of explosive-carrying equipment;
  - cleaning of explosives carrying equipment prior to hand-over to maintenance; and
  - specific emergency response procedures for explosive storage facilities or explosive-carrying equipment.

## **ANNEXURE 7: Generic operational and maintenance procedures**

*(For information purposes)*

The following is a series of technical solutions that might be considered for addition in the mine's action plans and/or as part of the **COP**. This includes but not limited to the following:

Procedures that could be considered for inclusion in action plans or operating standards associated with this **COP** include:

- (a) Good housekeeping practices in refuelling bays.
- (b) The safe operation of fuel transfer systems.
- (c) The refuelling of vehicles, equipment and fixed plant.
- (d) Fuel transfer between storage systems.
- (e) Replacement or changing of fuel cells or storage tanks.
- (f) The installation, location and maintenance of signage.
- (g) Management of data pertaining to vehicle and equipment maintenance.
- (h) Performing planned maintenance inspections and servicing of fuel transport and filling equipment.
- (i) Report on equipment condition and maintenance effectiveness and standards.

As part of the maintenance system, procedures should be implemented that incorporate the following to reduce **fire risk**:

- (a) Daily equipment servicing should include the removal of excess flammable materials (eg oil, grease) from the equipment before it is operated.
- (b) Maintenance work on equipment should include the removal of excess flammable materials (eg oil, grease) from the equipment before it is operated.
- (c) Immediate stopping of any equipment that develops a condition where heat sources or fuel sources may lead to a **fire**. These should be rectified and repaired before further operation. This procedure should be included as part of the induction training program for engineering employees.
- (d) Daily services should ensure that lubricant and coolant levels in mobile equipment and fixed plant are adequate.
- (e) Any maintenance work undertaken involving the use of oxy-acetylene equipment should be undertaken in a designated '**Hot work Areas**' or subject to a '**Hot work Permit**'.
- (f) Injector lines should be changed out at intervals as per the mine standard or as per OEM specification. Injector pipes should not be re-used unless they have been subjected to and passed an NDT (full name [sic]) inspection. Where this cannot be guaranteed, new pipes should be used.
- (g) A daily inspection of mobile equipment should include the following:
  - a check for oil and fuel leaks;
  - a tyre inspection and pressure test;
  - checking the integrity of the turbocharger and manifold guards. (Retrofit kits for older machines to minimise lines and hoses in hot zone where available); and
  - an inspection of wiring systems.

- (h) Tests of temperature alarms should be conducted as per mine standard.
- (i) Thermostats on electrical motors should be tested at least monthly.
- (j) A 250-hour inspection of mobile equipment should include the following inspections:
  - all sources of heat and all flammable materials;
  - 'V' belts (and adjustment, where required);
  - park brake operation;
  - battery compartments;
  - lube lines and fittings; and
  - fire suppression systems.
- (k) Brakes should be dynamically tested at least as per OEM and mine standards, with visual inspection for excess wear on a regular basis.

Mobile equipment maintenance procedures (both rail bound and trackless transport machinery) should include:

- (a) Monthly inspections of extra low voltage wiring to OEM requirements.
- (b) Standard procedure for the lubrication of equipment.
- (c) A procedure that requires maintenance personnel to remove excess lubricants and flammable materials following maintenance activities. This should be recorded as part of the maintenance report.
- (d) Running-up all equipment to normal operating temperature (20 min) inside the maintenance area before being returned back into service.
- (e) Maintenance inspections should identify leaks on equipment, which shall not be operated until these are repaired satisfactorily.
- (f) Inspection of hydraulic and fuel hoses for damage and wear at least every 250 hrs. These should be replaced where required. Specific hose check sheets should be developed for each class of machine as part of this process. Unplanned changes in hose specification and routes should be avoided.
- (g) Ensuring no overloading of tyres and correct tyre inflation pressure.
- (h) Where **auto-fire suppression systems** are specified, fire extinguishing media should comply to one of the following specifications:
  - **SANS 7202 (2012):** Fire protection—Fire extinguishing media—Powder.
  - **SANS 7203-1 (2013):** Fire extinguishing media—Foam concentrate Part 1: Specification for low expansion foam concentrate for application to water immiscible liquids.
  - **SANS 7203-2 (2013):** Fire extinguishing media—Foam concentrate Part 2: Specification for medium and high expansion foam concentrate for top application to water immiscible liquids.
  - **SANS 7203-3 (2013):** Fire extinguishing media—Foam concentrate Part 3: Specification for low expansion foam concentrates for top application to water immiscible liquids.
- (i) Explosives-carrying equipment should not be allowed into maintenance areas until all explosives and detonators have been removed and washed down.

The **COP** should address the following relating to electrical equipment maintenance:

- (a) Electrical equipment maintenance should be included in a formal maintenance plan or schedule.

- (b) Only non-flammable sprays should be used during electrical maintenance.
- (c) Only competent persons should do electrical maintenance work.
- (d) Modifications to an electrical equipment or reticulation systems should only take place with the approval of an electrical engineer or a statutory appointed person (eg Electrical Supervisor).
- (e) New installations should be tested to the requirements of OEM and checked for compliance with fire prevention controls (refer section 2.3) prior to being commissioned.
- (f) Thermal imaging surveys of Higher Voltage cable joints and appliance should be conducted every 12 months.
- (g) Electrical appliances in 'significant **fire risk**' locations (eg workshops, refuelling bays, **etc**) should be inspected on monthly basis.
- (h) The maintenance system should ensure continuing compliance with IP 55 Monthly inspection and testing of all electrical equipment associated with explosive storage facilities.

The following should be considered to be formal maintenance procedures, including regular inspections:

- (a) Fuel storage systems.
- (b) Fuel distribution systems.
- (c) Fuel nozzles and connections.
- (d) Spillage fuel containment systems (eg bunds, drains, sumps, etc).

The following pre-use checks by equipment operators could include the following—

- (a) Integrity of wiring systems.
- (b) Tyre condition and damage (including rocks jammed in treads).
- (c) Presence of fuel or oil leaks.
- (d) Excessive lubricant level.
- (e) The presence of rags and flammable materials (eg paper).
- (f) Condition of **fire** extinguisher and **fire** suppression system (eg charged or uncharged).
- (g) For heat sources and flammable materials (eg no combustible material in contact with lights).
- (h) That the outlets from the operator's cab are clear and useable.

The results of pre-use checks should be recorded (eg using a check-list) and any defects recorded by the operator. Any dangerous condition should be reported immediately to the supervisor and equipment use should be suspended until condition is rectified.

Completed pre-use check sheets should be provided to maintenance personnel and any defects recorded in the maintenance system.

All operators should be trained or instructed in pre-use checks at induction.

The following are suggested practices for '**hot work**' activities:

- (a) '**Hot work**' is defined as the use of thermal cutting equipment, grinding equipment, arc welding equipment, heating devices, naked **flames** or mechanical friction devices. This must be performed in accordance with the Chief Inspector of Mines Directive.

- (b) A mine should designate areas where **hot work** may be performed, such as a welding bay in a workshop. In these areas a general **risk** assessment should be conducted and all the identified controls applied.
- (c) **Hot work** can be conducted in these areas without a permit only if the appropriate controls are implemented. Any **hot work** in other areas should be controlled through the **hot work** procedure and associated permit.
- (d) A **hot work** permit system should be applied for any such activity in any part of a mine outside a designated **hot work** area. The system should be based upon a procedure that at least include but not limited to the following requirements.
- (e) The work or procedure should be authorised by an appointed person:
  - The provision of adequate flash-back arrestors for Oxy/acetylene equipment.
  - Inspection of the equipment for potential fuel sources prior to work commencing ('pre-work' inspection) must be performed.
  - The removal of any flammable materials in the immediate vicinity of the **hot work** site before the commencement of any work.
  - The provision and availability of **fire** extinguishers or other **fire**-fighting equipment in the immediate vicinity of the **hot work**-site.
  - An adequate fresh air flow is present at the **hot work** site. **Hot work** shall stop in the event of any detectable weakening or stoppage of fresh air flow.
  - Thermal blankets shall be provided to shield any exposed equipment where **hot work** is conducted particularly where this contains flammable constituents (focus on making available adequate means of extinguishing fire like water and water hoses).
  - The use of an observer or **fire**-watch, where required.
  - A thorough inspection of the equipment and work area after work has been completed ('Post-work' inspection).
  - All precautionary measures relating to the transport and storage of gas cylinders should be followed prior to and following the completion of **hot work**.
  - Use of the appropriate permit form or sheet and follow the standard procedure to record that the above checks have been undertaken.

The **COP** can include reference to the maintenance of cutting and welding equipment. The following can be considered:

- (a) The period for the inspection of oxy-acetylene handsets, regulators and hoses should be specified.
- (b) Inspections and tests periods of electrical welding transformers and leads should be specified.
- (c) In addressing the maintenance procedures for **fire suppression systems**, the **COP** should cover the following:
  - the distribution piping of all automatic **fire suppression systems** should be flushed on a routine basis in line with sound maintenance practices;
  - visual inspections to check **fire** suppression system lines, nozzle alignment and that debris caps are in place should be conducted on a routine basis in line with sound maintenance practices;

- full discharge tests (pressure test) should be conducted of mobile equipment or fixed plant automatic **fire suppression systems** regularly; and
  - full discharge tests should be conducted of automatic **fire suppression systems** on remotely operated equipment from the remote operating unit regularly (as per mine standard or OEM specification) every three months.
- (f) [sic] **Fire** protection systems, including smoke or heat detectors, in 'high-risk' areas (eg magazines, refuelling bays, workshops, combustible stores etc) should be inspected and tested every six months (alternatively as per mine standard or OEM specification).
- (g) [sic] Full discharge tests should be conducted of automatic **fire suppression systems** of fuel cells or fuel storage areas every six months and include a check that the operation of the equipment is inhibited following the test.
- (h) [sic] The maintenance of **fire** protection equipment should be undertaken in accordance with relevant **SANS**.

## **ANNEXURE 8: Inspections**

*(For information purposes)*

All inspections should include but should not be limited to the following to help reduce **fire risk**:

- (a) Compliance with explosives transport and storage procedures.
- (b) The presence of No smoking or No naked flame signs in designated areas.
- (c) Checks for flammable materials on equipment or in engine bays.
- (d) Use of the **hot work** procedure and compliance with **hot work** permit requirements.
- (e) Compliance with site housekeeping standards.
- (f) Correct vehicle or parking requirements (eg only in designated areas).
- (g) Compliance with combustible storage standards (eg in workshops and fuel storage areas).
- (h) Competencies should be provided through competency-based training delivered through the site's training system. This system should include the proper recording of all training and competency assessments.
- (i) The level of (adequate) **fire**-fighting competencies required to help reduce **fire risk** should include:
  - all employees who work at the mine;
  - operators of mobile equipment and fixed plant;
  - employees involved in the transport or handling of explosives in magazines;
  - employees maintaining mobile equipment and fixed plant; and
  - electrical maintenance personnel.



## ANNEXURE 9: Additional references

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**SANS 543:**

This standard specifies requirements for the construction and performance of fire hose reel systems with semi-rigid hoses for installation in buildings and other construction works, permanently connected to a water supply.

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**SANS 1128-1:**

This part of **SANS 1128** covers the construction and performance requirements of underground and above-ground hydrant assemblies.

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**SANS 1128-2:**

This standard covers fire hose delivery couplings to fit hose of nominal diameter 45 mm, 65 mm, 70 mm and 100 mm; suction couplings to fit hose of nominal diameter 80 mm, 90 mm, 100 mm, 115 mm, 125 mm, 140 mm, and 150 mm; connectors; and branch pipes and nozzle connections for delivery hose.

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**SANS 1151:**

This standard specifies the characteristics of stored pressure, portable rechargeable fire extinguishers of the halogenated hydrocarbon type, of capacity not exceeding 12 kg and suitable for use on **fires** of classes A, B and C.

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**SANS 1322:**

- (a) This standard covers class I and class II portable, non-refillable fire extinguishers of the stored pressure type and having a capacity of not more than 1.5 kg for use with all classes of fire other than class D.
  - (b) This standard does not cover extinguishers having a high pressure liquefiable gas as the extinguishing medium.
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**SANS 1475-1:**

- (a) This part of **SANS 1475** covers the administrative and technical details and controls applicable to the acceptable reconditioning of any portable and wheeled (mobile) rechargeable fire extinguisher. Amdt 1
  - (b) It covers only those fire extinguishers that have been removed from service and have been presented for reconditioning.
  - (c) It does not cover new fire extinguishers or a reconditioned fire extinguisher presented for sale.
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**SANS 1475-2:**

This part of **SANS 1475** specifies the procedures that apply to the effective reconditioning of fire hose reels and above-ground fire hydrants. It does not cover the replacement or installation of hose reels and above-ground hydrants.

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**SANS 1522:**

- (a) This standard covers the requirements for fire extinguishing powders for fires of class A, class B and class C.
  - (b) This standard does not cover the assessment of the performance of an extinguishing powder in a particular piece of equipment, other than the standard test extinguishers used in certain of the tests.
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**SANS 1567:**

This standard specifies the characteristics of portable rechargeable fire extinguishers of the CO<sub>2</sub> type, of charge mass not exceeding 9 kg and suitable for use on class BC **fires** (see 3.5.3).

**SANS 1825:**

- (a) This standard specifies minimum requirements for test stations for transportable gas cylinders of water capacity 0.5 L to 3 000 L, including CO<sub>2</sub> gas cylinders used in **fire** fighting applications.
  - (b) This standard excludes the testing of hand-held **fire** extinguishers with an operating pressure less than 2 000 kPa.
  - (c) This standard does not apply to gas cylinder test stations that carry out the replacement of cylinder valves, or screw-on type valve guards, and the straightening of bent foot rings or valve guards without the application of heat.
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**SANS 1910:**

- (a) This standard covers the principal requirements for the safety, reliability and performance of portable, stored pressure, refillable type **fire** extinguishers suitable for use on **fires** of classes A, B and C.
- (b) This standard covers the requirements for water type, foam type and dry chemical powder type **fire** extinguishers.
- (c) It does not cover the requirements for CO<sub>2</sub> **fire** extinguishers. For the requirements of this **fire** extinguisher, refer to **SANS 1567**.
- (d) It does not cover Halon type extinguishers. (South Africa has agreed to abide by the Montreal

Agreement on the use of CFC products. However, maintenance on this type of extinguisher is still carried out in terms of **SANS 1475-1**.)

- (e) It does not cover the cartridge operated extinguisher.

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**SANS 10019:**

- (a) This standard covers the minimum requirements for the design, manufacture, use and maintenance of refillable and non-refillable pressure receptacles of water capacity 0.5 L to 3 000 L and cartridges of 0.5 L, and may include requirements over and above those contained within the cylinder design and manufacturing standards.
- (b) In addition to industrial, medical and domestic type pressure receptacles, this standard also covers cylinders for self-contained underwater breathing apparatus (SCUBA) for recreational diving, self-contained surface breathing apparatus (SCBA), **fire-fighting** extinguishers and fixed **fire-fighting** extinguishing systems.
- (c) The standard covers the design requirements for CO<sub>2</sub> and High Pressure Inert gas mixtures used in portable and fixed **fire-fighting** systems, but excludes the operational performance requirements of portable and fixed **fire-fighting** extinguishing systems (see **SANS 1572** and **SANS 1567**).
- (d) It does not cover special pressure receptacles used in aircraft or air-brake reservoirs and SCUBA cylinders for professional use.

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**SANS 1015-1:**

This part of **SANS 10105** gives the requirements for the selection, installation, inspection and use of portable and mobile fire extinguishers.

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**SANS 10105-2:**

This part of **SANS 10105** covers the requirements for the installation and inspection of fire hose reels and above-ground hydrants.

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**SANS 10287:**

- (a) This standard establishes general principles for the design, installation and maintenance of automatic sprinkler installations for **fire-fighting** purposes in buildings and industrial plants;
- (b) It covers the classification of **fire hazards**, the provision of water supplies, components to be used, the installation of automatic sprinkler systems, the testing of installations, maintenance, and the extension of existing systems; and
- (c) With regard to buildings, it identifies construction details that are necessary for the satisfactory performance of sprinkler installations in terms of this standard.

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**SANS 10400-T:**

This part of **SANS 10400** provides deemed-to-satisfy requirements for compliance with part T (**fire protection**) of the National Building Regulations.

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**SANS 10400-W:**

This part of **SANS 10400** provides deemed-to-satisfy requirements for compliance with part W (**fire installation**) of the National Building Regulations.

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**SANS 7240** consists of the following parts, under the general title **Fire** detection and alarm systems:

- Part 1: General and definitions;
- Part 2: Control and indicating equipment;
- Part 4: Power supply equipment;
- Part 5: Point-type heat detectors;
- Part 6: Carbon monoxide **fire detectors** using electro-chemical cells;
- Part 7: Point-type **smoke detectors** using scattered light, transmitted light or ionisation;
- Part 8: Carbon monoxide **fire detectors** using an electro-chemical cell in combination with a heat sensor;
- Part 9: Test **fires** for **fire detectors** (Technical Specification);
- Part 10: Point-type **flame** detectors;
- Part 11: Manual call points;
- Part 12: Line type **smoke detectors** using a transmitted optical beam;
- Part 13: Compatibility assessment of system components; and
- Part 14: Guidelines for drafting codes of practice for design, installation and use of **fire** detection and **fire** alarm systems in and around buildings (Technical Report).

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**SANS 14113:**

Gas welding equipment - rubber and plastic hoses assembled for compressed or liquefied gases up to a maximum design pressure of 450 bar.

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**SANS 9244:**

Earth-moving machinery - Machine safety labels - General principles.

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**SANS 12100:**

Safety of machinery - General principles for design - **Risk** assessment and **risk** reduction.

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**SANS 10087-1:**

The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations - Part 1: Liquefied petroleum gas installations involving gas storage containers of individual water capacity not exceeding 500 L and a combined water capacity not exceeding 3 000 L per installation.

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**SANS 10119:**

Reduction of explosion **fire hazards** presented by electrical equipment - Segregation, ventilation and pressurisation.

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**SANS 10087-2 (SABS 087-2):**

The handling, storage and distribution of liquefied petroleum gas in domestic, commercial, and industrial installations - Part 2: Installations in mobile units and small non-permanent buildings.

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**SANS 10087-3:**

The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations - Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500 L.

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**SANS 10087-4 (SABS 087-4):**

The handling, storage and distribution of liquefied petroleum gas in domestic, commercial, and industrial installations - Part 4: Transportation of LPG in bulk by road.

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**SANS 10087-6:**

The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations - Part 6: The application of liquefied petroleum and compressed natural gases as engine fuels for internal combustion engines.

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**SANS 10087-7:**

The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial and industrial installations - Part 7: Storage and filling premises for refillable liquefied petroleum gas (LPG) containers of gas capacity not exceeding 9 kg and the storage of individual gas containers not exceeding 48 kg.

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**SANS 10087-10:**

The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial and industrial installations - Part 10: Mobile filling stations for refillable liquefied petroleum gas (LPG) containers of capacity not exceeding 9 kg.

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**SANS 10089-1:**

The petroleum industry - Part 1: Storage and distribution of petroleum products in above-ground bulk installations.

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**SANS 10089-2:**

The petroleum industry - Part 2: Electrical and other installations in the distribution and marketing sector.

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**SANS 10089-3 (SABS 089-3):**

The petroleum industry - Part 3: The installation of underground storage tanks, pumps/dispensers and pipework at service stations and consumer installations. Amdt 2 SANS 10108, the classification of fire hazardous locations and the selection of apparatus for use in such locations.

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**SANS 60079-0/IEC 60079-0:**

Explosive atmospheres - Part 0: Requirements - General requirements.

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**SANS 60079-2/IEC 60079-2:**

Explosive atmospheres - Part 2: Equipment protection by pressurised enclosures 'p'.

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**SANS 60079-13/IEC 60079-13:**

Electrical apparatus for explosive gas atmospheres - Part 13:

Construction and use of rooms or buildings protected by pressurisation.

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**SANS 60079-16/IEC 60079-16:**

Electrical apparatus for explosive gas atmospheres - Part 16: Artificial ventilation for the protection of analyser(s) houses.

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**SANS 1234:**

This standard specifies requirements for six classes of **fire**-door and **fire**-shutter assemblies that are intended to close permanent openings in walls or partitions, to provide a fire resistance of at least 30 min in order to stop the spread of fire and to limit the spread of smoke.

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**SANS 193:**

This standard specifies requirements for fire dampers and test methods for the determination of the resistance of fire dampers to fires and to the passage of gases at high temperatures.

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