Government Gazette
Staatskoerant

REPUBLIC OF SOUTH AFRICA
REPUBLIEK VAN SUID-AFRIKA

Regulation Gazette **No. 10338** *Regulasiekoerant*

Vol. 594 **Pretoria, 19 December Desember 2014** **No. 38339**

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DEPARTMENT OF MINERAL RESOURCES

No. R. 1024 **19 December 2014**

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

GUIDELINE FOR A MANDATORY CODE OF PRACTICE FOR THE SAFE USE OF CONVEYOR BELT INSTALATIONS FOR THE TRANSPORTATION OF MINERAL, MATERIAL OR PERSONNEL

I **DAVID MSIZA,** Chief Inspector of Mines, under section 49(6) of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) and after consultation with the Council, hereby issues the guideline for the safe use of conveyor belt installations for the transportation of mineral, material or personnel in terms of the Mine Health and Safety Act, as set out in the Schedule.

DAVID MSIZA
CHIEF INSPECTOR OF MINES

SCHEDULE

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Reference Number: DMR 16/3/2/2-B1
Last Revision Date: 28 July 2014
Date First Issued: First Edition
Effective Date: 30 November 2014

DEPARTMENT OF MINERAL RESOURCES

MINE HEALTH AND SAFETY INSPECTORATE

GUIDELINE FOR THE COMPILATION OF A

MANDATORY CODE OF PRACTICE FOR THE

SAFE USE OF CONVEYOR BELT INSTALLATIONS FOR THE TRANSPORTATION OF MINERAL, MATERIAL OR PERSONNEL

CHIEF INSPECTOR OF MINES

DATE

mineral resources
Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

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Part A: The Guideline

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PART A: THE GUIDELINE

1. FOREWORD

Over the past 20 years, 1 212 persons were involved in accidents relating to **conveyor belt installations**. Of these persons, 133 were fatally injured, 1 079 seriously injured and three disabled. Because of these accidents the Chief Inspector of Mines identified conveyor belt installation as an area requiring statutory regulation. A tripartite task group, with members chosen from the regions where **conveyor belt installation** are used, was established under the auspices of the Mining Regulation Advisory Committee (**MRAC**) to investigate the most appropriate means of regulating **conveyor belt installations**. After research was done on these accidents, on relevant South African and International Standards, on **SIMRAC** projects and having regard to the nature of the risks identified in a hazard identification and risk assessment process, it was decided that regulations and a guideline for a mandatory Code of Practice (**COP**) would be the most appropriate means of regulating **conveyor belt installations**.

2. LEGAL STATUS OF GUIDELINES AND CODES OF PRACTICE

In accordance with Section 9(2) of the **MHSA** an employer must prepare and implement a **COP** on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at the mines if the Chief Inspector of Mines requires it. These **COPs** must comply with any relevant guidelines issued by the Chief Inspector of Mines (Section 9(3)). Failure by the employer to prepare or implement a **COP** in compliance with this guideline is a breach of the **MHSA**.

3. THE OBJECTIVE OF THIS GUIDELINE

The objective of this guideline is to enable the employer at every mine to compile a **COP**, which, if properly implemented and complied with, would improve health and safety in connection with the use of **conveyor belt installations** at a mine.

4. ACRONYMS AND DEFINITIONS

In this guideline for a **COP** the following acronyms and definitions are used:

COP means a Code of Practice.
DMR means Department of Mineral Resources
ECSA means Engineering Council of South Africa
MHSA means the Mine Health and Safety Act, 1996, Act 29 of 1996.
MRAC means Mining Regulation Advisory Committee
SABS means South African Bureau of Standards.
SANS means South African National Standards
SIMRAC means Safety in Mines Research Advisory Committee
"Conveyor belt installation" means a mechanical system used for the transportation of mineral, material or personnel on a belt over a distance.
"Power supply" means any energy source feeding the drive motor of a **conveyor belt installation**.

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5. SCOPE

This guideline for a mandatory **COP** covers the significant health and safety risks relating to the use of **conveyor belt installations** for the transportation of minerals, material, or personnel. Consideration is given to the design, installation, operation, inspection and maintenance of conveyor belts.

6. MEMBERSHIP OF TASK GROUP

6.1 This document was prepared by the **MRAC** Task Group on **conveyor belt installations**.

6.2 The following persons were nominated to serve as members of this task group:

Messrs:	J Dodds	-	State (Project Leader)
	WC Botes	-	State
	J Smit	-	Employer
	CP Hughes	-	Employer
	R Bollen	-	Employer
	JP Pearson	-	Employer

No employee representatives were nominated by organised labour to serve on this task group, however various employee representatives at mines were consulted.

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PART B: AUTHOR'S GUIDE

1. The **COP** must, where possible, follow the sequence laid out in **Part C "Format and Content of the mandatory COP"**. The pages as well as the chapters and sections must be numbered to facilitate cross-reference. Wording must be unambiguous and concise.

2. It should be indicated in the **COP** and on each annex to the **COP** whether:

   (a) the annex forms part of the guideline and must be complied with or incorporated in the **COP** or whether aspects thereof must be complied with or incorporated in the **COP**, or

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

3. When annexes are used the numbering should be preceded by the letter allocated to that particular annex and the numbering should start at one (1) again. (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 sidenotes as well as in a separate bibliography

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PART C: FORMAT AND CONTENT OF THE MANDATORY CODE OF PRACTICE

1. TITLE PAGE

The title page must include the following:

1.1 Name of mine;
1.2 The heading: "**Mandatory COP for the safe use of conveyor belt installations for the transportation of minerals, material or personnel**";
1.3 A statement to the effect that the **COP** was drawn up in accordance with this guideline **DMR 16/3/2/2-B1** issued by the Chief Inspector of Mines;
1.4 The mine's reference number for the **COP**;
1.5 Effective date of the **COP**; and
1.6 Revision dates.

2. TABLE OF CONTENTS

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

3. STATUS OF MANDATORY CODE OF PRACTICE

This section must contain statements to the effect that:

3.1 The mandatory **COP** was drawn up in accordance with Guideline **DMR 16/3/2/2-B1** 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 incident/accident investigation/inquiry to ascertain compliance and also to establish whether the **COP** is effective and fit for purpose.
3.4 The **COP** supersedes all previous relevant **COP's**.
3.5 All managerial instructions or recommended procedures (voluntary **COP's**) and standards on the relevant topics must comply with the **COP** and must be reviewed to assure 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**.

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5. GENERAL INFORMATION

The general information relating to the mine must be stated in this paragraph.

The following minimum information must be provided:

5.1 A brief description of the mine and its location;
5.2 The commodities produced;
5.3 The mining methods/mineral excavation processes;
5.4 A description of the **conveyor belt installation(s)** used at the mine (including relevant information such as the application and technical specifications); and
5.5 Other relevant **COP's**.

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 **COP** must address how the significant risks identified in the risk assessment process must be dealt with, having regard to the requirements of Sections 11(2) and (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 program to monitor the risk.

7.2 A proper hazard identification and risk assessment must be conducted on the complete conveyor belt installation. The information must be kept readily available at the mine. To assist the employer with the hazard identification and risk assessment all possible relevant information such as incident statistics, ergonomic studies, research reports, manufacturers specifications, international standards, design criteria and performance figures for the **conveyor belt installation** should be obtained and considered.

7.3 In addition to the periodic review required by section 11(4) of the **MHSA**, the **COP** should be reviewed and updated after every serious incident/accident involving the **conveyor belt installation**, or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material.

8. ASPECTS TO BE ADDRESSED IN THE MANDATORY CODE OF PRACTICE

The **COP** must set out how the significant risks identified and assessed in terms of the risk assessment process referred to in paragraph 7.1 above will be addressed.

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The **COP** must cover at least the aspects set out below unless there is no significant risk associated with that aspect at the mine.

Annexure B contains extracts from the Conveyor Manufactures Association of SA Limited Guideline “Safety around Belt Conveyors” and must be consulted in preparation of the **COP**. Relevant minimum performance standards from Annexure B should be included in the **COP** unless other minimum performance standards can be justified in terms of the risk assessment.

8.1 Design

8.1.1 In order to prevent persons from being injured as a result of a **conveyor belt installation** collapsing, catching fire, a belt breaking or misalignment of the conveyor belt due to incorrect design, the **COP** must set out the design criteria for the belt conveyor installation, covering at least the following:

- Overall structural design;
- Environmental conditions that could effect the integrity of the **conveyor belt installation**;
- An appropriate drainage system along the **conveyor belt installation** to ensure efficient draining of water used for cleaning, dust suppression and prevent water seepage onto the **conveyor belt installation**;
- Appropriate **power supply** and braking systems;
- Conveyor belt extensions;
- Materials of which the conveyor belt is made of in order to minimise the risk of igniting flammable gas or dust during installation or operation;
- Materials of which the conveyor belt is made of in order to minimise the risk of any part of the conveyor belt catching fire; and
- Adequate lightning protection.

8.1.2 In order to prevent persons from being injured while crossing over or under any **conveyor belt installation** by means of a bridge, the **COP** must cover at least the following:

- Clearance requirements for persons and vehicles;
- Handrails and kickboard requirements;
- Prevention of slipping/sliding/falling;
- Sufficient number of cross over walkways;
- Method of access to walkway;
- Illumination; and
- Visibility (reflective paint tape etc).

8.1.3 In order to prevent persons from being injured due to inappropriate walkways while doing inspection, maintenance or repairs on the **conveyor belt installation**, the **COP** must cover at least the following:

- Safe clearances along and around **conveyor belt installations** or adjacent thereto; and
- Measures to prevent slipping, sliding and falling around and adjacent to **conveyor belt installations**.

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8.2 Installation, extension, dismantling, transport and re-installation

In order to prevent persons from injury during installing, extension, dismantling, transportation and re-installing of **conveyor belt installations** due to the installation collapsing, the belt breaking or running away, the **COP** must at least address the following:

- Means of installing the conveyor belt safely;
- Means of cutting, joining and extending any belt safely;
- Means of clamping any belt safely;
- Means of pulling any belt in safely;
- The chemicals to be used during belt extensions and measures to address the risks associated with such chemicals;
- Means of transporting any belt and structure to its new site or position;
- Means to test the **conveyor belt installation** after installation and extension; and
- Supporting the roll of belting on tressles.

8.3 Maintenance and repairs

In order to prevent injury to persons as a result of inadequate maintenance, repairs and splicing of **conveyor belt installations** the **COP** must address the scheduling of maintenance, inspections and over inspections. This should include identification of components critical for the safe operation of the **conveyor belt installation** and the regular inspection of these components. Such components include the following:

- Belt Drive – all pulleys;
- Belt scrapers/Belt cleaning devices;
- Belt Drive motor / gearbox / fluid coupling / brakes / run-back and run-on device;
- Installation of guards / nip angles;
- Belt illumination;
- Conveyor belt;
- Take-up pulley and limits;
- Stop switches and trip wire;
- Pre start warning devices;
- Tail End – all pulleys;
- Belt slip devices;
- Sequence interlocking;
- Belt adhesives and mechanical fasteners;
- Belt cleaning chemicals;
- Rigging;
- Welding;
- Grinding;
- Exposure to toxic liquids or fumes;
- Dust;
- Emergency preparedness;
- The use of hazardous substances associated with operation and maintenance; and
- Belt cleaning devices.

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8.4 Fire prevention

In order to prevent persons from being exposed to fires, fumes and smoke arising from a **conveyor belt installation** catching fire, the **COP** must set out measures to prevent, detect and combat such fires. Such measures should include measures to prevent persons from being exposed to chemicals released when a **conveyor belt installation** is ignited. The **COP** should also set out:

- A description of the design and the selection criteria for the **conveyor belt installation** (SANS 971-2003, Edition 3 – "Fire-retardant textile-reinforced conveyor belting (for use in fiery mines)" may be referenced for guidance); and
- Criteria for determining the location and length of a belt.

Cognisance must be taken of frictional ignition for example limit switches and scrapers

Side note:
The regulations and guidelines under Fires and Explosions and the Mine Environmental Engineering and Occupational Hygiene must be consulted as well as the Guideline for a Mandatory Code of Practice for the prevention of Flammable Gas and Coal Dust Explosions in Collieries.

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PART D: IMPLEMENTATION

1. IMPLEMENTATION PLAN

1.1 The employer must prepare an implementation plan for its **COP** that makes provision for issues such as organisational structures, responsibilities of functionaries and programs and schedules for this **COP** that will enable proper implementation of the **COP**.

A summary of/and a reference to, a comprehensive implementation plan may be included

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

2. COMPLIANCE WITH THE CODE OF PRACTICE

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

3. ACCESS TO THE CODE OF PRACTICE 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 is no such union, a health and safety representative on the mine, or if there is no health and safety representative, an employee representing the employees on the mine, must be provided with a copy on written request to the 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.

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ANNEXURE A: References

1. The safe use, operation and inspection of man-riding belt conveyors in mines - SABS 0266:1995
(UDC 622.647, ICS 53.040.10, ISBN 0-626-10508-0).
2. Steel-cord reinforced conveyor belting -
SABS 1366:1982
(UDC 622.647 : 678.066 : 621.778.4, ISBN 0-626-06202-0)
3. SANS 971-2003, Edition 3 – "Fire-retardant textile-reinforced conveyor belting (for use in fiery mines)"
4. General purpose textile-reinforced conveyor belting -
SABS 1173:1977
(UDC 621.867.2, ISBN 0-626-04412-X).
5. Conveyor belts - Flame retardation - Specifications and test method -
ISO 340:1988(E)
6. Steel Cord Conveyor Belting for Use within British Coal -
Part 8: Methods of test for fire performance -
British Coal Spec 730:1989 - Issue 1 – 1/11/89.
7. Degrees of protection provided by enclosures (IP Code) -
CEI IEC 529:1989 (second edition).
8. On-site non-mechanical jointing of plied textile and steel reinforced conveyor belting (British Standard COP) - BS 6593:1985
(UDC 621.867.2.052-427.4-034.14: 678.06 : 62-762).
9. Steel Cord Conveyor Belts for Hoisting and Conveying (German Standard) - DIN 22 131 Part 4
(UDC 621.867.21: 622.647.21).
10. Steel Cord Conveyor Belts for Underground Coal Mining (German Standard) - DIN 22 129 Part 4, November 1991
(UDC 621.867.21.06: 622.647.21 : 622.333).
11. Testing Method for Conveyor Belt Splices (German Standard) -
DIN 22 110 Part 3, September 1993.
12 Simrac Report – Gen 701
13 Lightning standard IEC 62305 parts 1 to 4
14 Standard for splicing of a conveyor belt

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ANNEXURE B: Minimum Performance Standards

This annexure forms part of the guideline and must be consulted in preparation of the **COP**.

This Annexure B contains extracts from the Conveyor Manufactures Association of SA Limited Guideline "Safety around Belt Conveyors" and must be consulted in preparation of the **COP**. Relevant minimum performance standards from Annexure B should be included in the **COP** unless other minimum performance standards can be justified in terms of the risk assessment.

Safe operating procedures

- Ensure that all personnel are equipped with the correct Personal Protection Equipment (PPE) relevant to the task and work area. Using PPE shall be strictly monitored by the appropriate safety officer.
- Ensure that all STOP/START and emergency controls are clearly marked and that maintenance staff are familiar with the location of these safety systems.
- Keep the area around the belt clean and tidy and apply good housekeeping practices to minimize potential hazards.
- Lock out, isolate and tag all areas before working on any part of the conveyor.
- Do not climb on, over or crawl under any conveyor.
- Do not ride on any conveyor unless the conveyor is approved and licensed for man-riding purposes.
- Ensure that the pre-start alarm is working correctly and if not, isolate the conveyor and request that it be repaired.

Basic check list prior to re-starting a conveyor

Ensure that:

- Nobody is working on the belt;
- Guards have been re-fitted and that all the safety interlocks are operational;
- The area is clean and clear of equipment and /or debris or spillages;
- All the fire fighting and fire suppression devices and equipment are in place and operational;
- All clamps are removed or released;
- All other spragging devices have been removed; stem is operational.

CONVEYOR SYSTEM PROTECTION DEVICES

The conveyor belt shall be provided with various devices and systems for protecting the system. These devices are used as run-permissive input commands to the general belt control system. The devices must be seen as safety-critical items and for that reason, deserve a high degree of attention and maintenance. The safety of personnel and the integrity of the conveyor system are largely dependent on the correct specification, installation and operation of these devices.

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Belt control

Belt control normally consists of the net sum of the belt permissives, the operator start/stop stations, the start warning system, interlock sequencing of individual conveyors and other process controls.

Belt control initiates a run command to the drive controller. Sometimes the belt control issues a running reference speed to the drive controller.

For stopping, the belt control simply removes the positive run signal to the drive controller or initiates a ramped stop command.

Stop/Start

A belt conveyor system is usually provided with one or more control stations for operators. Start stations normally require a momentary operator input to initiate a start sequence. Stop stations monitor a maintained input for a run permissive. Many conveyors are started and stopped from a central control room.

Complex belts have many operator stations distributed at various physical locations.

A stop/start station is a control device and shall not be considered a lock out of the conveyor power source.

Belt overload

The belt conveyor system is protected from overload via the overload of the electric drive motors. The motor overload indicator can be a simple bi-metallic or melting eutectic alloy or a complex computer-based motor thermal model.

Alternatively, the motor current can be monitored and any significant deviation from the standard operating signature for a pre-determined time will cause a power interruption.

A belt loading sail or paddle switch senses a belt overload at a specific point. However, such units must be designed to cater for the largest lump likely to be encountered in order to minimise spurious stops.

On the other hand, if a lump is large enough to activate the paddle switch, it makes operating sense to investigate the lump before it causes consequential damage downstream.

Complex belts are sometimes protected from overload by belt weigh scales that measure the belt loading at a given point.

Alternatively, a non-contact belt profile sensor, such as an ultrasonic, radar, laser or video device is used to measure the belt loading depth. Based on an assumed material density, the loading tonnes per hour can be projected. The actions regarding a single large lump apply in these cases as well.

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Weigh meter controls are usually coupled to the belt feeding device, such as a belt, apron or vibrating feeder. The overload sensing signal is then relayed to the feeder controller and the feeder rate is reduced to comply with the requirements of the system.

Of course, unscrupulous operators may bridge any control and continuous spillage occurrences, despite any other protective measures that are in place. There is often evidence of such bridging or over-riding control of controls found during routine inspections.

Other methods of overload control are fusible plugs on fluid couplings and shear pins on flexible couplings. Electronic sensing has largely overtaken the use of mechanical devices and is less easily tampered with.

Belt slip protection

Belt slip is the loss in transmission of tension from the drive pulley(s) to the belt cover and can destroy a belt or drive pulley, causing a fire hazard.

With the modern high-friction ceramic lagging of drive pulleys, the lagging itself may be destroyed depending on its type, or the belt cover completely stripped in localised areas.

Belt slip protection includes a belt drive speed sensor that compares the measured belt speed with the belt signature or specified design speed. Large conveyors with long ramp times require comparative slip detection during ramping similar to the slip protection applied to variable speed conveyors.

For constant speed belts this normally consists of a slip detection switch with a set point that trips the conveyor drive when the belt speed is below 80 percent of full speed. In order to prevent controller confusion, the belt slip switch is bypassed during starting and stopping and this is usually incorporated in the MCC, (motor control centre).

Belt slip in variable speed conveyors consists of a speed sensor that measures belt speed and compares it with the speed reference sent to the drive system. When the belt speed drops below 80 percent of the set speed, the drive is tripped. This type of belt slip is active during starting, running, and stopping.

In multiple pulley adjacent drives, tachometers are provided for each drive motor. The tachometer signals are compared to the normalised belt speed and sense slippage on any one of the multiple drive pulleys.

A method to adjust and test belt slip is normally an integral part of the belt control system. Slip detectors are often installed at other locations along the line of the belt, particularly at the tail pulley. In the event of the belt breaking for any reason, the tail pulley is usually the first to stop rotating.

Take-up over-travel

Over-travel limit switches can be placed at the far extremes of the counterweight or take-up device travel.

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> **Comment:**
> Use of over-travel limit switches is considered good practice even for section conveyors, but the use thereof for section conveyors may be omitted if justified in terms of the risk assessment.

In a gravity counterweight take-up, the top over-travel switch trip may suggest a jammed conveyor fabric condition.

A bottom over-travel switch may indicate belt stretch, or a broken belt fabric flight. Excessive take-up motion during starting and stopping indicates an inadequate or malfunctioning drive control.

Alternatively, excessive travel could indicate that one or more splices are failing or have failed.

Bin level

When conveyors discharge into bins or hoppers, bin level sensors provide protection to the belt in that they shut down the conveyor if the pre-determined level is exceeded.

> **Comment:**
> Use of bin level sensors is considered good practice, but the use thereof may be omitted if justified in terms of the risk assessment.

These can consist of simple hanging tilt switches or analogue measurement devices such as ultrasonic, radar or laser.

Fire detection

Some belts carrying combustible materials are fitted with fire detection protection systems. The belt material of construction can, however, also burn and give off noxious gasses and is protected in the same way.

These systems include point or distributed thermal trip switches located above the belt fabric, smoke sensors, carbon monoxide sensors, or fibre-optic temperature sensors.

The fire detection systems may be incorporated in the pull-wire switch systems, or may be installed as standalone systems.

Lightning protection

All conveyors are prone to lightning strikes and therefore the conveyor and the operating and maintenance staff will require protection from damage or injury.

Earthing and other applicable protection standards need to be installed and adhered to. The conveyor belt protection system shall be electrically isolated from the control system and all other control networks in accordance with the requirements of SANS 10313 or BS 6651. Any equipment or devices that are required to be directly connected to the control system shall be earthed to an acceptable minimum standard.

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Underground conveyors are earthed and electrically supplied from cables normally installed in the shaft or through boreholes, allowing an electrical lightning path to the underground conveyor.

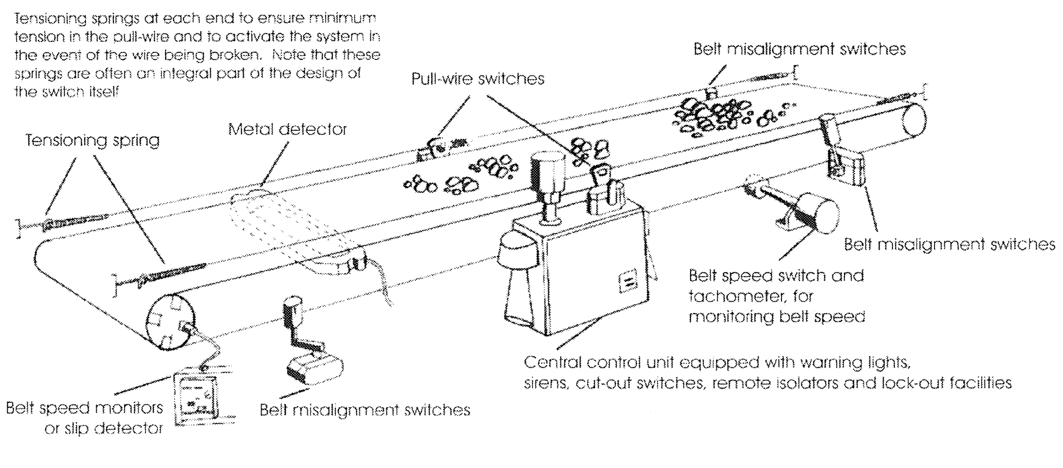
Lightning within the operational area needs to be monitored as such that systems can be shut down in the event of danger levels reaching pre-determined limits.

Dust suppression

Belts transporting dusty material are equipped with water or chemical-based dust suppression systems. These systems spray the belt material at selected transfer and belt loading points. In some instances, dust suppression systems are coupled to ultrasonic spray nozzles.

Systems spray a constant amount of dust suppression per unit of time whilst the belt is running. The dust sprays are turned off when the belt is idle or unloaded to prevent puddling, waste and slippage.

The way in which dust suppression mechanisms work is to reduce the size of the water droplets, making them smaller than the dust particles. This enables the dust particles to break the water surface tension, adhering to the water droplet and forming larger drops.



Typical Conveyor Protection Installation

Basics of conveyor guard design

Guards and fences

A guard or fence is only effective if it is constructed to prevent a person from reaching the danger or nip point. A person is capable of reaching upwards, over, into, around or through a guard or fence, and all these aspects must be taken into account when considering the effectiveness of a guard or fence.

For **conveyor belt installations** the so-called 'nip guard', examples of which are shown in the sketch below, extend over the whole width of the pulley and are regarded as a reasonable solution to prevent access to the danger points. Installation of this type of guard is strongly recommended but unfortunately it is impossible to install it in such a way

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that a person is completely prevented from reaching around it. A nip guard alone cannot therefore be regarded as sufficient protection and it is essential that pulleys are further guarded or fenced off to meet the requirements of the regulations.

The following may be provisionally accepted as safe in the absence of facts to the contrary:

Upwards

Any pulley or idler, which is 3,5 metres or more in height and therefore beyond an upward reach, may be regarded as being positionally safe and need not be guarded.

The possible reduction of this safe clearance by a build-up of spillage or discharge of material should, however, be borne in mind.

Over

Head and tail pulleys must be guarded on at least the two sides and the top unless the guards or fences on the sides are extended to a height that makes it impossible to reach over and contact the nip point.

If side guards are only attached with a very small clearance between the edge of the belt and the side guard, this may perhaps be regarded as adequate to prevent reach over the guard to the nip point, but will not necessarily prevent tools or clothing from being caught in the nip point.

If a top guard is attached it must be high enough above the belt to ensure that the load on the belt will not damage it.

Into

The distance that the guard or fence is placed from the side of the belt determines the distance that these extend away from the nip point along the length of the belt. An acceptable distance is at least 0,85 metres away from the nip point, preferably from the position of the nip guard.

Around

This is similar to 'into' so far as the conveyor pulley guard is concerned, but may also be applied to determine the length of the top section of the guard. The same minimum distance of 0,85 metres applies.

When a V-belt or chain drive is associated with the conveyor installation, a common point of error is that while the V-belts or chains are perfectly guarded around the perimeter and on one side, the guard is installed in such a way that the nip points can easily be touched by reaching around the section forming the perimeter guard.

Through

The protection afforded against injury by reaching through the guard is determined by the shape and size of openings in the material used for construction of the guard or fence.

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Square Openings:
It may be assumed that there is no reach through an opening of 10 mm × 10 mm or less, as it is too small for fingers. If the opening is such that it will admit one, two or three fingers, the reach is restricted by the roots of the fingers, a distance normally not exceeding 100 mm.

When the opening is sufficient to admit the whole arm and a small portion of the shoulder, the reasonable safe distance is based on the distance from the fingertips to the armpit, which is assumed to be 0,85 metres.

Screening materials with openings in excess of 80 mm × 80 mm shall not be used in the construction of guards or fences. Preference shall be given to materials with openings not exceeding 25 mm × 25 mm.

Elongated Openings (openings with parallel sides):
Openings up to 6 mm wide are of no consequence. The guard or fence so constructed may virtually be regarded as a sheet, and a working clearance of approximately 25 mm is all that is required.

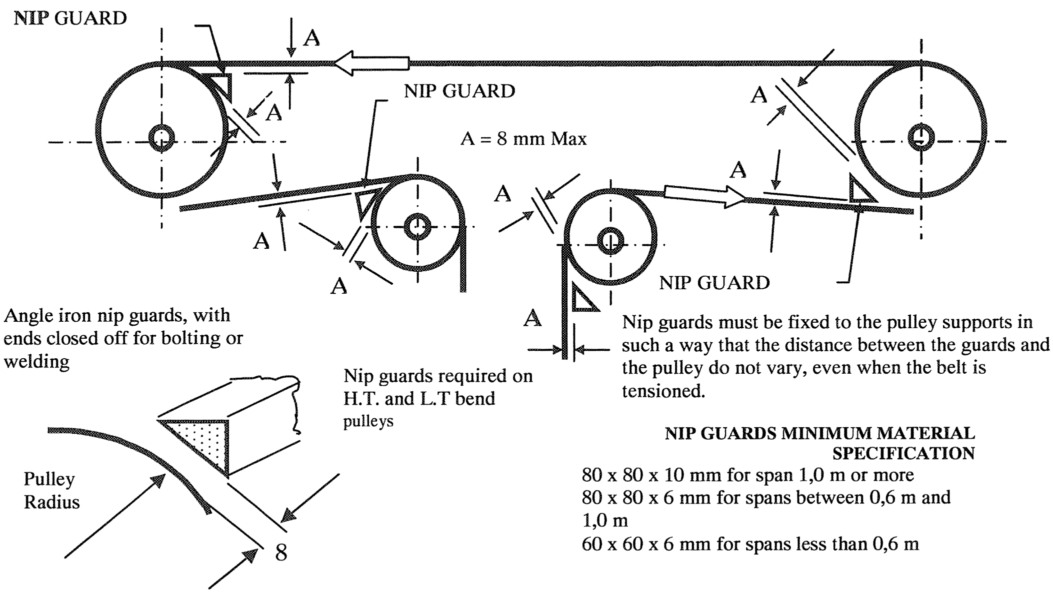
Openings greater than 6 mm but less than 13 mm will admit part of a finger and require at least 50 mm clearance from danger points.

Openings in excess of 13 mm but not greater than 80 mm are subject to the following formula:

$X = 10Y$ where X = reasonable safe distance from danger point in millimetres.
Y = width of opening in millimetres.

Note:
The tail pulley guard shall be closed at the rear.

Nip Points and Nip Guards



NIP GUARDS MINIMUM MATERIAL SPECIFICATION

80 x 80 x 10 mm for span 1,0 m or more
80 x 80 x 6 mm for spans between 0,6 m and 1,0 m
60 x 60 x 6 mm for spans less than 0,6 m

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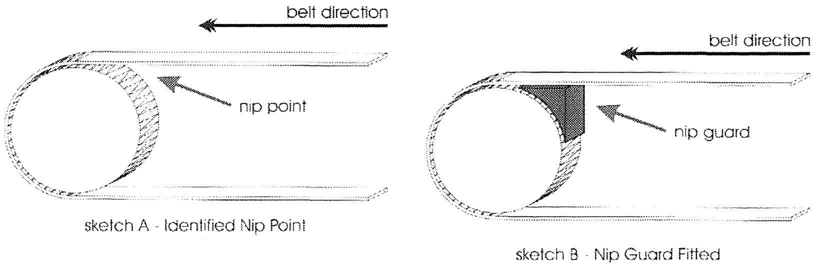
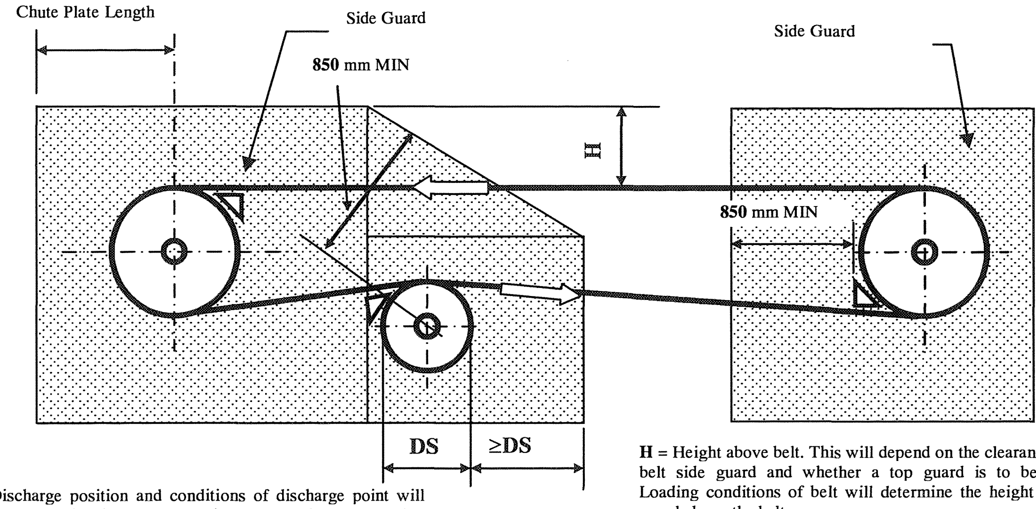
Typical Conveyor Belt Protection Installation Showing Nip Guards



Identified nip point and fitted nip guard

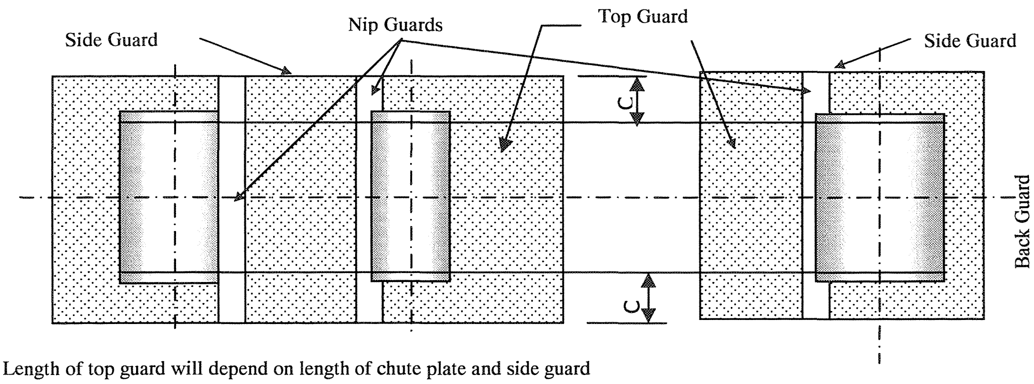
General Nip Guard Configurations – Side Elevation



Discharge position and conditions of discharge point will determine the chute plate length. Normally fully enclosed to minimise spillage

H = Height above belt. This will depend on the clearance between belt side guard and whether a top guard is to be provided. Loading conditions of belt will determine the height of the top guard above the belt.

General Nip Guard Configuration – Plan View



Length of top guard will depend on length of chute plate and side guard

C = Clearance between side guard and pulley. Minimum clearance will depend on size of mesh or guard material

Drive units

Driving belts, chains and couplings between driving motors and gear boxes or drive pulleys must be effectively guarded. Experience has shown that even when transmissions

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are apparently inaccessible they can still be a hazard. If the driving mechanism or any other part is fenced off completely in such a way that access thereto can only be gained through a gate or door forming part of the fencing, then this gate or door should be interlocked so that the conveyor stops when the gate or door is opened.

Interlocked guards

In some applications guards are fitted in conjunction with limit switches interlocked with the safety system such that if a guard is removed, power to the conveyor is immediately cut and the conveyor will coast to a stop. Equally so, the conveyor will not start up if the guard has not been replaced or re-fitted correctly after maintenance has been done

E.g. should a pulley be fully fenced and guarded and in addition be equipped with an electric interlock which switches the system off and prevents it from starting when a gate is opened or any one of the guards is removed, the fitting of nip guards may be considered as optional.

To keep the pulleys clean, suitable mechanical devices must be installed.

The manual removal of build-up shall not be permitted whilst the belt conveyor is in motion. It is often necessary for an attendant to cross a conveyor at various points. It is dangerous to climb onto the moving belt. Where it is impossible to establish safe passageways underneath the belt, crossover bridges with handrails must be provided.

The position of these bridges will depend on conditions at the **conveyor belt installation**, but unless a sufficient number are installed, they will not always be used.

The crossover bridge must be accessed via stairs equipped with handrails and a toe-board (or kick-flat) as well as an intermediate or knee rail. Avoid vertical ladders.

In many cases where walkways are fitted on elevated conveyors, no adequate hand and knee rails are installed on the outer sides of the conveyor stringers. This presents a danger, as there is often a large opening between the inside of the walkway and conveyor stringer section at knee height. These areas shall be guarded off with knee rails and kick flats.

Safety at **conveyor belt installations** may be further enhanced by creating the optimum working environment including not only adequate ventilation, illumination and absence of undue noise, but also sufficient clearance around the installation and along walkways. Walkways should have an even, non-slip surface, be properly drained and free from obstructions.

Ergonomics (human - machine interface)

To prevent accidents on conveyors it is vital to take engineering safety measures. It is possible to increase safety in existing installations at a very low cost. This document suggests ways of solving safety problems. Good engineering safety measures and an optimum working environment are not the only factors conducive to combating the high annual casualty rate associated with belt conveyors. One of the principal keys to success is an understanding of the human element.

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Even a properly guarded **conveyor belt installation** is not in itself inherently safe but with adequate training and proper awareness of dangers, an operator may use it with perfect confidence.

Operator training is usually the personal responsibility of the staff member in charge of the correct operation and running of the machinery. Awareness of the fact that familiarity with the machine on his part and an over-estimation of the operators' skills and knowledge does not result in an under-estimation of the amount of instruction and degree of supervision necessary for the safe execution of tasks.

Comprehensive training schemes to ensure that operators have the required knowledge and skills to run the relevant equipment, including compulsory re-training opportunities are essential.

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ANNEXURE C: Ergonomic Data - extracts from to AS1755-2000 (Normative)

C1 GENERAL

The data below are for users who need to design and build guards that prevent persons from encroaching into a danger zone associated with a machine.

They are taken from AS 4024.1—1996, and the most recently published version of that Standard shall be used, except for the specific variations detailed in Figure C4 herein. Users shall carefully consider whether the data are appropriate for use with the specific workforce which may be taller, shorter or thinner than the population from which the data were taken.

Where doubt exists, measurements of the workforce may be taken and careful trials made to ensure that the danger points are beyond reach. Where such trials are made, the machinery shall be in a safe condition during the trials.

C2 REACHING UP

With the body upright and standing at full height, the minimum safety distance when reaching upward is 2500 mm (see Figure C1).

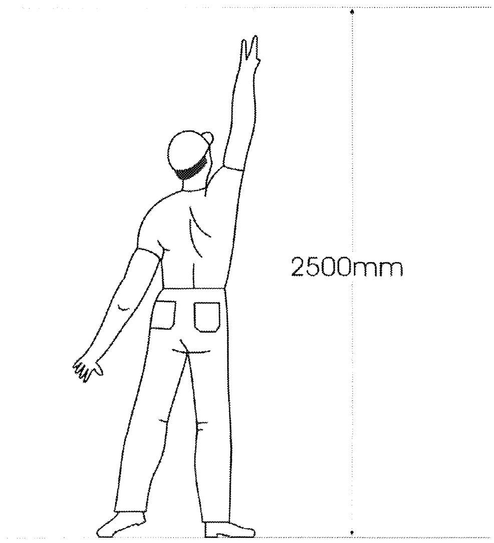

FIGURE C1: Safety distance for reaching

C3 UPPER LIMB REACH DISTANCE WITH FIXED FENCES

C3.1 General

Selection of the appropriate safety distance for reaching over a fixed fence shall depend on a risk assessment. The assessment shall be based on the probability of occurrence of injury and the likely severity of that injury.

C3.2 Reaching down and over

When reaching down over an edge, e.g. on machine frames or barriers, the safety distance is found from Figure C2.

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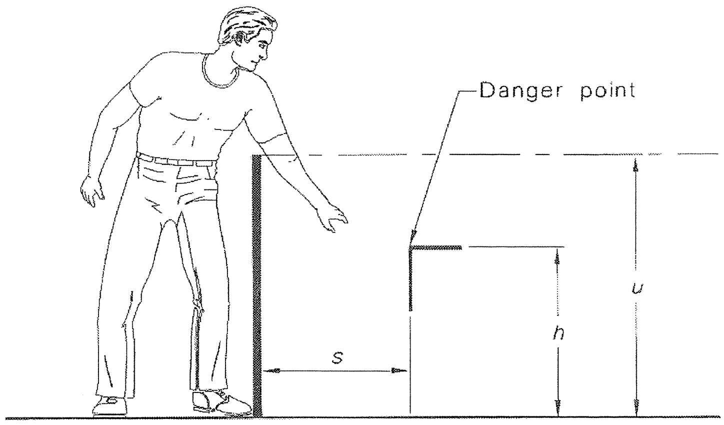
NOTE:
Attention is drawn to the increased danger of overbalancing when reaching over a 1m high barrier.



LEGEND:
h = Height of danger zone above floor
s = Horizontal distance from edge of barrier to danger zone
u = Height of edge of barrier above floor

Height of danger zone (*h*)	Horizontal distance to danger zone (*s*)								
	Height of protective structure (*u*)*								
	1 000†	1 200†	1 400†	1 600†	1 800	2 000	2 200	2 400	2 500
2 500	—	—	—	—	—	—	—	—	—
2 400	100	100	100	100	100	100	100	100	—
2 200	600	600	500	500	400	350	250	—	—
2 000	1 100	900	700	600	500	350	—	—	—
1 800	1 100	1 000	900	900	600	—	—	—	—
1 600	1 300	1 000	900	900	500	—	—	—	—
1 400	1 300	1 000	900	800	100	—	—	—	—
1 200	1 400	1 000	900	500	—	—	—	—	—
1 000	1 400	1 000	900	300	—	—	—	—	—
800	1 300	900	600	—	—	—	—	—	—
600	1 200	500	—	—	—	—	—	—	—
400	1 200	300	—	—	—	—	—	—	—
200	1 100	200	—	—	—	—	—	—	—
0	1 100	200	—	—	—	—	—	—	—

FIGURE C2: Guard distances

* Protective structures less than 1000 mm height are not included because they do not sufficiently restrict movement of the body.

† Protective structures having a height of 1600 mm and less should only be used where a risk assessment indicates low probability and low severity of injury.

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NOTE:
1) There shall be no interpolation of the values in the Table.
2) Barriers are not foolproof and they cannot prevent access to persons intent on gaining access. Therefore, as a person's intent on reaching a dangerous part increases, e.g. by climbing on chairs, ladders or the barrier itself, the protection provided by a barrier decreases.

C3.3 Reaching under

Where clearance is provided under a guard for cleaning spillages, swarf and similar, the clearance shall not exceed 200 mm. (See also Figure C3.)

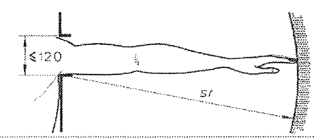
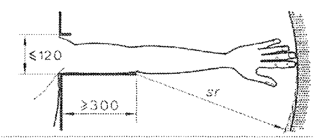
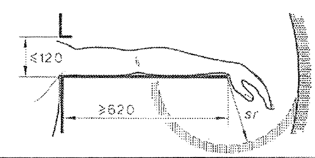
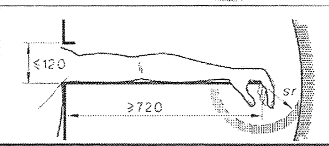
C4 REACHING AROUND WITH UPPER LIMBS

When reaching around edges in any position, the safety distance of freely articulating upper limbs is given in Figure C3.

The radius of the movement about a fixed edge is determined by the reach of given body parts. The safety distances assigned shall be respected as a minimum if the body part concerned is not to be allowed to reach a danger point.

Of special importance is the danger area which can be reached when these body parts are introduced through slots.

When applying safety distances, it is to be assumed that the basic joint component of the relevant body part is in fixed contact with the edge. The safety distances apply only if it is ensured that further advance or penetration of the body part towards the danger point is excluded.

Limitation of movement	Safety distance *(sr)*	Illustration
Limitation of movement only at shoulder and -armpit	≥ 850	
Arm supported up to elbow	≥ 550	
Arm supported up to wrist	≥ 230	
Arm and hand supported up to knuckle joint	≥ 130	

* Either the diameter of a round opening, the side of a square opening or the width of a slot opening.

FIGURE C3: Safety distances for reach around

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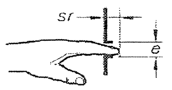
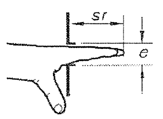
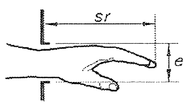
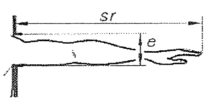
C5 REACHING IN AND THROUGH REGULAR OPENINGS WITH UPPER LIMBS

Safety distances are as given in Figure C4. The dimension of openings (e) corresponds to the side of a square opening, the diameter of a round opening or the narrowest dimension of an elongated opening or slot.

Should any opening allow access past the shoulder, safety distances shall be selected using Figure C2

Part of body	Illustration	Opening	Safety distance (*sr*)		
			Slot	Square	Round
Fingertip		$e \leq 4$	≥ 2	≥ 2	≥ 2
		$4 < e \leq 6$	≥ 10	≥ 5	≥ 5
Finger up to knuckle joint or hand		$6 < e \leq 8$	≥ 20	≥ 15	≥ 5
		$8 < e \leq 10$	≥ 80	≥ 25	≥ 20
		$10 < e \leq 12$	≥ 100	≥ 80	≥ 80
		$12 < e \leq 20$	≥ 120	≥ 120	≥ 120
		$20 < e \leq 30$	≥ 850	≥ 120	≥ 120
Arm up to junction with shoulder		$30 < e \leq 40$	≥ 850	≥ 200	≥ 120
		$30 < e \leq 50$*			
		$40 < e \leq 120$	≥ 850	≥ 850	≥ 850
		$50 < e \leq 120$*			

* For mining operations

FIGURE C4: Reaching in and trough regular openings

C6 OPENINGS OF IRREGULAR SHAPE

To choose a safety distance for upper limbs entering an opening of irregular shape, the following procedure shall be followed:

(a) Determine:
- (i) the diameter of the smallest round opening;
- (ii) the side of the smallest square opening; and
- (iii) the width of the narrowest slot opening into which the irregular opening can be inserted (see Figure C5).

(b) Select the corresponding safety distances from Figure C4.

> **NOTE:**
> The shortest safety distance of the values selected may be used.

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C7 LOWER LIMB REACH DISTANCE

C7.1 General

The data given in Figure C6 may be used where the risk assessment shows that there is a risk only to the lower limbs. Where there is a risk to both upper and lower limbs, then the longest safety distance appropriate to the aperture size and given in Figure C4 or Figure C6 shall be used.

C7.2 Reaching in and through regular openings

The dimension of openings (e), corresponds to the side of a square opening, the diameter of a round opening or the narrowest dimension of an elongated opening or slot.

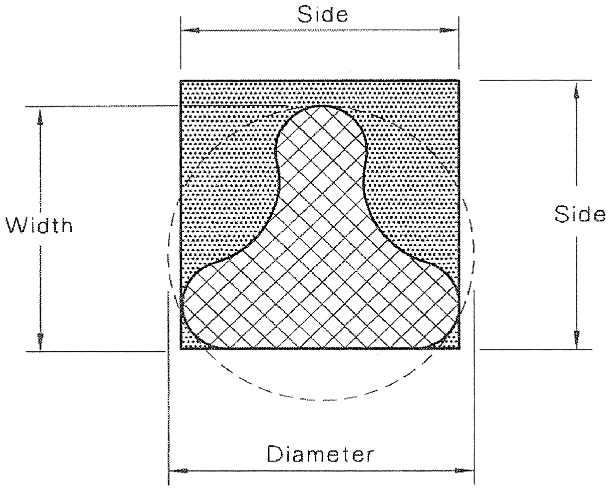
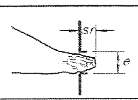
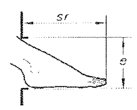
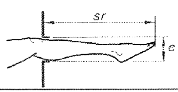
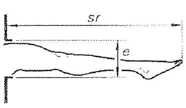


FIGURE C5: Irregular-shaped opening

Part of lower limb	Illustration	Opening	Safety distance *(sr)*	
			Slot	Square or round
Toe tip		$e \leq 5$	0	0
Toe		$5 < e \leq 15$	≥ 10	0
		$15 < e \leq 35$	≥ 80*	≥ 25
Foot		$35 < e \leq 60$	≥ 180	≥ 80
		$60 < e \leq 80$	≥ 650†	≥ 180
Leg up to knee		$80 < e \leq 95$	$\geq 1\ 100$‡	≥ 650†
Leg up to crotch		$95 < e \leq 180$	$\geq 1\ 100$‡	$\geq 1\ 100$*
		$180 < e \leq 240$	not admissible	$\geq 1\ 100$‡

* If the length of the slot opening is ≤ 75 mm the distance can be reduced to ≥ 50 mm.
†The value corresponds to leg up to knee.
‡The value corresponds to leg up to crotch.

FIGURE C6: Reaching in and through regular openings with the lower limbs

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C8 MINIMUM GAPS TO PREVENT CRUSHING

A crushing hazard will be generated if either two movable parts are moving towards one another, or one movable part is moving towards a fixed part.

The minimum gap dimensions to minimize the risk from a crushing hazard are given in Figure C7. Care must be taken to assess the risk of a person entering the crush zone in a different body orientation to those given. Where such a risk is considered to be unacceptable, additional measures will be required to minimize the risk, e.g. the use of fixed barriers to prevent access.

In addition, consideration shall be given to the increase in hand or body part dimensions as a result of holding tools or work pieces, or from the use of personal protective equipment such as gloves or helmets.

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No. R. 1025 **19 December 2014**

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

GUIDELINE FOR A MANDATORY CODE OF PRACTICE FOR RISK-BASED FATIGUE MANAGEMENT AT MINES

I **DAVID MSIZA**, Chief Inspector of Mines, under section 49 (1) of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) and after consultation with the Council, hereby issue the guideline.

DAVID MSIZA

CHIEF INSPECTOR OF MINES

Reference Number:	DMR 16/3/2/4-B2
Last Revision Date:	28 July 2014
Date First Issued:	First Edition
Effective Date:	30 November 2014

DEPARTMENT OF MINERAL RESOURCES

MINE HEALTH AND SAFETY INSPECTORATE

GUIDELINE FOR THE COMPILATION OF A

MANDATORY CODE OF PRACTICE FOR

GUIDELINE FOR THE COMPILATION OF A MANDATORY CODE OF PRACTICE FOR RISK-BASED FATIGUE MANAGEMENT AT MINES

CHIEF INSPECTOR OF MINES

DATE

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

CONTENTS

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PART A: THE GUIDELINE

1. FOREWORD

1.1 **Fatigue** is more than simply feeling tired or drowsy. It is caused by prolonged periods of physical and/or mental exertion without enough time to rest and recover.
1.2 **Fatigue** is associated with multiple factors which among others include spending long periods of time awake and having an inadequate amount and/or quality of sleep over an extended period.
1.3 **Fatigue** can significantly affect an individual's capacity to function. Its side-effects include decreased performance and productivity, and increased potential for injuries to occur.
1.4 **Fatigue** management is a responsibility that must be shared between employer and employee – it involves factors that occur both in and outside of the workplace.

1.5 The aim of this Guideline is to provide a framework to assist the employer of every mine to prepare a risk-based Code of Practice (**COP**) on Fatigue Management.

2. LEGAL STATUS OF GUIDELINES AND CODES OF PRACTICE

In accordance with Section 9(2) of the **MHSA**, an employer must prepare and implement a **COP** on any matter affecting the health or safety of employees and other persons who may be directly affected by activities at the mines if the Chief Inspector of Mines requires it. These **COP**s must comply with any relevant guideline issued by the Chief Inspector of Mines (Section 9(3)). Failure by the employer to prepare or implement a **COP** in compliance with this guideline is a breach of the **MHSA**.

3. THE OBJECTIVES OF THE GUIDELINE

This guideline has been developed to assist employers in achieving the objectives of risk-based fatigue management at any working place, which are to assist mines to:

3.1 Develop strategies for controlling risks of **fatigue** effectively;
3.2 Develop site specific **fatigue** management plans and programmes; and
3.3 Look at factors to be considered when managing **fatigue**.

4. DEFINITIONS AND ACRONYMS (Arrange alphabetically)

"Bio-roster" means a biologically-compatible roster that takes into account the effects of circadian rhythms, sleep cycles and the additive effect of fatigue during the working week.

"Circadian rhythm" means the internal cycle of roughly 24 hours that regulates the physiological and behavioural activities of all living organisms – also referred to as "the body clock".

"COP" means Code of Practice;

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"EAP" means Employee Assistance Programme;

"Fatigue" means reduced mental and physical functioning caused by sleep deprivation and/or being awake during normal sleep hours. This may result from extended work hours, insufficient opportunities for sleep, failure to use available sleep opportunities, or the effects of sleep disorders, medical conditions or pharmaceuticals which reduce sleep or increase sleepiness.

"FMC" means Fatigue Management Committee;

"FMP" means Fatigue Management Programme;

"MHSA" means Mine Health and Safety Act, 1996 (Act No. 29 of 1996), as amended;

"MHSC" means Mine Health and Safety Council;

"MQA" means Mining Qualifications Authority;

"Risk" means the likelihood that occupational injury or harm to persons will occur;

"SAQA" means South African Qualifications Authority;

"SETA" means a Sectoral Education and Training Authority established under the Skills Development Act No. 97 of 1998;

"Shift work" means an organisation of work where workers succeed each other at the same workplace while performing similar operations at different times of the day thus allowing longer hours of operation than feasible for a single worker;

"Supervisor" means any individual having authority, in the interest of the employer and is responsible for the day-to-day performance of a group of employees;

"Work schedule" means the hours to be worked for each day, shift, week, month or year, as scheduled by the employer.

5. SCOPE

This guideline:

5.1 Addresses areas of **fatigue** management as required at a mine;
5.2 Addresses areas of **fatigue** management from fatigue risk assessment to interventions that will be developed to mitigate the impact of **fatigue**; and
5.3 Covers all employees at a mine.

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6. MEMBERS OF TASK COMMITTEE

This guideline was prepared by:

Members of the **Fatigue Task Team**, which comprised of:

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Dr. D. Mokoboto	(State)
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Ms. M.A Hlapane	(State)
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Dr. C Badenhorst	(Employers)
Ms. M Kunene	(MHSC Office)

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PART B: AUTHOR`S GUIDE

The **COP** must, where possible, follow the sequence laid out in **Part C "Format and Content of the mandatory COP"**. The pages as well as the chapters and sections must be numbered to facilitate cross-reference. Wording must be unambiguous and concise.

IT SHOULD BE INDICATED IN THE COP AND ON EACH ANNEX TO THE COP WHETHER:

(a) The annex forms part of the guideline and must be complied with or incorporated in the **COP** or whether aspects thereof must be complied with or incorporated in the **COP**, or

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

When annexes are used the numbering should be preceded by the letter allocated to that particular annex and the numbering should start at one again. (e.g. 1, 2, 3, A1, A2, A3,).

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

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.

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PART C: FORMAT AND CONTENT OF THE MANDATORY CODE OF PRACTICE.

1. TITLE PAGE

The title page must include the following:

1.1 Name of mine;

1.2 The heading: "**Mandatory Code of Practice for Risk-based Fatigue Management**;

1.3 A statement to the effect that the **COP** was drawn up in accordance with this guideline **DMR 16/3/2/4-B2** issued by the Chief Inspector of Mines;

1.4 The mine's reference number for the **COP**;

1.5 Effective date of the **COP**; and

1.6 Revision dates.

2. TABLE OF CONTENTS

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

3. STATUS OF MANDATORY CODE OF PRACTICE

This section must contain statements to the effect that:

3.1 The mandatory **COP** was drawn up in accordance with Guideline **DMR 16/3/2/4-B2** 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 incident/accident investigation/inquiry to ascertain compliance and also to establish whether the **COP** is effective and fit for purpose.

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

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 assure 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**.

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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

The general information relating to the mine must be stated in this paragraph.

The following minimum information must be provided:

5.1 A brief description of the mine and its location;

5.2 The commodities produced;

5.3 The mining methods/mineral excavation processes taking care to identify the potential situation and/or sources that could give rise to fatigue;

5.4 The unique features of the mine that have a bearing on the **COP** must be set out and cross referenced to the risk assessment conducted; and

5.5 Other relevant **COPs**.

6. TERMS AND DEFINITIONS AND ACCRONYMS

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 **COP** must address how the significant **risks** identified in the **risk** assessment process must be dealt with, having regard to the requirements of Sections 11(2) and (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 program to monitor the **risk**.

7.2 To assist the employer with the hazard identification and **risk** assessment all possible relevant information such as accident, locality of mine, ergonomic studies, research reports, manufacturers' specifications, approvals, design criteria and performance figures for all relevant equipment should be obtained and/or considered.

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7.3 In addition to the periodic review required by Section 11(4) of the **MHSA**, the **COP** should be reviewed and updated after every serious incident/accident involving the conveyor belt installation, or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material.

In addition to the periodic review required by Section 11(4) of the **MHSA**, the **COP** should be reviewed and updated after every altered circumstance or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material

8. ASPECTS TO BE ADDRESSED IN THE CODE OF PRACTICE

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

8.1 Factors to be considered when addressing fatigue at mines

The **COP** should set a process for determining general considerations for **fatigue** management.

8.1.1 *Causes of **fatigue***

Human fatigue is multifactorial and from a health and safety perspective, fatigue is most appropriately conceptualised as either work related or non-work related.

8.1.1.1 *Work-related causes*

Common workplace issues that can cause **fatigue** include:

- Work time arrangements;
- High physical workloads;
- Temperature extremes;
- Excessive noise;
- Work stress; and
- Poor ergonomic design of workstations and equipment.

8.1.1.2 *Non-work-related causes*

Non-work-related causes that are variable on an individual level include the following:

a) Undiagnosed medical conditions – many diseases and disorders can trigger **fatigue**, including:

- Sleep disorders, such as sleep apnoea or restless leg syndrome;
- Chronic **fatigue** syndrome;

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- Tuberculosis;
- Chronic pain;
- Heart problems; and
- HIV.

b) Living conditions (housing and nutrition).
c) Alcohol and substance abuse.
d) Lack of exercise.
e) Certain medications.

It is the responsibility of employees to inform the employers of any health condition or medication they are on.

8.1.1.3 *Total worker **fatigue***

The **fatigue** experienced by an individual is usually an accumulation of several of the above factors and can be expressed in the following equation:

$F_T = F_{SS} + F_{EW} + F_{PF}$

Where;

F_T	=	total **fatigue**
F_{SS}	=	**fatigue** caused by the shift system/work time arrangements
F_{EW}	=	**fatigue** caused by poor ergonomics, environmental and work factors
F_{PF}	=	**fatigue** caused by personal factors such as insufficient/poor sleep, health, nutrition and personal lifestyle.

8.2. Development of a fatigue management plan

In general, the goal of a **fatigue** management plan is to maintain and, where possible, enhance safety, performance and productivity in operational settings, and manage the **risk** of **fatigue** in the workplace.

The recommended process of developing and maintaining a successful **fatigue** management plan consists of the following interrelated elements:

a) Securing and maintaining senior management commitment;
b) Establishing a **fatigue** management committee;
c) Developing policy and programme;
d) Managing **fatigue**;
e) Communicating policy and **fatigue** management plan;
f) Information, education and communication; and
g) Monitoring, reviewing and modifying.

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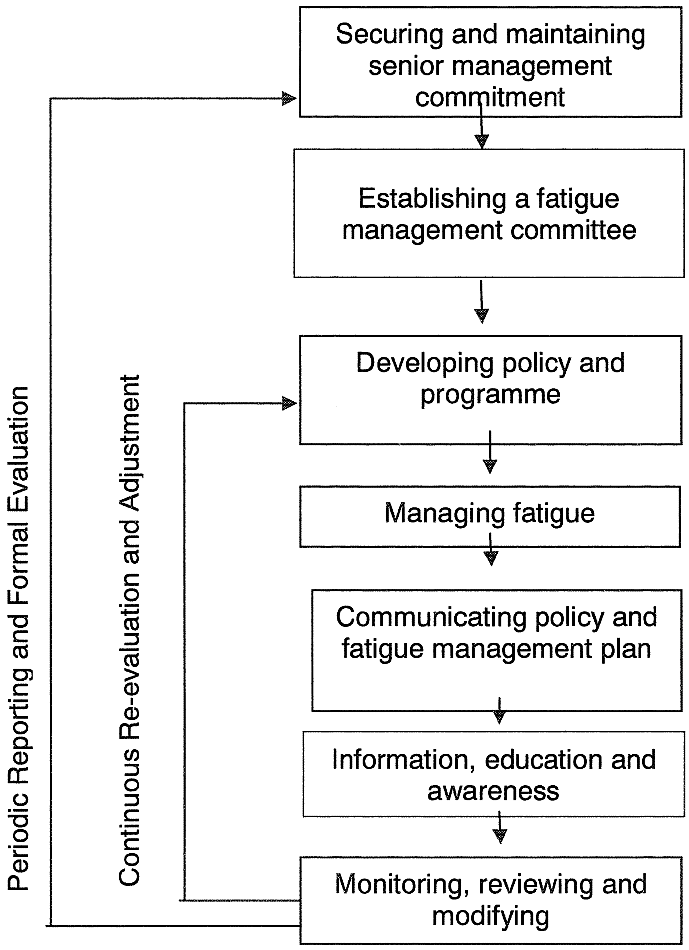
Figure 1:
The **fatigue** management plan development process as a flow chart diagram



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8.2.1 *Management commitment and Stakeholder Buy-In*

In order for a Fatigue Management Programme (**FMP**) to be effective, senior management must provide visible support, endorsement and allocate sufficient resources to establish, sustain, monitor and optimise the **FMP**.

8.2.1.1 *Assign responsibility for the development of the **FMP***

Management should form a specific committee or assign responsibility to an existing high level Health and Safety Committee to establish and oversee the implementation the **FMP**. This should be a truly representative cross section of the mine's stakeholders; managers and union representatives (preferably health and safety representatives). Responsibilities, authority and accountability for managing **fatigue** within the **FMP** need to be defined. These roles and responsibilities include:

- Creating a statement of safety, performance, business goals and benefits the mine expects to achieve as a result of implementing the **FMP**;
- Identifying and listing of the internal and external resources, support and expertise the mine will require to implement, monitor and improve the **FMP;**
- Developing procedures for handling cases of employee **fatigue**;
- Initialising protocols and objectives to evaluate the FMP. This can include comparative pre and post Key Performance Indicator (KPI) analysis and auditing of compliance; and
- Planning, implementing and executing all facets of the **FMP**.

8.2.2 *Establish a **fatigue** management committee*

Given the complexities involved in the design, implementation, monitoring and review of a **FMP** and the various different disciplines and department's involved~~,~~ close co-ordination and effective management are essential. The mine should establish a Fatigue Management Committee (**FMC**) at the mine to discuss and address the identified circumstances leading to **fatigue** and the control measures necessary. Action plans should be monitored at committee meetings.

The **FMC** should elect its own chairperson and scribe.

8.2.3 *Develop a policy (to be integrated into health policy)*

The **FMC** should develop the policy which should include:

a) Statement of goals and objectives;
b) Clear roles, responsibilities and accountabilities for managing **fatigue** in the workplace;
c) Documentation of the support and expertise available to the programme;

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d) Policies regarding employee alertness and fatigue, including possible disciplinary action for failure to maintain satisfactory levels of alertness on the job; and
e) Plan for reporting and reviewing organisational progress toward **FMP** goals.

8.2.4 *Fatigue Risk Management*

In order for the mines to manage the risks of **fatigue** effectively and efficiently the following steps should be followed:

Step 1: Hazard identification;
Step 2: Risk assessment;
Step 3: Risk control;
Step 4: Monitoring and evaluation; and
Step 5: Documenting **FMP**.
(Refer to Annexure A – C)

8.2.4.1 *STEP 1: Hazard identification*

a) *Identify factors that contribute to **fatigue***

The first step when managing **fatigue** is to identify, and develop a list of all the factors that have the potential to contribute to **fatigue** within the workplace. Factors to consider are work time arrangements, type of work performed, work environment and non-work-related factors.

There are many ways of identifying workplace factors that contribute to **fatigue**. They include:

i. Inspecting workplace rosters;
ii. Consulting with workers (ask them if they regularly feel **fatigued** and about any problems they have encountered, any near misses or unreported injuries);
iii. Consulting with workplace health and safety representatives and committees;
iv. Conducting a health and safety audit; and
v. Analysing injury and incident reports (pay particular attention to injuries and incidents that occur in periods of high **fatigue**, i.e. the latter half of shifts and night work, particularly between 2:00 and 6:00).

b) *Identify the hazards of **fatigue***

i. Shift systems and rostering (See Annexure A);
ii. Ergonomics, environmental and work factors (See Annexure B);
iii. Personal factors (See Annexure C);
iv. **Fatigue risk** worksheets (see annexure D); and
v. Review accident or incident reports (See Annexure E).

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8.2.4.2 *STEP 2*: ***Risk** assessment*

a) Assess the **risks** of **fatigue**

Managing **fatigue** involves assessing the **risks** associated with the workplace factors that contribute to **fatigue**. For each of the **risks**:

- Determine the likelihood of an incident occurring at the workplace, bearing in mind the existing control measures;
- Determine the consequences of an incident occurring at the workplace, bearing in mind the existing control measures; and
- Combine the estimates of the likelihood and consequences to rate the risk.

Site-specific information and evidence of **fatigue**-related incidents could be used to assist in the risk assessment process. In this context review:

- Incident reports;
- Self-reports and complaints from employees;
- Reports from supervisors about any evidence of **fatigue**;
- Aggregate data from any **EAP** (ensure that confidentiality is maintained when using such data); and
- Environmental and medical monitoring and other advice from those with technical expertise in the relevant disciplines.

From this information, determine the risk factors that need to be controlled and prioritise actions.

8.2.4.3 STEP 3: ***Risk** Control*

Implement **risk** control measures

Control mechanisms should be put in place to manage the factors (identified through the risk assessment process) contributing to **fatigue** and to reduce the risks from employee **fatigue**.

The controls should address the sources of **fatigue** in the workplace and take into account the factors identified in the personal environment.

Control measures should be introduced using the hierarchy of controls. According to the hierarchy of controls, the ideal solution when managing **fatigue** is to completely eliminate factors that contribute to **fatigue**.

This may involve, for example, the elimination of night shifts and extended working hours. If possible, there are a number of control options that may be used alone, or in combination, to minimise and control exposure to **fatigue**:

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These could include:

a) Review and amendment of policies and procedures that are identified as having an effect on employee **fatigue**.
b) Adjustment of shift rosters to the most optimal, using the **Bio-roster** concept. The shift roster should take into account the need for the person to spend time with his/her family and participate in family and community affairs. The shift systems devised shall have the support of employees.
c) Elimination of unnecessary routine from the **work schedule**.
d) Control of the working environment to reduce factors that promote **fatigue** and drowsiness (e.g. physical workload, noise, vibration, temperature, lighting, etc.).
e) Lighting of rest areas to promote wakefulness and assist with adjustment of the **circadian rhythm**.
f) Suitable systems to monitor the performance of workers in safety-critical positions (e.g. drivers and operators) during the course of the shift and, where appropriate, suitable technology to monitor performance during the shift.
g) Regular medical examination and certification of fitness of employees and contractors in safety critical positions. Follow-up at suitable intervals on employees with chronic illnesses that may contribute to **fatigue** through the medical surveillance programme. Provision of education and information on how to best manage the condition to these employees by a suitable medical practitioner.
h) Availability of a suitable and easily accessible source of drinking water to all employees.
i) Designing meals that are provided on night shifts to reduce drowsiness and adverse health effects associated with eating at this time of day.
j) Substitute: introduce safer practices in place of those currently in use, e.g. increasing the length of breaks in a shift:
k) Engineer: introduce engineering controls, e.g. improve ventilation and illumination levels to improve alertness.
l) Administrative controls: introduce procedures and training programmes to support effective control of **fatigue**.
m) Personal protective equipment: carefully manage the use of protective gear as a control measure because it may not provide sufficient reductions in exposures, e.g. hearing protection devices may not provide sufficient attenuation over a 12-hour shift as opposed to an eight-hour shift.

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FATIGUE RISK MANAGEMENT TOOL

Hazard Identification	**Risk Assessment** (Low - Moderate - Higher Risk: Tick applicable box)			**Risk Control**
MENTAL AND PHYSICAL DEMAND OF WORK	***Low***	***Moderate***	***Higher Risk***	***Interventions***
These include:				
Monotonous work				
Sustained physical or mental effort				
Complex physical or mental tasks				
WORK SCHEDULING AND PLANNING	***Low***	***Moderate***	***Higher Risk***	***Interventions***
Length of shift				
Sequential right shifts				
Breaks during work				
Breaks between work periods				
EXCESSIVE COMMUTING TIMES	***Low***	***Moderate***	***Higher Risk***	***Interventions***
WORK ENVIRONMENTAL CONDITIONS	***Low***	***Moderate***	***Higher Risk***	***Interventions***
Exposure to hazardous substances				
Exposure to extreme temperatures				
Exposure to vibration				
Exposure to noise				
INDIVIDUAL AND NON-WORK FACTORS	***Low***	***Moderate***	***Higher Risk***	***Interventions***
Sleep (amount and quality)				
Chronic conditions				
Alcohol and substance abuse				
Fitness levels (BMI)				
Nutrition				

For ease of reference it is recommended that the fatigue risk management charts be used to list the identified hazards, the qualitative risk assessment and the interventions that have been put in place to mitigate the risk of fatigue.

8.2.4.4 *STEP 4: Evaluation*

Monitoring and Evaluation

The fatigue management plan should be reviewed at regular intervals to ensure that all relevant hazards are included and to assess the effectiveness of the controls. Some of the specific factors to consider as part of the monitoring and evaluation include:

a) Have the control measures been implemented as planned?
b) Are there any new operational processes that have been introduced?
c) Review available fitness, health, EAP and absenteeism data.
d) Review incident data.

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8.2.4.5 *STEP 5: Documentation*

Documenting **fatigue** management plan

The fourth step in the **fatigue** management process is to develop and document a plan detailing how control measures will be implemented. The **fatigue** management plan should be integrated as part of an overall occupational health and safety programme. The plan should be:

a) Specific to the mine site.
b) Developed through consultation.
c) Publicly available, e.g. on display.
d) Communicated regularly and appropriately, e.g. in inductions and safety talks.
e) Regularly reviewed to take account of changes in site needs and knowledge about the risks.

It should include:

a) A statement of the principles for managing **fatigue**.
b) Roles and responsibilities of all levels of the organisation.
c) The **risk** assessments that have been undertaken.
d) The **risk** controls that are and will be in place, along with an implementation plan.
e) The support systems that already exist and that will be set up along with an implementation plan, e.g. **EAP**, training programmes and monitoring systems.

8.2.5 *Communicating the policy and **fatigue** management plan*

Careful, but vigorous, communication is critical when 'rolling out' the **fatigue** management plan. Once the policy and the **FMP** framework have been adopted, they must be communicated to the entire workforce of the organisation. The communication framework should also provide and encourage opportunities for family members to be included in the information exchange.

Overall, the **FMP** will benefit from open lines of communication between all stakeholders, including employees, line supervisors, middle managers and senior management.

Providing information to families of employees can stimulate or reinforce the employees' willingness to focus attention on the important issue of **fatigue**.

8.2.6 *Information, education and awareness*

An appropriate information, education and awareness programme should be put in place to create awareness and educate all employees and their families on the impact of **fatigue** in the workplace, their role in managing the risks, and the controls in the workplace.

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The programme should provide information and education on:

- The factors that cause **fatigue**.
- The signs and symptoms of **fatigue**.
- The risks of **fatigue** in the daily execution of their duties and the factors that cause **fatigue**.
- The action they can take when feeling the effects of **fatigue** during their shift.
- The impact of **shift work**, the importance of quality sleep and good nutrition to combat the effects of **shift work**.
- How to maintain an environment that will allow good quality sleep.

8.2.7 *Monitoring, reviewing and modifying*

The **FMP** should be subject to periodic assessments (minimum at least every two years) to ensure that it remains appropriate and effective, and can address existing and emerging or changed **fatigue** risks. Targets should be set for key parameters of the **FMP**. The review should cover the testing and auditing of all aspects of the **FMP**, in order to determine if controls are meeting business and safety goals.

The review should strike an appropriate balance between 'leading indicators' and outcome measures. The following are examples of the former:

a) The number of individuals diagnosed and treated with sleeping disorders.
b) The number of individuals who self-report **fatigue** when at work.

Obviously, attention should also be paid to outcomes and these will involve the usual measures such as:

a) Incident / accident rates.
b) Near misses and safety-critical events.
c) Equipment damage.
d) Feedback from employees.
e) Absenteeism.
f) Staff turnover.

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PART D: IMPLEMENTATION

1. IMPLEMENTATION PLAN

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

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

2. COMPLIANCE WITH THE CODE OF PRACTICE

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

3. ACCESS TO THE CODE OF PRACTICE 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 union, a health and safety representative on the mine, or if there is no health and safety representative, an employee representing the employees on the mine, must be provided with a copy on written request to the 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.

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ANNEXURE A:
Shift systems and rostering (F_{SS})

Work time arrangements and work systems that might have a negative impact on an individual's ability to adjust to **shift work** include but are not limited to:

a) a shift roster with an irregular or unpredictable pattern.
b) more than four consecutive 12-hour night shifts.
c) more than five consecutive 8-hour night shifts.
d) **work schedules**/rosters that do not allow opportunity for continuous sleep of seven to eight hours in each 24-hour period.
e) excessive regular overtime and on-call work.
f) early morning shift start times (before 6:00).
g) backward rotating rosters (day to night to afternoon).
h) shifts lacking appropriate shift breaks.
i) less than 36 hours off after a period of night shift work.
j) 12-hour shifts that involve critical monitoring tasks, heavy physical work, potential exposure to harmful agents/substances.

To assess the **fatigue** risks caused by shift systems and work time arrangements at a mine site, the relevant **risk** factors should be examined in detail in detail (Table 1.1).

Table 1.1:
Risk assessment of shift systems and work time arrangements

Risk factor	Consideration
	Shift schedule design factors
Night shifts, including the number of consecutive night shifts	• Are too many consecutive night shifts worked? • Is more than eight hours' work required over-night shift? • Are tasks requiring sustained physical or mental effort undertaken on night shift? • Are complex physical or mental tasks undertaken on night shift? • Do night shift workers have difficulty getting undisturbed sleep during the day?
Long hours of work in a single shift. This includes travel time, especially to remote sites	• Does one shift involve more than 12 hours in a day (including call-outs)?
Long hours of work across a shift cycle	• Do hours of active work (total time spent at work including overtime) exceed 50 hours in any seven days?
Long hours because of on-call duties	• Are there irregular and unplanned schedules as a result of call-outs? • Is the working day or working week extended beyond 12 hours in a single day or hours in any seven days as a result of call-outs?

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Risk factor	Consideration
Short breaks between work shifts	• Is there enough time between work shifts to allow for adequate sleep: – Enough time in a break for five hours' uninterrupted sleep in 24 hours (only for one night)? – Enough time in breaks for 12 hours of sleep in 48 hours (i.e. in two days)? – Enough time in breaks for 50 hours' sleep in 7 days? – Is the break between shifts less than 10 hours?
Short breaks within work shifts	• Are breaks within shifts long enough and frequent enough to allow workers to rest, refresh and nourish themselves?
Shift start/finish times	• Do any shifts start or finish between midnight and 6:00? • Are there split shifts? • Are complex, difficult or strenuous tasks required at the start or end of such shifts?
Changes to rosters	• Do workers get sufficient notice of roster changes? • Is **fatigue** management taken into account in roster changes?

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ANNEXURE B:
Ergonomics, environmental and work factors (F_{EW})

Exposure to environmental stressors, physical strain and work stress play an important role in the development of **fatigue**. To assess the **fatigue** risks caused by these factors, they should be examined in detail (Table 1.2).

Table 1.2:
Risk assessment of environmental and work factors

Risk factor	Consideration
	Task-related factors
Repetitive or monotonous work	• Do jobs involve repetitive or monotonous work, e.g. haul truck driving?
Sustained physical or mental effort	• Is the work physically demanding? • Is there time pressure due to a heavy workload? • Is work fast paced? • Is work intensive? • Can workers vary work pace or work tasks as desired? • Do workers have a say over work tasks or how to carry them out?
Complex physical or mental tasks	• Are high vigilance and/or concentration required? • Are there different demands that can be difficult to combine? • Are complex, difficult or strenuous tasks required at the end of shifts or shift cycles?
Adverse working conditions	• Are there adverse working conditions, e.g.: • Exposure to noise? • Exposure to heat? • Exposure to hazardous substances? • Whole body vibration? • Awkward body posture? • Restricted ceiling heights? • Travel distances to workplace facilities.

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ANNEXURE C:
Personal factors (F_{PF})

There are human factors and employee choices that might have a negative impact on an individual's ability to remain alert and adjust to **shift work**. In order to assess the **fatigue** risks caused by personal factors the following should be examined in detail (Table 1.3).

Table 1.3:
Risk assessment of personal factors

Risk factor	Consideration
Personal factors	
Excessive commuting times necessary	• Is significant travel to and from work necessary each day so that time for adequate sleep is reduced? • Are long-distance commutes necessary at the beginning of a work cycle?
Socio-economic issues	• Do jobs involve high demand, but low control? • Are there poor social relations at work, e.g. bullying? • Is there a low level of social support from peers and **supervisors** at work? • Second job for pay. • Family commitments.
Health conditions and medication	• To what extent is there evidence of problems as a result of: a) Pregnancy; b) Chronic Diseases; c) Medication; d) Other medical issues; e) Sleeping disorders; and f) Psychological issues.
Alcohol and substance abuse	• Alcohol and/or drug misuse/abuse
Living conditions	• Housing • Nutrition • Poor sleeping conditions • Unfavourable sleeping environment

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ANNEXURE D:
Fatigue risk worksheets for FSS/FEW

1. Worksheet A: Example of **fatigue** hazard identification checklist

Are any of these statements true in the workplace?	**Yes**	**No**
Many employees work shifts that include nightshifts		
Working overtime/long shifts is common		
Back-to-back shift working is common		
Breaks during shifts are short and do not provide a good rest		
Some people have to drive a long way to work, work long hours, then drive home		
Some shifts start very early (before 7:00)		
Shifts rotate 'backwards' (nights, evenings, day shifts)		
Shifts rotate forwards on a slow pattern		
Safety critical work is often done at:		
— a 'circadian low point'		
— two to four hours into a shift		
— at the end of a shift		
— following mealtimes		
— just before or just after a break (crew member may be tired just before the break, not fully alert after the break)		
Work is mainly very boring and uneventful		
Work is done:		
— in a hot environment		
— where the lighting is low		
— where it's fairly comfortable		
Shift workers don't have any say in the design of shift patterns		
Shift workers' family and friends don't provide much support for their unusual working hours		
There is no realistic support from employers on how to handle problems caused by shift working (e.g. 'education', briefings, counselling)		
Fitness for duty is not checked – especially the amount of sleep someone has had before starting a shift		
Some employees 'moonlight' during scheduled rest periods between shifts		
There is an ageing workforce working nights or long hours		
People rely on tea, coffee or other stimulants to stay alert		
The shift system has been designed entirely by the workforce		
Some people need to take unofficial 'naps' to keep working		

Scoring:
Add the number of ticks in the 'Yes' column. This gives a broad indication only of whether there is an alertness or **fatigue** problem.

- Three or fewer ticks – there is probably no need for action.

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- Four to 10 ticks – it would be wise to investigate further and consider solutions.
- More than10 ticks – there is definitely a problem; there should be further investigation and immediate action.

2. Worksheet B: Example of Checklist to interview shift workers to assess the **fatigue risk**

	Yes	**No**
Do you regularly lose one or two hours' sleep when working shifts?		
Is the quality of sleep you get generally poor – e.g. frequently interrupted (by noise or bright light)?		
Do you sometimes have to work on safety-critical tasks at a 'low point' in the day, e.g. early hours of the morning; mid to late afternoon or after a meal?		
Do you regularly work long shifts – e.g. over 12 hours?		
Do you have enough breaks during the shift?		
Are the breaks long enough?		
Are rest periods between shifts long enough to recover from the previous shift (at least 12 hours)?		
Can you rest properly (or even nap) during breaks?		
Do you feel generally drowsy a lot of the time?		
When changing from night shifts to day shifts, do you feel 'rough' for the first few days?		
Are you noticeably absent-minded or forgetful at work or do you find it hard to concentrate?		
Do you sometimes feel that you just can't move; or don't want to?		
Do you suffer from a lot of heartburn, indigestion or a generally upset stomach?		
Do you find it difficult to get a good undisturbed sleep between shifts?		
At work, do you:		
Often find it hard to concentrate, make clear decisions or take in and act on information?		
Have more than occasional lapses of attention or memory?		
Find your reaction times are slow (for example, responding to an alarm or a threat that builds up in your workplace)?		
Make lots of errors?		
Occasionally fall asleep at work – momentarily or for several minutes?		
Find that you are often irritable?		
Do you have the opportunity and facilities to rest properly (or even nap) during breaks?		

Scoring:
Some of the above are normal and unavoidable effects of **shift work**. This doesn't mean that answering 'Yes' to any of the above is acceptable. If anyone is showing severe or long-term symptoms of **fatigue**, action should be taken

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ANNEXURE E:
Review of accident or incident reports

There is evidence that **fatigue** is under-reported in incident investigations. The following will be helpful in identifying whether **fatigue** was an issue:

Consider the time of day the incident occurred. Was it:

- At a 'circadian low point'? (13:00 – 16:00; midnight and 06:00)?
- Close to the end of a shift?
- Within a period of two to four hours from the start of a shift?

Consider the point within the shift cycle when the incident occurred. Was it:

- At changes of shift, for example during the first day shift following a cycle of night shifts?
- At the end of a period of night shifts?

Consider the sleeping patterns of those involved in the incident, in particular, those who seem to have 'caused' the incident. Were they:

- Sufficiently rested during the off-shift period before coming on shift?
- Suffering from disrupted sleep?
- Doing a second job during an extended period of rest days between shifts?

Consider the work environment. Was it:

- Dark?
- Hot?
- Quiet?
- Generally conducive to sleep?

Consider the type of work being carried out. Was it:

- Routine (boring)?
- Work requiring sustained attention or extended concentration?
- Work requiring significant physical effort?
- Safety-critical work that could have been scheduled at another time?

Consider those involved in the incident. Were they:

- Taking any medicines that could have caused drowsiness or lack of attention?
- Taking stimulants (such as caffeine) to maintain their alertness?
- Assessed for fitness for duty before starting work or monitored during the shift for signs of **fatigue**?
- Tired on arrival after a long journey to work?

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NOTICE – CHANGE OF TELEPHONE NUMBERS: GOVERNMENT PRINTING WORKS

As the mandated government security printer, providing world class security products and services, Government Printing Works has adopted some of the highly innovative technologies to best serve its customers and stakeholders. In line with this task, Government Printing Works has implemented a new telephony system to ensure most effective communication and accessibility. As a result of this development, our telephone numbers will change with effect from 3 February 2014, starting with the Pretoria offices.

The new numbers are as follows:

- Switchboard : 012 748 6001/6002
- Advertising : 012 748 6205/6206/6207/6208/6209/6210/6211/6212
- Publications Enquiries : 012 748 6052/6053/6058 GeneralEnquiries@gpw.gov.za
  - Maps : 012 748 6061/6065 BookShop@gpw.gov.za
  - Debtors : 012 748 6060/6056/6064 PublicationsDebtors@gpw.gov.za
  - Subscription : 012 748 6054/6055/6057 Subscriptions@gpw.gov.za
- SCM : 012 748 6380/6373/6218
- Debtors : 012 748 6236/6242
- Creditors : 012 748 6246/6274

Please consult our website at www.gpwonline.co.za for more contact details.

The numbers for our provincial offices in Polokwane, East London and Mmabatho will not change at this stage.

Printed by and obtainable from the Government Printer, Bosman Street, Private Bag X85, Pretoria, 0001
Publications: Tel: (012) 748 6052, 748 6053, 748 6058
Advertisements: Tel: (012) 748 6205, 748 6208, 748 6209, 748 6210, 748 6211
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Gedruk deur en verkrygbaar by die Staatsdrukker, Bosmanstraat, Privaatsak X85, Pretoria, 0001
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