CONVEYOR MANUFACTURERS ASSOCIATION OF SA LIMITED

GUIDELINE

Safety Around Belt Conveyors

Disclaimer
This CMA “Safety Guideline” was drawn up by a committee of people drawn from member companies of the Conveyor Manufacturers Association of SA Ltd (CMA). The purpose of the guideline is to provide information that would enhance the safe operation and maintenance of belt conveyor systems. Many man hours were expended to gather information and document local and international practices that were considered by the committee to be safe and practical. Every effort has been made to ensure that the information provided is accurate. In all cases the applicable National legislation, local procedures, duly documented and approved risk assessments and safe working practices shall take precedence over anything else contained in this “Safety Guideline”. The CMA, its corporate members, directors, committee members or any individual associated with the generation of this “safety guideline”, or any individual committee member is not responsible for any consequences, legal or financial or otherwise, arising from the use of this guideline. The entire CMA “safety guideline” is applied and used solely at the discretion of the user.
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1. INTRODUCTION

Belt conveyors are probably the most efficient means of transporting bulk materials. However, they are considered dangerous due to the sheer size of the installation which prevents clear and unimpeded visibility down the length of the system. Conveyors can be one of the most hazardous mine or plant equipment installations if safety regulations are not strictly followed or if the conveyors are not properly maintained.

The South African Mines Health and Safety Act (Act 4 of 1996, Section 21) states that the onus is on the supplier to provide the correct conveyor design taking into consideration the risk to the health and safety of operating personnel. These same conditions are further extended to cover the installation of the conveying system as a whole.

The Mines Health and Safety Act (Ibid. Regulation 20.5) stipulates that all exposed machinery, that when in motion, may be dangerous to any person, must be securely fenced off or adequately guarded. Guards must be provided to such part of any machinery that may be a source of danger to any person.

Furthermore, the regulations (Chapter 8, Section 98 (1)) as revised in February 2008 need to be considered. See Appendix B.

2. PURPOSE

The purpose of this document is to serve as a minimum specification for the design of safe operating conditions and fulfilment of safety requirements for belt conveyors in accordance with the statutory regulations and Acts pertaining to machinery, particularly those sections applicable to conveyors.

3. SAFETY AROUND BELT CONVEYORS

3.1 Safety Requirements for Maintenance

On a moving conveyor belt, the belt, pulleys and idlers are all in motion, and each idler, chute skirt, belt cleaner or pulley has a potential nip point, depending on its accessibility.

The prohibition of work on moving machinery relates to tasks such as belt cleaning, house-keeping and the removal of spillage at localised points. Where build-up of carry-back material occurs on the face of pulleys and idler shells, the removal of this build-up is only permitted when the conveyor system has stopped and been safely locked out.

In instances where work needs to be carried out on the conveyor while the belt is running, such as belt training or the adjustment of material stream deflectors, it is important that this be performed by competent teams, in accordance with approved risk assessments and safe working procedures pertaining to the task being performed. While undertaking the necessary task, it’s important for operators to be on the alert and to stop the conveyor by activating a pull key or an emergency stop button which must be readily accessible. In all cases, except for those mentioned in the previous paragraph, pull keys and 3-phase isolation must be locked out and tagged prior to the commencement of any maintenance, construction or repairs.
3.2 Stored Energy

When maintenance is required on a conveyor system, it is important to remember the danger presented by residual energy stored within the system and to address this adequately.

Thus it is necessary to isolate the stored energy from the work area or to completely release all stored energy from the system, so that work can be performed in a safe environment. This can be done by applying clamps to isolate this energy from the work area or releasing the energy applied by the take-up system. The system tensions may also be relieved by the controlled lifting of the counterweight, or the controlled pay-out of the take-up winch system.

Where belt clamps are utilised, these must be securely anchored to the structure. This applies to both permanent clamps and temporary belt pulling clamps. Belt clamps must be inspected and tested before attachment to ensure that they are able to withstand the belt tensions in the localised area.

It is vital that a competent engineer designs the belt clamps, followed by verification by a Professional Engineer. The clamps can be designed in accordance with the CMA Specification Number MC01 (2005) and other relevant, safe engineering standards.

3.3 Lock out Systems

When any work is carried out on the conveyor, whether to the belting, components, or to the structure, the responsible person must ensure that the system is properly locked out, following the prescribed lock out procedures.

Where more than one team is required to work on the system concurrently, multiple lock out procedures must be applied in accordance with the regulations and the applicable risk assessment.

3.4 Personnel Training in Safe Working and Operating Procedures

It is mandatory that all maintenance operations have prescribed safe working procedures and policies which must be adhered to. It is important that operating staff be regularly reminded of the necessity to adhere to these safe working procedures.

All new staff, whether temporary or permanent, must be formally instructed in the safe work procedures for a particular task, and records of training must be maintained. Regular training of the work force is a priority.

3.5 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.

• The only action that can be undertaken with the belt in motion is tracking of the belt.

• Ensure that pre-start alarm is working correctly and if not, isolate the conveyor and request that it be repaired.

3.6 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;
• the take-up system is operational.

4. CONVEYOR SYSTEM PROTECTION DEVICES

The belt conveyor 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.

4.1 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 should not be considered a lock out of the conveyor power source.

**Pre-Start Warning**

All conveyors must be equipped with an audible and visual system that provides a pre-start warning along the entire length of the conveyor. These include horns, sirens, flashing lights or strobes, or a combination of two or more warning signals. The start warnings are activated for a period after a start is requested, but before initiating motion of the conveyor.

**Interlock**

Classically, interlock is the run permissive for the conveyor to any other unit's run status. It is the control relationship between adjacent material transferring and interdependent machines.

Interlock normally proceeds through a system in the reverse order of material flow. For example, a belt conveyor numbered 01 transfers material to another belt conveyor numbered 02. Conveyor 01 is interlocked to 02. If conveyor 02 shuts down, 01 must shut down. Interlock then flows from 02 to 01.

Running a belt *out of interlock* or *in bypass* are common terms for operation of a conveyor with the interlock system disabled or defeated.

Interlock can be performed by physically wiring the conveyor control systems together, by computer coding interlock, by providing a motion sensing switch on the tail of the receiving conveyor and sensing that signal as a run permissive for the feeding conveyor. An alternative is to signal by telemetry from one conveyor to the next over a distance.

A conveyor may be interlocked to other machinery and devices such as screens, breakers, crushers, magnets or as the process requires.

**Telemetry**

Telemetry is the distribution of belt control and informational signals over significant distances. Since conveyors transport material over wide areas, some belts require signal telemetry. Signal telemetry can be simply multi-conductor cables with DC digital on/off controls or can involve a multiplex of more than one signal over a single wire path.
Today, telemetry may involve the conversion of electrical signals to computer-based serial transmission of data, to light signals run over fibre optics, or to wireless radio transmission.

Control, remote operator interface and conveyor monitoring can be geographically located a distance away from the physical conveyor location and controlled using commercial telephone networks and modern technology.

**Lock out**

Lock out of a belt conveyor is the physical lock out of all motive power sources to the conveyor so that people may access the conveyor equipment for service, inspection, clean up or maintenance. Lock out implies security supervision of the lock out elements and involves all sources of power including electrical, hydraulic and pneumatic.

Each drive and conveyor system requires an assessment of lock out requirements which includes any equipment or apparatus that is compliant with owner practices and policies, manufacturer's recommendations, and regulatory requirements.

The lock out system must be interfaced with the belt control system.

A permit system is necessary to monitor the maintenance crew and record exactly what work is carried out. After the system/conveyor is locked out, the system must be tested by attempting to start it to confirm the lock out.

![WARNING]

**WARNING**

SPECIAL ATTENTION MUST BE PAID TO THE LOCK OUT PROCEDURE OF RING FEED SYSTEMS ON CONVEYOR DRIVES.

### 4.2 Belt Alignment

It is important that the belt stays aligned with the drive pulleys and the carrying and return idlers. Belt alignment sensors are typically positioned along the edges of the conveyor fabric. They are usually located at the discharge and at the loading areas of the conveyor, but can be distributed along the conveyor at intervals, depending on the conveyor route and the requirement.

Belt alignment switches are often located on the unsupported section of belting in a horizontal take-up system in order to minimise the damage that misalignment can do in this area. Switches consist of roller switches, limit switches, whisker switches, proximity switches or photoelectric switches.

When the edge of the belt trips the alignment switch for a timed period, power to the conveyor is interrupted and the system halts immediately. An adaptation of alignment sensors for large steel cord belts is the continuous measurement of edge displacement, termed 'edge tracking'.
Edge tracking in steel cable belts provides an indication of tension distribution within the carcass among the support cables. Upon installation, each steel cable belt exhibits an edge-tracking signature for a belt revolution.

A deviation in the edge tracking displacement at a later time would suggest a problem in the belt cable tension distribution. However, these systems are relatively sophisticated and are usually installed only on extremely strategically sensitive conveyor systems.

### 4.3 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.

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 can bridge, for example, 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.

### 4.4 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 deco 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.

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.

4.5 Take-up Over-travel

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

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.

4.6 Transfer Chute Plug or Blocked Chute

A plugged chute or blocked chute device provides belt protection at the discharge end of the conveyor into a transfer chute. Blocked flow can result in damage to the moving conveyor.

A blocked chute can also cause severe damage to the belt being fed, particularly in the case of a single large lump stuck in the feeding boot and slitting the belt.

Plugged chute switches are used in many configurations depending on the application.
Actuation of the plugged chute switch with time delay normally results in the tripping of the conveyor drive.

Typical devices used are laser, ultrasonic, pressure diaphragm or simple overflow detection.

A popular system is to use a mercury switch unit that interrupts the power in the event of a tilt beyond 15° to the vertical.

Blocked chute sensors require careful maintenance because they are required to operate in extremely harsh conditions, often in the flow of material and in relatively inaccessible locations.

### 4.7 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 predetermined level is exceeded.

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

### 4.8 Pull-cord Stations

Pull-cord stations are distributed stop switches with latching attachments. Pull-cord or pull-wire switches are required on all conveyors.

Where conveyors are able to be accessed from both sides, the pull-switches must be located on both sides of the conveyor. Ingenious crossover systems have been developed to allow the use of pull-cord switches on both sides of the conveyor while utilising only one control system.

Pull-switches are located along the conveyor at intervals not exceeding 100 metres between the individual switch units. The units are interconnected with a pull-wire.

An operator activates the switch by pulling the pull-cord until the switch trips, interrupting power to the conveyor and usually raising a visual indicator flag. The switch remains tripped until reset manually at the switch location. The belt does not restart on reset of the pull-cord for safety reasons.

Tripping of the pull-cord is a controlled stop, and shall not be considered a lock out of the conveyor power source, unless the units are specifically so designed. It is important to note that pull-wires are not substitutes for guards.

The pull force required to operate the switch shall not exceed 70 N when applied at mid span between supports, with a movement of not more that 300 mm when applied at right angles to the wire and must not exceed 270 N when pulled in-line.

The pull-wire supports shall not exceed 6,0 metres (Australian Standard. AS1755 of 2000) irrespective of the distance between switch locations.
Systems available in South Africa range from a simple power switch, with a local isolator knob which is also available as a lockable switch, to sophisticated systems that allow voice communication, diagnostics and other protection devices.

Modern systems use either a standard $\phi 5$ mm or $\phi 6$ mm PVC covered steel cable, or weatherproof cables that encase the control lines, communication lines and other instrumentation requirements in one cable.

Pull-wires must be installed in such a way that they are clearly visible and readily accessible from all areas that provide access to the conveyor.

### 4.9 Rip Detectors

Rip detectors indicate rips or tears in the belt fabric, allowing quick action to be taken to protect the belt from further damage.

Simple rip detectors are usually spill switches located below the centre of the belt near the point of belt loading. Note that particularly with steel cord conveyors, a central rip is often undetectable with the naked eye, due to the high closing forces of the troughed belt. For this reason, mechanical systems tend to be unreliable.

Complex belt rip detectors on larger belts involve the embedding of antennae into the belt construction, generally in the bottom cover, about 50 metres apart. The antennae usually consist of looped copper wire, and the sensor on the opposite side of the belt detects, by induction, the transmission of a pulsed signal from the sensor on the other side of the belt. If a rip cuts an antenna, signal sources and detectors located along the edge of the belt detect a broken antenna and shut down the belt.

Complex belt rip detection systems require periodic maintenance, especially to their controllers and sensors.

If a rip has been repaired, the sensors are programmed to skip the broken antenna, thereby preventing erroneous trips. However, in the event of several adjacent broken antennae, there is, in this example, a potential that 150 metres of belting is, essentially, unprotected. It is possible to have the antennae removed by local skiving of the belt covers, with the broken antennae being replaced and re-vulcanised in-situ.

Other electronic systems rely on the ultrasonic transmission of pulses transversely through the conveyor carcass. When the belt is ripped, the signal will change and trip the conveyor.

The major cause of belt loss on overland systems is belt rip. In most cases, simple items such as liner plates coming loose or jumper bars or rods in the material stream passing over the feeding conveyor terminal cause the damage.

In most cases, minimal maintenance carried out on a regular basis prevents the rips occurring.
4.10 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.

4.11 Lightning Protection

All conveyors are prone to being struck by lightning and require protection from being damaged and to protect all operating and maintenance staff.

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.

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 such that systems can be shut down in the event of danger levels reaching pre-determined limits.

4.12 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.

In the case of coal dust, wetting agents are required, since coal dust and water are immiscible under normal conditions.
Figure 1  Typical Conveyor Protection Installation

5. BASICS OF CONVEYOR GUARD DESIGN.

5.1 Guards & 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 belt conveyor 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 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.

Figure 2  Pulley Guard
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 shall, 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 only are 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.

**Square Openings:** It may be assumed that there is no reach through an opening of 10 mm x 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 metre.

Screening materials with openings in excess of 80 mm x 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 x 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.
5.2 Nip Points & Nip Guards

Nip guards must be fixed to the pulley supports in such a way that the distance between the guards and the pulley do not vary, even when the belt is tensioned.

NIP GUARD 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

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.

Figure 5  Typical Belt Conveyor Protection Installation Showing Nip Guards

Figure 6  Identified Nip Point & Fitted Nip Guard

Figure 7a  General Nip Guard Configurations – Side Elevation
Carry Idlers
Although it has been stated that it is essential that the head, tail and snub pulleys of belt conveyor installations which are ‘within reach’ shall be guarded, accidents have happened on carrying idlers.

The outcome has frequently been serious particularly where the amount the belt that can lift off the idlers is restricted. The danger at idlers is more serious when fixed hoppers or skirt plates under which the hand can be trapped are fitted directly above the idlers. If this is the case, the danger points must be very carefully guarded or completely enclosed. This also applies, even more so, to belts on which hand sorting is performed.

Return Idlers
On belt conveyors, the return belt or idlers may also present a hazard especially if specific places exist where persons regularly pass underneath the belt. At such places, it is recommended that the underside shall be guarded and crossing at other places shall be discouraged or prevented, even if only two or three strands of eight gauge galvanised wire is used along the outside of the supporting framework to achieve this purpose.

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 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 shall be interlocked so that the conveyor stops when the gate or door is opened.

Trip Wires
When faults, accidents or blockages occur, it is necessary to bring the conveyor to an immediate halt. If pulled, a continuous ‘tripwire’ stretching the whole length of the conveyor shall be set to actuate the conveyor’s stop switch. This is an effective and essential safety device. With such a facility available, the operator will be less tempted to try to rectify faults while the conveyor is running.

The tripwire must, however, extend to the full length of the conveyor, even as far as the inside of the guarded sections. If the belt conveyor is
installed in such a way that people can walk along the conveyor avoiding the wire, then a tripwire must be installed on both sides of the conveyor.

It is also recommended that a ‘lock out’ facility be provided on this trip wire arrangement.

**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.

### 5.3 Maintenance and Access

Lateral movement of the belt is usually caused by a build-up of material on the head and tail pulleys, the carrying idlers or snub pulleys. The manual removal of build-up is slow and complicated, and frequently dangerous.

To keep the pulleys and rollers 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 belt conveyor 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’ 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. 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.

Safety at belt conveyor 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 shall have an even, non-slip surface, be properly drained and free from obstructions.

### 5.4 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.
Even a properly guarded belt conveyor 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.

Disclaimer
This CMA "Safety Guideline" was drawn up by a committee of people drawn from member companies of the Conveyor Manufacturers Association of SA Ltd (CMA). The purpose of the guideline is to provide information that would enhance the safe operation and maintenance of belt conveyor systems. Many man hours were expended to gather information and document local and international practices that were considered by the committee to be safe and practical. Every effort has been made to ensure that the information provided is accurate.

In all cases the applicable National legislation, local procedures, duly documented and approved risk assessments and safe working practices shall take precedence over anything else contained in this "Safety Guideline".

The CMA, its corporate members, directors, committee members or any individual associated with the generation of this “safety guideline”, or any individual committee member is not responsible for any consequences, legal or financial or otherwise, arising from the use of this guideline. The entire CMA "safety guideline" is applied and used solely at the discretion of the user.

Appendices:


List of amendments
46 No. 30698 Government Gazette, 1 February 2008 No. R. 93 1 February 2008
No. 36761 Government Gazette, 23 August 2013 No. R. 622 23 August 2013

Appendix B: Risk Assessment Form

Appendix C: Ergonomic Guard Design Data to AS 1755-2000

[For ease of reference, the August 2013 changes are underlined – they amount to relatively simple adjustments to the text in 8.9(1)(a); 8.9(1)(e); 8.9(2) by the removal of a semi-colon after “run-on”; 8.9(8); and 8.9(8)(b).]

Previous amendment 46 no. 30698 Government Gazette, 1 February 2008.
No. R. 93 1 February 2008

AMENDMENTS TO MINES HEALTH AND SAFETY ACT GAZETTED ON 23 AUGUST 2013

I SUSAN SHABANGU, Minister of Mineral Resources, under section 98 (1) of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) and after consultation with the Council, hereby amends Chapter 8 of the Regulations in terms of the Mine Health and Safety Act, as set out in the Schedule.

SUSAN SHABANGU
MINISTER OF MINERAL RESOURCES

SCHEDULE

CHAPTER 8: MACHINERY & EQUIPMENT

General Machinery Regulations

8.8(1) The employer must take reasonably practicable measures to prevent persons from being injured as a result of them, the clothes being worn by them or any equipment being held by them coming into contact with or being drawn into any moving part of any machine.

8.8(2) The employer must take reasonably practicable measures to prevent persons from being injured because of any machinery falling as a result of-

(a) incorrect design;
(b) incorrect installation;
(c) poor maintenance; or
(d) incorrect use or non-compliance with proper operating or safety procedures.

8.8(3) The measures to be taken by the employer in terms of regulation 1 must include measures to ensure that-

(a) only persons authorized by the employer to do so, start, operate and maintain any machine where such starting, operation or maintenance may pose a significant risk to any person;
(b) where the moving of machinery may pose a significant risk to any person, such machinery is only moved under the constant supervision of a competent person who is fully aware of the risks attached to such moving of the machinery;
(c) only persons authorised by the employer to do so enter any area where machinery is operated, where such operation may pose a significant risk to any person;
(d) machinery is only operated if all installed safety devices are operational and functional;
(e) persons in close proximity to moving parts of machinery do not wear or are not permitted to wear clothing or anything else that can be caught in such moving parts;
(f) where the unexpected moving of any machinery or any part of any machinery could pose a significant risk to any person, appropriate pre-start warning devices, such as audible warning devices, the delay time must be determined by risk assessment with a minimum of a ten
second time delay, are fitted to such machinery and used to warn persons that such machinery is about to be set in motion;

(g) where there could be a significant risk to any person working on any machinery due to the release from such machine of any mechanical, electrical, hydraulic, chemical or other source of energy, a written lockout procedure is prepared and implemented to ensure that such source of energy is effectively locked out and de-energised before any person works on such machinery;

(h) access scaffolding is erected, used, maintained and dismantled safely and in accordance with SANS Standard 10085-1:2004 "The design, erection, use and inspection of access scaffolding";

(i) means are provided, on or in close proximity to any machine, to immediately remove the source of power to that machine in case of an emergency;

(j) where the starting of machines are interlocked, no unintended starting of any of those machines can take place;

(k) starting devices are so arranged that no accidental starting of machinery can take place; and

(l) all electrical, pneumatic and hydraulic portable equipment are operated and maintained in a safe working order;

8.8(4) The measures to be taken by the employer to prevent any person from coming into contact with any moving part of machinery or any equipment attached thereto, must include-

(a) effective physical barriers at the machinery such as screening, guarding or fencing; or

(b) failsafe electric or electronic barriers interlocked with the machinery in such a way that the machinery would be stopped before persons come into contact with moving machinery or parts thereof; or

(c) effective barriers at a safe distance away from any machinery.

8.8(5) The employer must take reasonably practicable measures to ensure that:

(a) when a compression ignition engine system is found to have any defect which may cause a significant risk to the safety or health of persons, the use of such engine system is discontinued immediately;

(b) all services, maintenance and repairs to diesel-powered equipment are performed by a competent person;

(c) all areas where diesel fuel is stored and where fuelling is carried out are clearly marked and that measures are in place to prevent spillage, contamination and fire, including that -

(i) diesel engine fuel is delivered underground in such a way that no spillage takes place during delivery;

(ii) when fuel is piped underground fuel delivery pipes are drained each time after use;

(iii) fuel is stored underground only in non-flammable robust containers which do not leak; and

(iv) the quantity of fuel stored underground is limited to 3 (three) day's estimated consumption.

8.8(6) The employer must take reasonably practicable measures to ensure that every mobile diesel engine powered unit, when not in use, is kept at a location that is sufficiently ventilated to prevent a build up of diesel fumes in the air at that location sufficient to cause a significant risk when starting up that engine.

8.8(7) The employer must take reasonably practicable measures to ensure that all
areas where diesel fuel is stored are clearly indicated on the mine's rescue plan contemplated in regulation 17 (19).

**Conveyor Belt**

**Definitions**

The Final Amendment of Chapter 8, Conveyor **Regulations** of the Mine Health & Safety Act (Act No. 29 of 1996) is as follows: (29-06-2011)

**DEFINITIONS:**

For purposes of regulation 8,9, unless the context otherwise indicates-

"**conveyor belt installation**" means a mechanical system used for the transportation of minerals, material, or persons on a belt.

"**power supply**" means any energy source feeding the drive motor of a **conveyor belt installation**.

"**designated sections**" means the drive section, take up tension section, snub pulley sections, transfer point sections and tail pulley sections.

**REGULATIONS:**

8.9(1) In compliance with regulation 8.8(1) the employer must ensure that -

(a) the designated sections of a conveyer belt installation are to be guarded, as per regulation 8.8(4) and not cleaned when any of its parts are in motion; provided that washing with pressurized water from a safe distance may be carried out, subject to regulation 8.9(1)(i)

(b) the power supply and all sources of stored energy of a stationary conveyer belt installation are isolated, made safe and locked-out during either repairs, maintenance or cleaning of spillage in the designated sections; provided that the alignment and training of a conveyer belt installation may be carried out whilst the belt is in motion subject to it being carried out in accordance with a procedure prepared and implemented for this purpose.

(c) the driving machinery of the **conveyor belt installation** can be stopped by any person from any point, along its length where access to the belt is possible;

(d) the driving machinery of the **conveyor belt installation** is stopped should the belt break, jam or slip excessively;

(e) persons are prevented from entering any side of a **conveyor belt installation**, unless means have been provided to do so safely;

(f) one or more devices are fitted and used to give all persons at any point where access to the **conveyor belt installation** is possible sufficient prior warning for a period to be determined by the mines risk assessment with a minimum period of 10 seconds that any part of such a **conveyor belt installation** is about to be put into motion;

(g) the take up or belt tensioning device will not move when repairs, routine cleaning, cleaning of spillage, maintenance at the belt tensioning device or where belt splicing is carried out;

(h) where two or more **conveyor belt installations** are used in series, sequence interlocking is provided which automatically will, except when approved maintenance specific procedures are carried out that require an independent conveyor test run, -

(aa) stop all **conveyor belt installations** feeding a **conveyor belt installation** that has stopped; and
(bb) prevent a **conveyor belt installation** from starting until the **conveyor belt installation** onto which it feeds is running; and

(i) only persons authorised to do so by the employer operate, maintain, clean and repair a **conveyor belt installation**; and provided that any routine cleaning outside the designated sections of the conveyor section of the belt is carried out in accordance with a procedure prepared and implemented for this purpose;

(j) the belt of any **conveyor belt installation** is installed in such a way that no uncontrolled run away can occur; and

(k) the overall structural design of every **conveyor belt installation** is approved by a competent person.

8.9 (2) The employer must take reasonably practicable measures to prevent persons from being injured by material or mineral falling from a **conveyor belt installation**, which measures must include the fitting and use of one or more devices to prevent run-back or run-on when such **conveyor belt installation** is stopped.

8.9 (3) The employer must take reasonably practicable measures to prevent persons from being exposed to flames, fumes or smoke arising from a **conveyor belt installation** catching fire, including instituting measures to prevent, detect and combat such fires.

8.9 (4) The employer must take reasonably practicable measures to prevent persons from being injured as a result of the breaking, misalignment or damage of conveyor belting due to any mineral, material or coal dust accumulating on or around the moving parts of any **conveyor belt installation**.

8.9 (5) The employer must take reasonably practicable measures to prevent persons at or near **conveyor belt installations** from being injured due to lightning directly or indirectly striking the installation.

8.9 (6) The employer must take reasonably practicable measures to ensure that the use, operation and inspection of man-riding conveyors comply with SANS 10266: 2006 - Edition 1 “The safe use, operation and inspection of man-riding belt conveyors in mines”.

8.9 (7) The normative references in SANS 10266: 2006 are not applicable to the employer.

8.9 (8) The employer must take reasonable measures to ensure that the functionality of the devices contemplated in regulation 8.9(1)(c) and (f) and of any other safety devices relating to the **conveyor belt installation** are tested.

(a) once a week not exceeding ten days, where such devices are in the designated sections;

(b) every three months where such devices are outside of the designated sections; and

(c) immediately after any belt extension or shortening thereof has taken place.

8.9 (9) The employer must ensure that a written procedure is prepared and implemented for conveyor belt splicing, joining and repairing and for the safe use of chemicals during such splicing, joining and repairing.
APPENDIX B: RISK ASSESSMENT FORM

<table>
<thead>
<tr>
<th>DEPARTMENT</th>
<th>SCOPE AND BOUNDARY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>DATE</th>
<th>RISK ASSESSMENT TEAM</th>
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</tbody>
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<table>
<thead>
<tr>
<th>REVIEW DATE</th>
<th>REFERENCE NO</th>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The risk assessment is being done to identify the hazards and assess the risks associated with the new conveyor system on 2 seam and bring the mine in line with the legal requirements.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACCIDENT SEVERITY</th>
<th>HEALTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>INJURY</td>
<td></td>
</tr>
<tr>
<td>DISABLING</td>
<td></td>
</tr>
<tr>
<td>PERMANENT</td>
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</tr>
<tr>
<td>FATALITIES</td>
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</table>

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<th>HEALTH</th>
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</tr>
<tr>
<td>PERMANENT</td>
<td></td>
</tr>
<tr>
<td>FATALITIES</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ITEM NO</th>
<th>TASK/EQUIPMENT</th>
<th>HAZARD EVENT</th>
<th>EXISTING CONTROLS</th>
<th>RESIDUAL RISK RATING</th>
<th>SHORTCOMINGS IN EXISTING CONTROLS</th>
<th>RECOMMENDATIONS</th>
<th>APPROVAL HEALTH &amp; SAFETY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Patrolling Conveyor</td>
<td>Moving parts on conveyor. No guards or guards not in place.</td>
<td>Injuries Fatalities/amputations/lacerations.</td>
<td>Regulation 20.5 All exposed machinery which, when in motion, may be dangerous to any person, shall be securely fenced off. Effective guards shall be provided to such parts as may be a source of danger to any person. Engineering Procedure Standard for the installation, operation, repair, maintenance and patrolling of belt conveyor systems</td>
<td>10</td>
<td>There are no guards along the sides of the cross conveyor and also at the top section of the sub incline.</td>
<td>Effective guards to be fitted on both sides of the conveyor to prevent people walking under or into moving conveyor. All other guards that are not already fitted to be fitted with immediate effect.</td>
</tr>
<tr>
<td>2</td>
<td>Electric Motors</td>
<td>Electricity</td>
<td>Electrocution Fatalities. Electrical burns. Electrical shock.</td>
<td>Mine Health and Safety Act and Regulations. 21.7.1 Any accessible metallic portion of electric apparatus which may accidentally become live, shall be connected to earth by a conductor of adequate cross sectional area.</td>
<td>10</td>
<td>Some motors are not earthed.</td>
<td>Adhere to Regulation 21.7.1</td>
</tr>
</tbody>
</table>

What will injure: What you have in place to prevent the event
<table>
<thead>
<tr>
<th>ITEM NO</th>
<th>TASK/ EQUIPMENT</th>
<th>HAZARD</th>
<th>HAZARD EVENT</th>
<th>EXISTING CONTROLS</th>
<th>RESIDUAL RISK RATING</th>
<th>SHORTCOMINGS IN EXISTING CONTROLS</th>
<th>RECOMMENDATIONS</th>
<th>APPROVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Conveyor</td>
<td>Fire</td>
<td>Damage to property. Noxious fumes - CO</td>
<td>What you have in place to prevent the event</td>
<td>10</td>
<td>None, however there are some fire extinguishers missing and not in place.</td>
<td>Adhere to regulations.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Transfer Points</td>
<td>Dust</td>
<td>Inhalation of fine dust</td>
<td>Regulation 10.1.1 No person permitted to work in dust visible by sight.</td>
<td>6</td>
<td>There are no water sprays fitted at transfer points. Some persons do not wear the protective equipment.</td>
<td>Adhere to Regulation MS15. Fit and use water sprays at all transfer points.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Conveyor Drive</td>
<td>No hand rail on chute side of top platform (Slip and fall)</td>
<td>Fractures and/or contusions</td>
<td>Mine Health &amp; Safety Act &amp; Regulations Regulation 20.8 Every precaution shall be taken in connection with the use of machinery to ensure that the safety of every person employed on or about such machinery is not endangered.</td>
<td>10</td>
<td>There are no hand rails to prevent persons falling into the transfer chute.</td>
<td>Hand rails to be fitted.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Pulleys and Nip Points</td>
<td>Conveyor Pulleys</td>
<td>Fatalities, Abrasions. Amputations.</td>
<td>Regulation 20.5 All moving machinery when exposed to be effectively guarded. Engineering Standard Standard for the installation, repair, patrolling and maintenance of conveyor systems.</td>
<td>20</td>
<td>Not all the nip points have nip guards fitted.</td>
<td>Fit nip guards to all places requiring them.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Transfer Chutes</td>
<td>Flying objects/ coal</td>
<td>Eye injury. Abrasions. Lacerations.</td>
<td>Mining Standard MS15 Personal protective equipment – eye protection to be worn.</td>
<td>6</td>
<td>None.</td>
<td>PPE to be worn at all times.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Patrolling Conveyor</td>
<td>Noise</td>
<td>Loss of hearing ability.</td>
<td>Mining Standard MS15 Personal protection equipment – hearing protection to be worn.</td>
<td>6</td>
<td>None.</td>
<td>PPE to be worn at all times.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C – TO AS1755-2000
ERGONOMIC DATA – (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](image)

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.

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

---

**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 shall only be used where a risk assessment indicates low probability and low severity of injury.

**Notes:**
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.
**FIGURE C3  SAFETY DISTANCES FOR REACH AROUND**

**C5  REACHING IN AND THROUGH REGULAR OPENINGS WITH UPPER LIMBS**

Safety distances are as given in Figure C4. The dimension of openings (e) correspond 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
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.

### 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.

![Diagram of irregular-shaped opening](image)

**FIGURE C5 IRREGULAR-SHAPED OPENING**

<table>
<thead>
<tr>
<th>Part of lower limb</th>
<th>Illustration</th>
<th>Opening</th>
<th>Safety distance (sr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Slot</td>
<td>Square or round</td>
</tr>
<tr>
<td>Toe tip</td>
<td></td>
<td>Ø ≤ 5</td>
<td>0</td>
</tr>
<tr>
<td>Toe</td>
<td></td>
<td>5 &lt; Ø ≤ 15</td>
<td>≥ 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 &lt; Ø ≤ 35</td>
<td>≥ 80*</td>
</tr>
<tr>
<td>Foot</td>
<td></td>
<td>35 &lt; Ø ≤ 60</td>
<td>≥ 180</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 &lt; Ø ≤ 60</td>
<td>≥ 180</td>
</tr>
<tr>
<td>Leg up to knee</td>
<td></td>
<td>80 &lt; Ø ≤ 95</td>
<td>≥ 1100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>95 &lt; Ø ≤ 180</td>
<td>≥ 1100*</td>
</tr>
<tr>
<td>Leg up to crotch</td>
<td></td>
<td>180 &lt; Ø ≤ 240</td>
<td>not admissible</td>
</tr>
</tbody>
</table>

* 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**

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.
LIST OF REFERENCES

Control of Substances Hazardous to Health Regulations of the United Kingdom. London. HMSO.

ACKNOWLEDGEMENTS

This Code of Practice was devised by a Working Group comprising representatives from:

Nepean Conveyors
Anglo Technical Division
Dunlop S.A.
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SASOL Mining
Brink Cohen Le Roux Attorneys
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We acknowledge with thanks information derived from many other sources, and apologise that they do not appear in the List of References.

REVISIONS

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