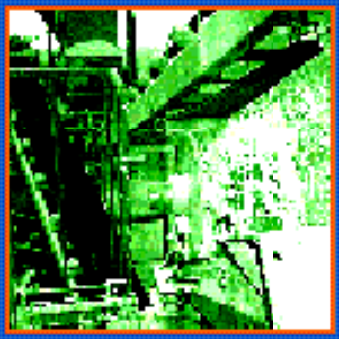
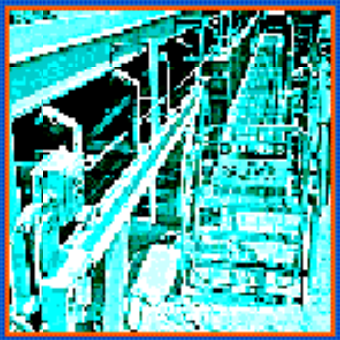
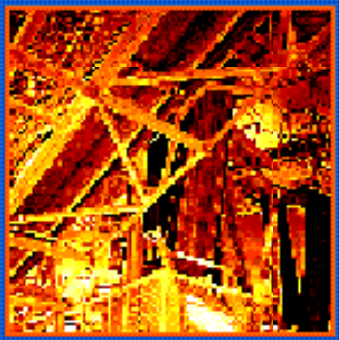
Mining & Quarrying

A Guide to Conveyor Safety







Mining & Quarrying Occupational Health & Safety Committee

Mining & Quarrying
OCCUPATIONAL HEALTH & SAFETY COMMITTEE

A Guide to
Conveyor Safety

Mining & Quarrying Occupational Health & Safety Committee

WorkCover
CORPORATION

April 2000

Contents

Disclaimer

Information provided in this publication is designed to address the most commonly raised issues in the workplace relevant to South Australian legislation such as the Occupational Health Safety and Welfare Act 1986 and the Workers Rehabilitation and Compensation Act 1986. They are not intended as a replacement for the legislation. In particular, WorkCover Corporation, its agents, officers and employees :

* make no representations, express or implied, as to the accuracy of the information and data contained in the publication,
* accept no liability for any use of the said information or reliance placed on it, and make no representations, either expressed or implied, as to the suitability of the said information for any particular purpose.

ISBN Number: 0 9585938 4 1

Foreword

Safety is a much talked about issue throughout the mining and quarrying industry and there isn't anyone about who would say that their quarry is unsafe. But the fact of the matter is, we still experienced 323 incidents in the 1998/99 financial year, as well as some **10 fatalities between 1989 &1999**. And that is in South Australia alone. Obviously, there is a lot more that we can still do.

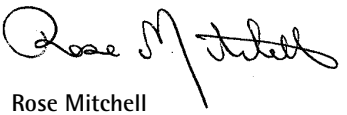
There are a number of reasons for running a safe operation and it's a lot more than just doing it because it's the right thing to do. Firstly, it's good business practice. At an average cost of approximately $33,000 per injury, it doesn't take many incidents to put a dent in your bottom line. And this doesn't take into account your production downtime or the hidden costs of having low worker morale and having to find replacements for your injured people.

Secondly, how much do you really value your people or your workmates? Good safety practice is a very visible way of showing that you do value the people you work with, and you **will** be rewarded by a workplace that's not only safer but more productive as well.

Thirdly, it's the law. There are some pretty tough penalties for companies and individuals who breach their duty of care when it comes to safety, and these penalties can extend to jail sentences.

So please use this manual to help make your operation safer. The hazards identified in this manual are ones that only cause an accident once in a while, but when it does happen, it will most likely be a big one. They are the kinds of hazards that you've probably walked past every day for the last 5 years without having a second thought. But think, how much consolation will that be to a child when you're explaining why their parent won't be coming home again.

Safe mining.



Rose Mitchell
Presiding Officer
Mining & Quarrying Occupational Health and Safety Committee.

Introduction

As quarrying is essentially the process of moving product, most quarries inevitably have some form of conveying system as conveyors are a very efficient way of moving material. To move large amounts of material requires a lot of energy, and it is this energy which makes conveyors one of the most dangerous items of plant in a quarry.

Typically, people do not spend much time around conveyors. Most of the work done around conveyors involves inspections, cleaning up or maintenance. Generally this work occurs infrequently and the belt is (usually) turned off when it does occur. Also, walkways next to conveyors are used to access crushing and screening plants.

As a result, accidents don't often occur around conveyor belts. However, because of the energy associated with conveyor belts, when an accident does occur, it is likely to be major, resulting in a fatality or very serious injuries.

There are many different hazards that exist around conveyor belts (for example dust, noise, rotating/moving parts) . This manual will only focus on the risk of becoming tangled with moving parts. It will explain what you are obliged to do by law and give you a few hints on how you can make your plant safe and achieve compliance, while still keeping your plant practical.

What the Law requires

The Occupational Health Safety and Welfare Act 1986 places an obligation of a "general duty of care" by an employer to its employees. "General duty of care" includes the observance of approved codes of practice, of which Australian Standard AS 1755 is the code relevant to conveyor operation. It can essentially be summarised into two key areas:

Provision of Appropriate Guarding:

Australian Standard AS 1755 states that "Guards shall be designed to prevent injury to persons and shall be provided at every dangerous part of a conveyor normally accessible to personnel."

The term "designed to prevent injury to persons" should be understood as making a guard that makes it physically impossible it for a person to access the dangerous part. This means that people shouldn't be able to put their hands or fingers through it, put their arms around, over or under it to reach the dangerous part of the conveyor.

The term "accessible" basically means any item of conveyor plant which is less than 2.5 metres above the ground or from any walkway.

Provision of emergency stop controls :

Legislation requires that all conveyors be fitted with emergency stop controls, these being:

Lanyards or Pullwires:

For accessible conveyors (less than 2.5 metres above the ground or from any walkway), lanyards should be used in preference to emergency stop buttons. Lanyards should be supported every 4.5m and cause the conveyor to stop in the event of their being pulled in any direction, breaking, slackening or removal

Emergency Stop Buttons:

If the conveyor is accessible (less than 2.5m above the ground or walkway), in the absence of a lanyard an emergency stop button must be located every 30m. Emergency Stop buttons should be:

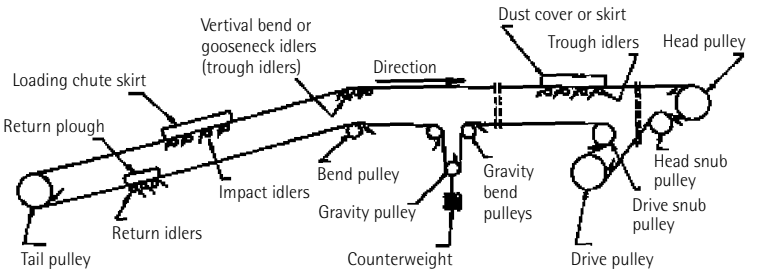
* Red
* Prominently marked
* Readily accessible
* Mushroom head latch in or lock in with manual reset.

For conveyors higher than 2.5m above the ground or any walkway (inaccessible to persons) an emergency stop button must be located every 100m.

Note: **The use of lanyards or emergency stop buttons is not a substitute for and does not reduce your obligation to provide physical guarding!**

Major Conveyor Hazards

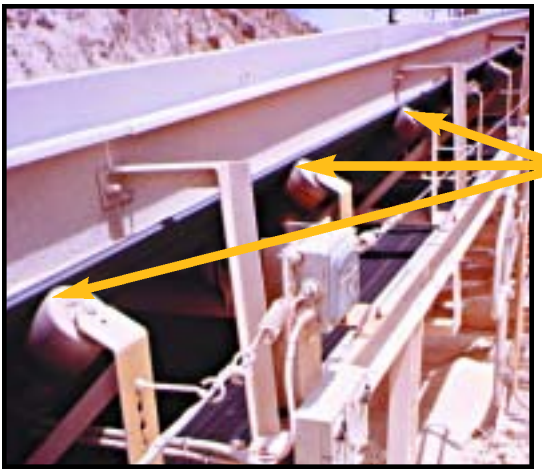
Dangerous parts of conveyor can include (but are not limited) to the following items:



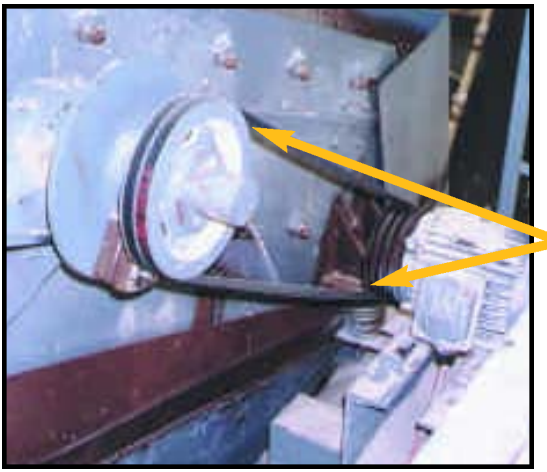
Reproduced by kind permission of Standards Australia. Full text of the Standards AS 1755-1986, *Conveyors – Design, construction, installation and operation – Safety requirements*, can be obtained from Standards Australia

Tail Drum and Head Drum Arrangements

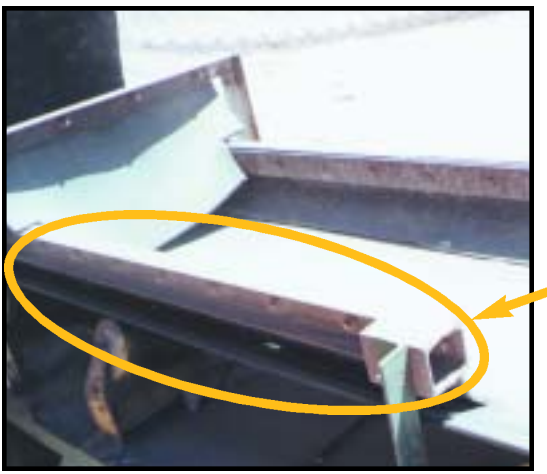
Any section of the belt where there are exposed idlers in combination with skirts



Any belt drive arrangement



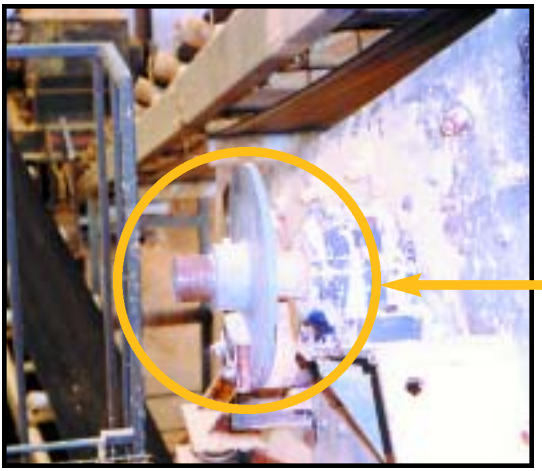
Any skirting or scraper arrangements



Any belt takeup or tensioning devices

Nip point

Any exposed drive shafts



Exposed shaft around which long hair or loose clothing can easily be tangled with.

Making your conveyor safe

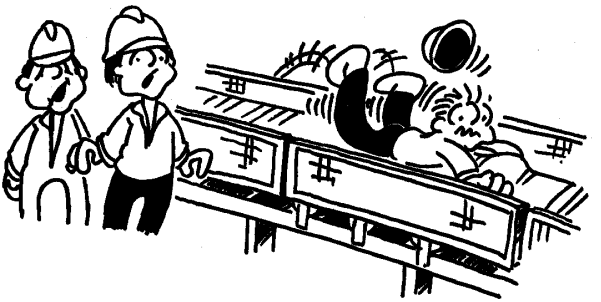
There is a combination of things that should be done in order to eliminate the hazard associated with moving parts on conveyors. They can be loosely classified into 2 categories: direct physical guarding and indirect methods such as procedures, training, signage, and so on.

Direct Physical Guarding

A physical barrier is your first line of defence against a conveyor accident and is the most effective means of protection from dangerous points on conveyors. It is a means of physically preventing access to dangerous areas, and is also a requirement by law. There are 3 key points that should always be considered when designing and fitting guards:

(1) The guards must actually make access to the nip point physically impossible (see Appendix 1)

This means that people shouldn't be able to put their hands or fingers (depending on clearance) through it, put their arms around, over or under it, or lean over it to reach the dangerous part of the conveyor (even if they try!). **Remember, hand rails are not guards!**



MAYBE BIGGER CONVEYOR GUARDS WOULD BE BETTER...

(2) The guard must not impede the operation of the plant:

If the guard makes maintenance and housekeeping difficult, or restricts general thoroughfare and access , it is likely that it will be taken out at some later stage or not replaced after maintenance.

(3) The guard itself must not create a new manual handling risk:

Care must be taken during the design of the guards to ensure that that they are not too heavy or awkward to create a hazard each time they need to be lifted or moved. Ideally, every guard should be designed to be self supporting if possible.

Types of Guarding and Where to use Them

Where Regular Access to or past Nip Points is not Required

Specifically for situations where:

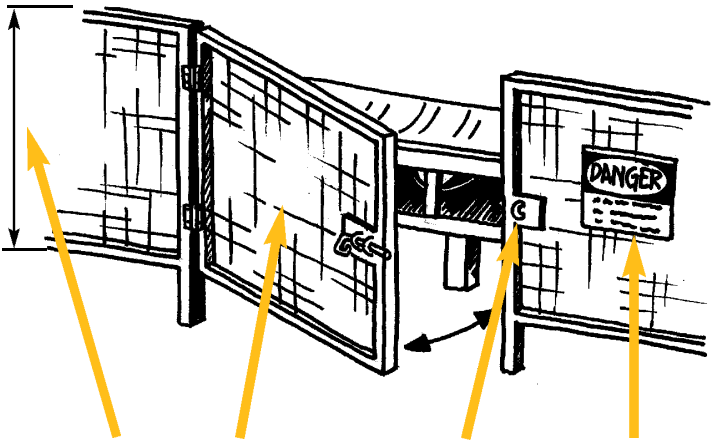
- the belt does not run alongside an access to another part of the plant, and
- if maintenance of, or housekeeping around, the belt is only required to be undertaken when the belt is not operating and isolated.

Gates (and fencing) are a very simple and effective option to use. To be successful, the following key points need to be considered:

- Gate dimensions are such that people cannot reach in over the top or reach in from underneath. The distance of the gate from the belt should be as far away as practical and determines the size of the mesh in the gate or fence. (see diagram)
- The gate has an interlock mechanism to turn off the belt once it is opened or conversely for smaller operations be padlocked shut (with an isolation procedure in place). Interlock mechanisms can be susceptible to dust , so you must judge your own individual situation. If using padlocks, the only keys should be held by the manager or senior supervisor, and the stop controls for the belt should be outside of the restricted area.
- Correct signage indicating the conditions under which you are allowed to pass through the gates is used.

Things to watch out for with this type of arrangement:

- Gates can be left open or not secured
- Interlocks can be overidden or not maintained
- Cannot be used solely for tail drum protection



Gate dimensions so that people can't reach over the top or slide underneath to reach conveyor

Mesh size correctly so people can't climb

Padlock or interlock mechanism (see Appendix 3)

Appropriate danger signs (for example: no entry while plant is running)

Note: locks on both gates

Some examples of gates restricting access to whole sections of plant

Where Regular Access to or past Nip Points is Required

In many situations, regular access is required to, or past nip points. For installation of guards in these cases the key points that need to be considered are:

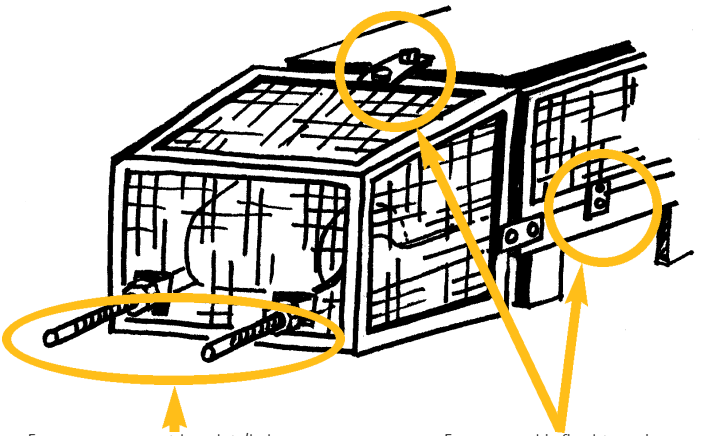
- No physical access can be available to the nip point. As these guards can be very close to the nip point, care must be taken to ensure that the mesh is small enough to disallow fingers or hands to reach the nip point.
- Practicality - The guard should be light enough to be handled by one person and easy to install or remove for maintenance. Where possible, a self supporting guard should be used to eliminate any manual handling hazard.
- Must require some type of tool for removal.
- Must have signage saying that drive must be isolated prior to removal.

People will sometimes try to reach through, over, around or under guards to avoid stopping the belt for a quick job. Guards should be built such that this is not possible to do! (See appendix 1)

Tail & Head Drum Guards:

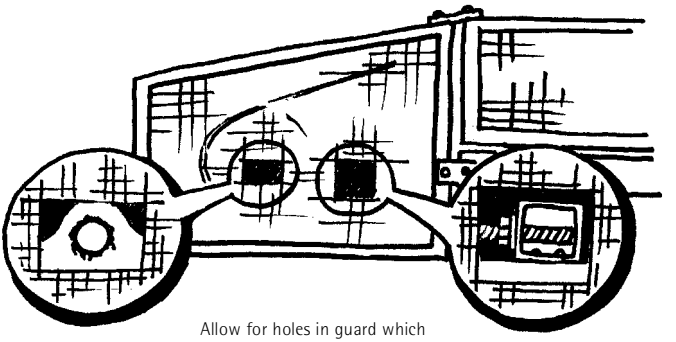
Tail and head drums are one of the most hazardous sections of a conveyor with access being required occasionally for lubrication, belt alignment, spillage cleanup and condition monitoring. Key issues to watch out for with tail drum guards are:

- guards must be designed so that belt alignment can be done with guards on
- guards must allow for ease of cleaning around pulley
- lubrication points should be accessible with the guard on (for example use tubing)
- Tail drum nip point must be physically impossible to reach!



Ensure arrangement has slots/holes cut out for drum adjustment. Watch out that the slots aren't to big to allow access to the drum, and don't forget the trip hazard created by the protruding threads!

Ensure guard is fixed to main conveyor framework. Configure to your situation.



Allow for holes in guard which provide access for lubrication and drum adjustment. Make sure that it is not possible to reach the nip point through these holes!

- In some cases with old plant it may not possible to repair, adjust or track the belt while it's operating with normal guarding in place. In these cases, it is important that such work is carried out by an authorised competent person with an attendant at the emergency stop station, and that an appropriate safe work procedure is in place.

Don't forget to use warning signs around all conveyor guards!

Idler and skirt guards:

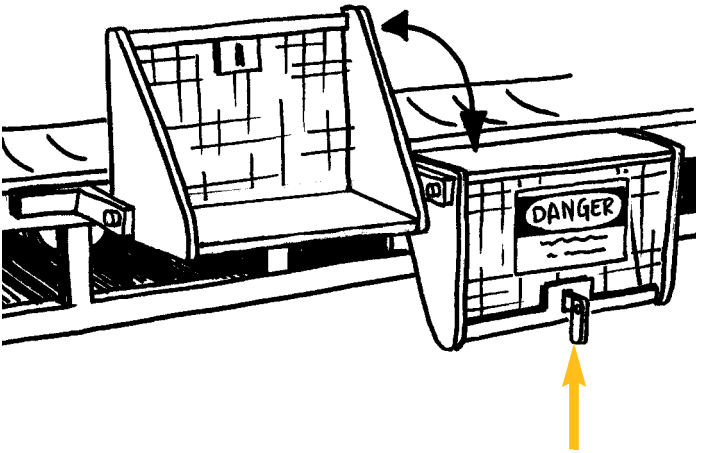
There are a number of different types of guards which can equally offer good protection. It is recommended you choose the hinged type guards if possible, as they avoid the manual handling issues and ongoing hassles that bolt on guards incur after the initial installation.

Type 1:

Simple, easy to use idler guard. Incorporates hinges so that one person can take down and a locking device. Locking device can be attached to any vertical member, and doesn't have to be in the middle of the guard. Once unlocked, the guard hinges down to allow easy access for maintenance or cleaning.

Type 2:

Hinged guard which swings up rather than down. Good in situations where there is a lot of horizontal steelwork and not many uprights. Use same hinges and locking mechanisms as for the Type 1 guard.



Locking mechanism at most convenient place

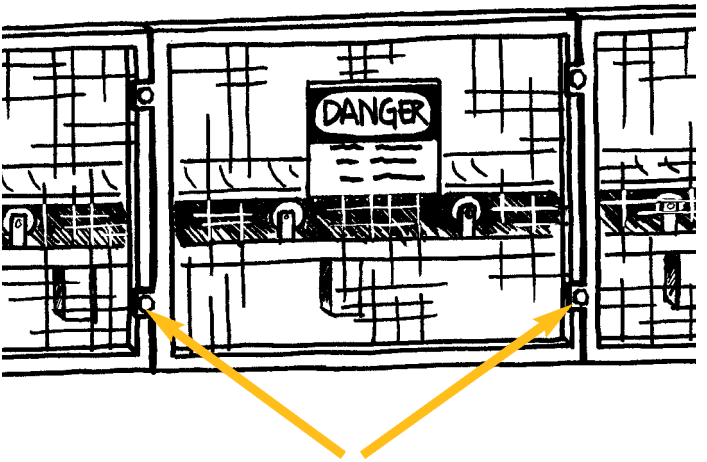
Type3:

Standard bolted guards are by far the simplest of guards and most commonly used, with the guard being bolted to the most convenient piece of steelwork.

Watch out:

(a) that you don't build the guard too big for one person to remove and install easily

(b) that the bolts don't get covered with dust and have to be cut off when needed to be used. It's very easy for guards not to be replaced when this happens.



Bolts attached to most convenient steelwork

Upright swinging hinged guard

Example of a hinged guard which swings downwards

Return idler guards:

Special care must be taken to ensure full coverage of roller and that ease of cleaning is considered. Particularly necessary where access underneath belt is required (Note: where access under belts is required, an appropriate canopy should also be in place to protect from falling objects).

Commonly used return idler guard. Inclusion of locking device and hinge allows for easier cleaning. Concept can be extended to cover more than one set of return idlers.

Belt Drive guards:

Some examples of typical belt drive guard arrangements

There are many different types of arrangements that can be satisfactorily used as long as:

- enclosure of the belt drive is complete (this includes the back of the belt drive)
- the mesh is small enough to ensure that people can't accidentally access the belt drive

Indirect Safety Measures

Physical guarding is the best means for increasing the safety around your conveyors, but there are a number of measures which should also be taken to complement guarding and act as another means of preventing a conveyor incident. While they cannot be used as the sole means of protection, they will play a large role in raising awareness and increasing safety around your conveyors. These measures are discussed below.

Training & Inductions

Training (and retraining) is important for all staff, but it is especially critical that people like contractors, casuals, new starters, visitors and anyone else who will be exposed to conveying plant be fully briefed and familiar with the following key points:

Awareness of no entry areas

People must be aware of where they can go or can't go, and this must be reinforced by correct signage and barriers.

Awareness of correct safety apparel

It must be made clear what items are mandatory (eg hardhat, steel capped boots, glasses, dustmasks, earplugs etc) and where they are to be worn. The type of clothing and hair requirements should also be included here.

Awareness of emergency stop mechanisms

All personnel should be made fully aware of the location of emergency stop mechanisms (such as lanyards and stop buttons) and how to operate them in case of an emergency. Personnel should also be aware that emergency stop mechanisms should not be used for isolating belts!

Awareness of basic conveyor procedures

Of course that new bloke will be alright ... only an idiot would put their hand near a conveyor while it's running!

Basic conveyor protocol should be reinforced(for example don't take off the guard when the belt is running, isolate the belt before cleaning or maintenance, no riding on the belt and so on).

Procedures & Standards

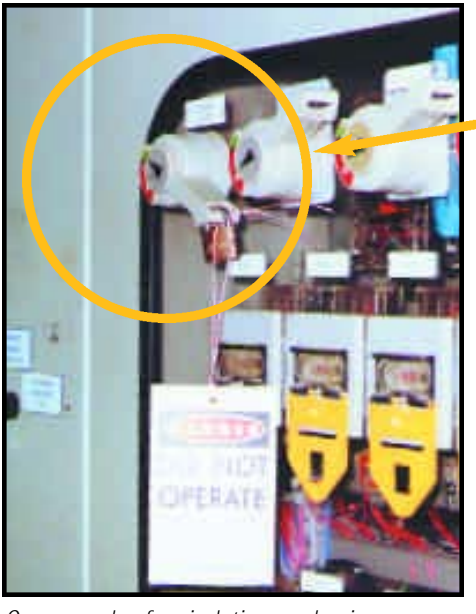
Procedures and standards help provide a safe system of work and remove the heavy reliance on the use of common sense (which tends to be very uncommon). They let everyone know how a job should be done and allow you to maintain your operation at a standard that you set, regardless of the people that you have working for you at the time. Typical procedures and standards which are particularly relevant to conveyor safety are:

Isolation procedures

Crucial for any work on or close to conveyors that requires guards to be removed before it can be carried out. Four key points that should be included are:

- The system is locked out at a point where is not possible to override and start the system from another point. The individual lockouts should not be able to be physically removed except by the person who put it on. **Under no circumstances should emergency stop mechanisms be used for the purpose of equipment isolation.**

- Everyone who is going to work in the "danger zone" must have their individual lockout mechanisms at the lockout point.
- Nobody is to remove anyone else's lockout. Each individual is responsible for removing their tag and their tag only. (The site should have a system in place to allow a senior manager to remove the lockout provided they are totally satisfied that the individual cannot be exposed to any danger as a result). This will allow the site to manage the situation where a person goes home and forgets to remove their tag.
- Verification of isolation must occur prior to commencing work to ensure that the correct plant has been isolated.



Pad lock and danger tag on main isolating switch which makes it physically impossible to energise the equipment unless padlock is removed. The person who has the keys is the one who is doing the work requiring the isolation.

One example of an isolating mechanism

Housekeeping Standards

Tools, rocks or rubbish lying around can lead to trip hazards, fires, conveyor damage and so on. Maintaining good housekeeping standards involves:

- Any rubbish (rags, tramp metal and so on) that is deposited around a conveyor system is to be cleaned up immediately.
- Any spillage should be cleaned up as soon as is practicable. (This could be at the end of a shift after crushing and conveying is finished of during a maintenance period when the conveyors aren't running)
- All tools required for maintenance should have racks or holders etc, so that they are not lying around on walkways or leaning loosely against handrails.

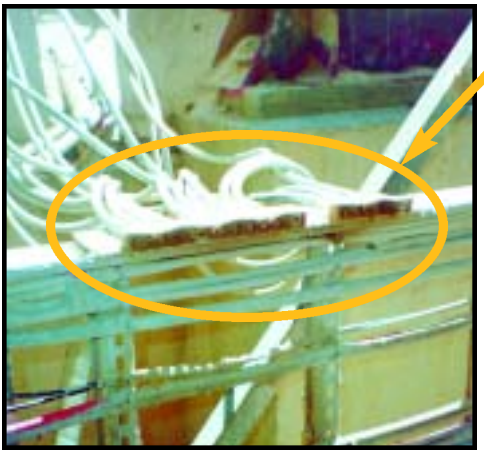
Storage shelves near a conveying area.

Cleaning around belts

Unless nip points are completely guarded and inaccessible, no cleaning is to be undertaken under or in the close proximity of belts unless the belt is turned off and isolated.

Lubrication

Lubrication points should always be positioned outside the guards and be remote to the nip points with the use of tubes. If this is not possible, then the belt should be isolated during any lubrication activities.



Remote lubrication points situated in a safe position on the plant

A final word on standards and procedures:

If you're going to have standards you must be prepared to enforce them. Remember, the minimum standard that is set is the highest standard most people will work to.

Signage

Correct signage plays a big role in the overall safety of the plant. In some cases it may be compulsory and serves to act as a last warning against hazards for people who are unfamiliar with them.

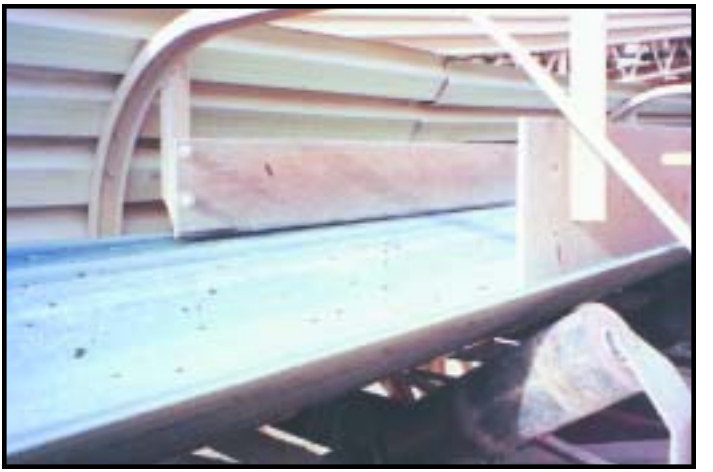
Signs should be used in any area where people could be exposed to hazards, or in situations where somebody could do something to create a hazardous situation. Typical situations include:

- to restrict access – no entry past this point
- to indicate areas where correct safety apparel is compulsory – hard hat and glasses must be worn beyond this point
- to remind of something that needs to be done before another action is carried out – Warning: isolate belt before removing guards.

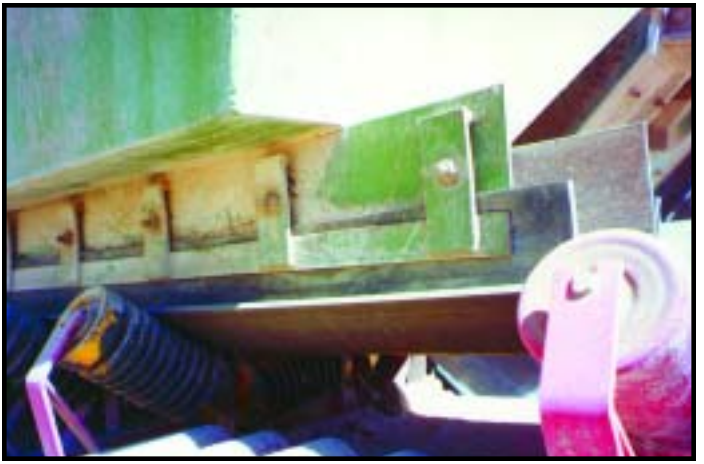
Note: Care must be taken when placing signs to ensure that they are relevant for the area and do not contradict each other.

Skirts

The use of skirts plays no direct role in increasing the overall safety of a system (in fact each set of skirts introduces additional nip points!), but the correct use and maintenance of skirts and scrapers will eliminate spillage, the source of many conveyor incidents. Spillage around tail drums, mud building up on idlers and so on often require guards to be taken off so that the spillage can be cleaned up. It is in these situations where if the job is a quick one, the temptation to not go through the correct procedure and isolate the belt is high. Accordingly, the use of good skirts and scrapers will reduce how often you will need to clean up around the belt, and this fact alone will reduce the exposure of people to the belt and hence make it safer.



Different types of skirt arrangements (shown with guards removed). Note the use of a steel plate to secure the rubber flap in the photo on opposite page, which allows easy replacement when worn.



A commonly used arrangement (with guards removed). The use of bolts to secure the rubber skirts is effective, but makes for an awkward job when the flap needs to be replaced.

For More Information refer to:

Australian Standards AS 1755 -
Conveyor Design, Construction, Installation and Operation - Safety Requirements

Australian Standards AS 4024.1 -
Safeguarding of Machinery - Part 1 - General Principles

Occupational Health, Safety & Welfare Act - 1986

or contact:

Mining and Quarrying Occupational Health and Safety Committee (MAQOHSC)

Telephone: (08) 8 238 5791 or (08) 8233 2002
Facsimile: (08) 8233 2223

Group Health and Safety Services (GHSS)

Telephone: (08) 8379 9711
Facsimile: (08) 8379 1142

Workplace Services - Department of Administrative and Information Services (DAIS)

Telephone: (08) 8303 0257
Facsimile: (08) 8303 0255

Acknowledgments

Special thanks to the following groups for their patience with site visits, editing & provision of information without which this document would not have been possible:

Rocla Quarry Products - Staff at Maslins Beach Sand Quarry, **Boral** - Staff at Stonyfell and Linwood Quarries, **Southern Quarries** - Staff at Selleck's Hill Quarry, **Penrice Soda Products** - Staff at Angaston Quarry, **Pioneer** - Staff at WhiteRock Quarry , Magill, Staff at **Rosedale Quarry** - Barossa Valley, **Commercial Minerals** - Staff at Gilman Operations, **Mount Isa Mines Holdings** - Staff at Mount Isa Mines Operations, **BHP** - Staff at Ardrossan Dolomite Quarry, Staff at **Workplace Services** - **Department of Administrative and Information Services**, Members of the **Hazard Management Committee**, Staff at **Workcover Corporation** , Staff at the **South Australian Chamber of Mines and Energy**, **CSR** - Staff at Riverview Quarry, **Martin Art**, Staff at **Blackwood and Sons**, **Laurie Mason and Associates**, Staff at **Fortress Systems, WMC Resources Ltd –** Staff at **Olympic Dam Operations.**

Appendix 1

Reach & other key dimensions (as per AS 1755)

Minimum distance above floor before guarding of nip points is not required:	**2500 mm**
Minimum distance of guard from danger point if mesh opening is up to and including 9mm:	**Working clearance only**
Minimum distance of guard from danger point if mesh opening is above 9mm up to 50mm square:	**150 mm**
Minimum distance of guard from danger point if it is possible to get wrist through the mesh or guard:	**280mm**
Minimum distance of guard from danger point if it is possible to get elbow through the mesh or guard:	**500mm**
Minimum distance of guard from danger point if it is possible to get entire arm through the mesh or guard:	**1000mm**

Maximum distance of underside of guard from the floor (in the case of gates, fences or guards providing protection from floor level):	**250mm**
Maximum size of mesh (in the case of gates or fences):	**50mm²**
Minimum height of fencing:	**1600mm**

Emergency Stop Locations

Maximum distance between emergency stop locations if conveyor is accessible:	**30m**
Maximum distance between emergency stop locations if conveyor is inaccessible:	**100m**
Maximum distance between supports for lanyard emergency stop mechanism:	**4.5m**

Appendix 2

An example of a locking device used in some South Australian quarries

Picture in open position

Picture in Closed position

This particular fastening device utilises a slotted cam which can swivel in a 90° arc. A hinged gate or panel or guard with a hole in it can slide over the device when the tab is in the open position, and then be locked into place when the tab is swivelled. Any pressure or weight put on the device actually serves to further lock the device in place.

It typically needs to be loosened with a hammer or similar tool when it is locked into place, and has the added advantage that a padlock can be used with it for extra security. A version can be obtained with a fitted spring which will further improve its locking capabilities.

Appendix 3

An example of an interlock system

Trapped Key Interlock System for One Energy Source, and One Acess Point

H31S interlocked rotary switch
When key is in the H31S switch the power supply is on. Removing the key breaks contacts in the switch and isolates power. This key is taken to the H31 access interlock.

H31S access interlock mounted on access door
The key is inserted and turned in the H31CN access interlock, this allows the bolt to be removed and the door opened. Whilst the door is open the key remains trapped, ensuring that the key cannot be reinserted into the switch and the power restored. The sequence is reversed to restore power.