Sugar Mill Safety – Supplement to the Sugar Industry Code of Practice 2005

Workplace Health and Safety Queensland

Department of Justice and Attorney-General

Queensland Government

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Sugar Mill Safety – a supplement to the *Sugar Industry Code of Practice 2005*, made under the *Workplace Health and Safety Act 1995*.[1]

This document is a supplement to, and forms part of, the *Sugar Industry Code of Practice 2005* (the Code). It must be read in conjunction with the Code, and relevant workplace health and safety legislation.

What is this document about?

The purpose of the *Sugar Mill Safety* supplement is to give practical advice about ways to manage exposure to risks identified as typical in sugar milling operations. This document focuses on the risk assessment process through the development of hazard registers by mill operators. Hazard registers should include the hazards identified within this document.

Figure one outlines the hazard control method recommended by this document for sugar milling operations.

Sugar mill operators should ensure that hazards identified by this document, and other sugar milling and associated hazards, are controlled using a risk management approach. It is expected that mill operators will develop a hazard register based around this document, assess the risk involved with those hazards, implement controls, and monitor and review the systems implemented.

***NOTE*:** There may be additional risks at your workplace, which have not been specifically addressed in this document, or the *Sugar Industry Code of Practice*, including the *Cane Rail Safety supplement*. You are still required under the *Workplace Health and Safety Act 1995* to identify and assess these risks and ensure that control measures are implemented and reviewed to eliminate or minimise exposure to these risks.

[1] This document has been revised to conform with the *Workplace Health and Safety Act 1995* and the *Workplace Health and Safety Regulation 2008* as in force on 1 September 2008.

Contents

Part 1 Introduction

1.1 Who is this document intended for?

This document is a supplement to the *Sugar Industry Code of Practice 2005*, and forms part of that code. It is intended to be used by persons with an obligation under the *Workplace Health and Safety Act 1995*.

This document does not identify all hazards within a sugar milling environment and obligation holders should implement risk management systems which identify hazards and reduce associated risks by implementing appropriate controls. The management system should also have a method of monitoring and review, particularly after changes are made, so that the controls implemented for particular hazards remain effective.

Many hazards are common within sections of a sugar mill, such as the use of confined spaces or plant. Hazards that are addressed by this document are considered to be typical in a sugar milling environment and should be assessed by operators as part of the risk management process.

A range of example risk assessments for sugar manufacturing operations have been included in Appendices 9.3 to 9.7 in order to provide mill operators with guidance on the types of systems which can be implemented for sugar specific hazards.

This document should assist sugar mill operators to develop a hazard register for the sugar mill, assess the risks associated with those hazards, and implement appropriate controls.

1.2 How this document is organised

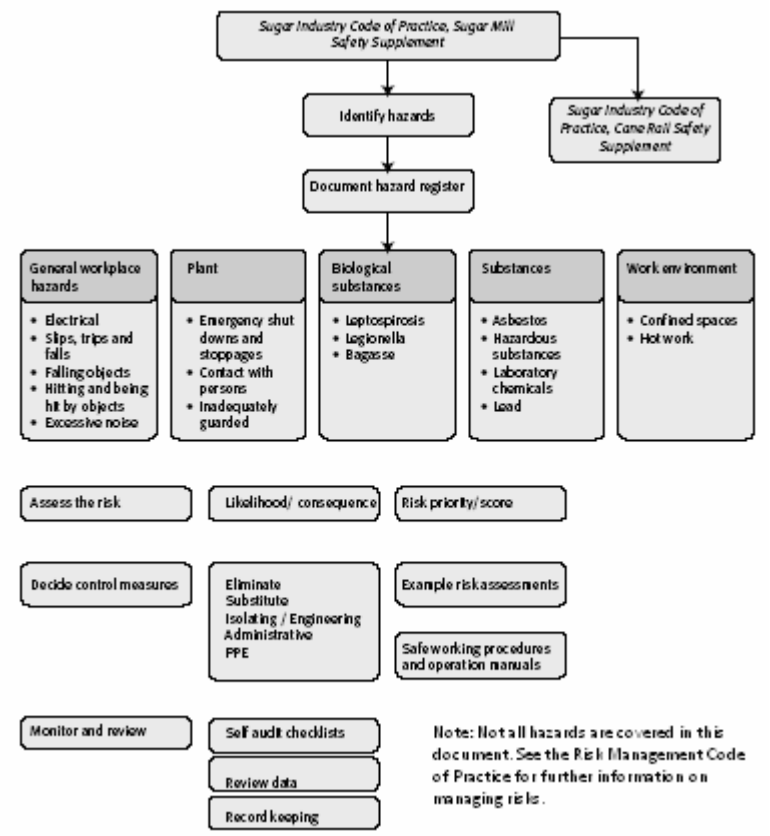
This code has been organised into the major hazard areas including general workplace hazards; manual tasks; plant; substances; biological substances and work environment.

There is also a section on managing health and safety. Within the hazard specific sections the document is generally structured in a numbered format.

For example:

1 - The major heading i.e. Substances
The specific hazard
(such as Hazardous substances)
Possible control measures for the specific hazard.
(an outline of the issues which should be considered as control measures for the specific hazard)

Figure 1 Hazard register and controls



Part 2 Sugar manufacturing operations

A sugar mill is a large factory used to produce raw sugar and other products from sugar cane. Mills are made up of a range of industrial plant such as boilers, storage and processing vessels, crushing and hammer mills and a large range of maintenance equipment. Mills operate in two distinct modes, crushing and non-crushing, both of which introduce a range of specific and general hazards to employers, workers and others. In essence, a sugar mill can be broken into the following processes (see Figure 2 for a diagram that shows the sugar milling process).

2.1 Cane handling

Cane handling describes the methods used to move cane billets into the milling section of the process. Billets are transported and stored using items such as:
(a) cane railway bins
(b) road transport systems (such as multi-lifts and semi trailers)
(c) in field transporters.

The cane billets are then transferred into the milling system by:
(a) trans-loaders (such as from road to rail)
(b) tipplers (tipping cane bins into carriers)
(c) direct tip into the carrier (by infield transporters and road transport).

Rail transfer methods use large hydraulic systems to push or pull rakes of bins into the tippler which tips them onto a 'carrier' (a moving floor conveyor). Most mills have storage yards for excess bins. Tipplers are a rotary device which hold the rail bin in place and turn it 180 degrees to empty its contents into the main conveyor (carrier).

2.2 Milling

The milling process involves the initial breakdown of cane into its primary fibres by a large hammer mill (shredder). Shredders consist of a number of large hammers (usually around 12 kg in weight) attached to a rotor by swing rods which are then driven at around 1200 revolutions per minute (rpm) by mechanical means (either by steam turbine or electric motor). The billets are shredded by smashing them between the hammers and the grid bar (a hard set of plates on one side of the shredder) breaking them into individual strands of fibre. This fibre is then processed through a series of crushing mills to extract juice. Mill rollers exert huge forces on the shredded cane which is fed through them via a vertical chute. The pressure between the rollers is large enough to break down the cell structure of the fibres so that the sucrose can be extracted within the juice. Juice contains a large amount of water which is removed or reduced in subsequent processes. The remaining fibre is then burned in a boiler to produce steam which drives most mill processes in a typical factory.

Extraction of as much of the sucrose as possible is a key element in milling. Mills use a number of methods to aid sugar extraction which include the application of hot water (around 95˚ C) to the fibre within the mill set, a series of crushing mill sets (the milling train) and reapplication of mixed juice and water (maceration) throughout the milling process.

2.3 Clarification/evaporation

The clarification/evaporation stage executes a number of functions such as:
(a) mixed juice incubation
(b) adjusting PH by addition of lime
(c) heating
(d) addition of flocculant (a product which assists contaminants to subside)
(e) addition of anti-scale chemicals
(f) removal of mud and heavy contaminants
(g) reduction of water levels in the juice.

Heating is completed using shell and tube heaters that are normally either cylindrical units with multiple passes for juice in tubes surrounded by steam (allowing thermal transfer between the two products) or multi-path plate and frame commercial units that are smaller than conventional heaters and are constructed from pressed SS sheets separated by gasket material.

Lime and flocculant are usually added to the juice as a slurry. A subsider then removes heavy contaminants from the juice. Subsiding, the process of allowing heavy materials to sink or fall to the bottom, usually removes the majority of dirt and the chemical mud formed from the reaction between the phosphate in the juice and the added lime from juice. The mud is then spread across a moving filter (a rotary drum filter) and 'washed' to leech out any remaining sucrose before removal from the factory. Mill mud is a nutrient rich product which is normally returned to the field.

The effet stage consists of a number of evaporators (large kettles) in series that boil the juice to reduce the water content. Effets are constructed in a particular pattern using multiple effet evaporation. Vapour produced from each vessel is used to boil the juice in the subsequent vessel at a lower pressure making maximum use of the energy initially put into the first vessel as low pressure steam. The latter effets in the set are operated at a vacuum in order to reduce the boiling point. The final product from the effet stage is usually known as 'liquor' or 'syrup' and is a dark gold coloured liquid.

Dependent on juice properties heating surfaces within the effets and contact heaters are prone to contaminant build up (scale) which reduces heating efficiencies and after a period needs to be removed. Most factories use a chemical process to remove scale build up, normally by boiling caustic soda in the vessels or other chemical means such as sulphamic acid or rarely EDTA. On some occasions manual cleaning is required and is completed by blasting with high pressure water or mechanical brushing.

2.4 The pan stage

The pan stage is a similar process to the effects in that a pan boils off additional water. The main function of the pan stage is to produce sugar crystal from the liquor. In order to increase the speed of this process the pan stage operates in a manner which utilises 'seed crystal' and a combination of products with varying levels of sugar content to produce a range of crystal sizes and hence qualities. The pan stage has many storage tanks such as receivers (tanks which receive product from the pans), crystallisers (a series of tanks and stirrers which cool

the product from the pan stage resulting in additional crystal growth before fugaling) and large transfer pipes and valves.

2.5 The fugal stage

A fugal is a large electric centrifuge which spins up to 1200 revolutions per minute (rpm) dependent on its function and stage of operation (while filling batch fugals only turn at around 50 rpm). There are two types of centrifuge in use within sugar mills, high grade centrifuges (usually batch, but sometimes continuous) and low grade centrifuges which are continuous. Continuous fugals maintain a constant flow of product through them while batch fugals fill, operate and then discharge the final product. The fugal stage removes the remaining liquid product which surrounds the crystal, washes the crystal and delivers it into the final sugar system through a series of conveyors and a drier. The material removed during the centrifuge process is known as molasses and has a range of uses including sale as stock feed, fermentation for distillery production and as a component of cattle licks.

2.6 Final sugar

Finally, the sugar crystal is dried and moved to large storage bins awaiting transport to sugar terminals or other areas (such as refineries). Driers are large cylinders which are fluted and rotate to pass the crystal through at an even rate whilst dry air is applied via ducted fans or large air conditioners. Moisture levels and sucrose purity are important measures for sugar quality. Storage bins hold large amounts of raw sugar and the conveyor system supplying them can be directed into different bins dependent on the product type. Low moisture levels in final sugar product and atmospheric conditions can create a risk of sugar dust explosion. Sugar dust explosions are rare, however, they have caused significant damage and loss of life in sugar mills overseas.

2.7 Energy supply systems

Mills are usually powered by steam and subsidised by electrical devices, however in recent years a number of factories are moving to predominantly electric powered equipment. A standard sugar mill will still include equipment such as suspension or multiple fuel boilers, steam turbines, electrical generators and all of the associated distribution equipment for electric and steam power. A range of equipment is associated with steam and electric energy including transformers, high and low voltage distribution systems, protection devices such as circuit breakers, steam relief valves, expansion joints and water traps.

Mills also have extensive air distribution systems supplying general and instrument air.

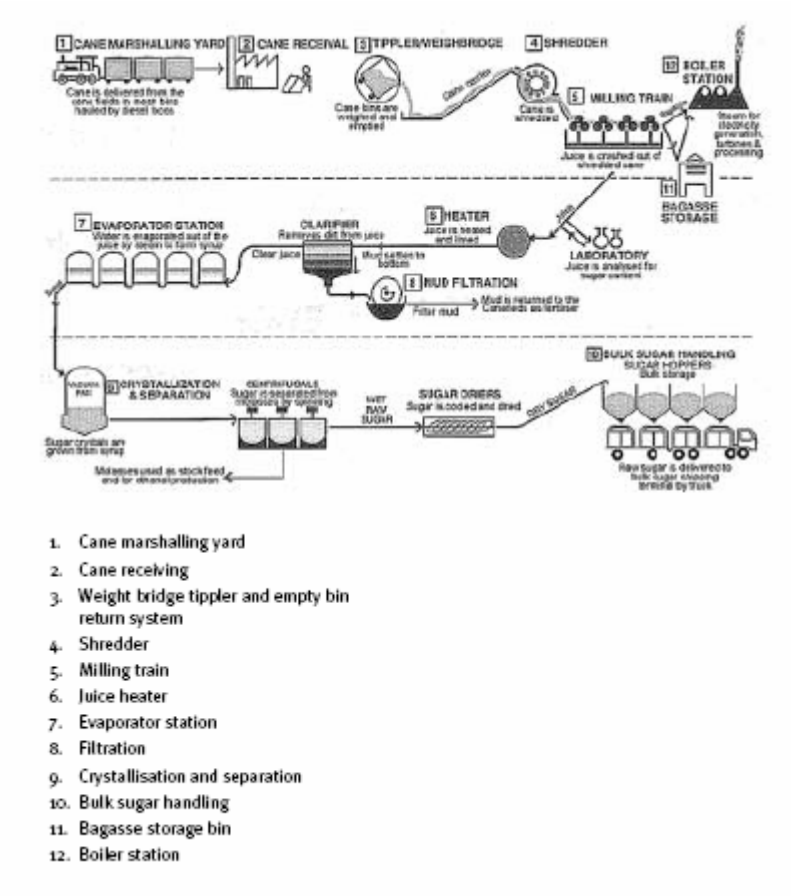
2.8 Associated operations

A range of facilities associated with sugar production are located on site including:

(a) laboratory and associated processes
(b) packaging lines
(c) engineering workshops covering areas such as rolling stock repair, general engineering and fabrication, and electrical
(d) administration areas

(e) molasses storage and distribution systems
(f) water supply and effluent systems
(g) mud, ash, bagasse and other by-product handling and storage.

Figure 2 The sugar milling process



1. Cane marshalling yard
2. Cane receiving
3. Weight bridge tippler and empty bin return system
4. Shredder
5. Milling train
6. Juice heater
7. Evaporator station
8. Filtration
9. Crystallisation and separation
10. Bulk sugar handling
11. Bagasse storage bin
12. Boiler station

Part 3 Managing health and safety

As outlined previously, the intent of this document is to identify industry specific hazards, suggest possible controls, and provide examples on the risk management process which mill operators could adopt to assess and control risks specific to their operation. It is expected that mill operators would develop a hazard register as outlined in the *Risk Management Code of Practice*, assess the risks in their operation, implement controls and monitor and review the systems implemented to control those risks.

When managing health and safety in sugar mills, operators should consider the following issues as key components of the management system:
(a) hazard registers
(b) risk management
(c) consultation
(d) training
(e) emergency procedures.

Further details on these issues are provided in the following sections, and in the *Sugar Industry Code of Practice 2005*.

3.1 Hazard registers

The *Risk Management Code of Practice* recommends the development of a hazard register or list for all hazards at a workplace. Hazards can be classified under the following areas:
(a) general workplace hazards
(b) plant
(c) biological substances
(d) substances
(e) work environment.

A number of hazards typical to the sugar milling process have been classified into these areas in the following sections and a range of possible controls suggested for each hazard. There is also a section on general workplace hazards and possible control measures. As each mill operates differently it is necessary for each mill to assess the risk of identified hazards so that the most appropriate controls can be implemented within that operation. A number of example risk assessments have been included in the appendices to provide guidance on this process.

3.2 Emergency procedures

A number of emergency situations may arise within sugar milling operations including but not limited to:
(a) fire and or explosion
(b) rescue from heights
(c) rescue from confined spaces
(d) chemical spills
(e) natural disasters
(f) bomb threats.

Mill operators should ensure that appropriate, adequate and effective emergency response procedures are planned, distributed, understood and rehearsed so that in the event of an accident or emergency, people are prepared.

In some instances hazards which create emergency situations such as natural disasters cannot be controlled. However, the hazards associated with these events can be managed. Sugar mill operators should implement processes which enable:
(a) the notification of incidents to emergency services
(b) identification of the location of the incident site by emergency and other services and the provision of clear instructions and information
(c) the provision of basic first aid
(d) a first response system for dealing with emergency situations
(e) a method of instigating and controlling a site evacuation.

These procedures should be implemented in a manner which allows the emergency system to successfully operate regardless of the status of the factory (e.g. when the mill is operational, non-operational, on continuous shift roster or on a five day roster). Consideration should also be given to other operational factors such as the general availability of personnel because of sick leave and annual leave.

3.3 Housekeeping

Housekeeping is an important part of maintaining a system aimed to reduce or eliminate risk in the workplace. Workers, supervisors and managers all have roles to play in maintaining the required housekeeping standards in their work area and in all their activities. Training designed to encourage awareness of the importance of housekeeping, using systems set up at each site, should be included in induction programs. Additional training may be provided as appropriate.

Key methods for maintaining good housekeeping include:
(a) allocate responsibility for housekeeping for particular areas to teams or individuals
(b) regular housekeeping inspections and records
(c) process for corrective action for identified hazards based on risk management practices
(d) barricading areas where spills have created a health and safety hazard. The barricade should be of a standard which will contain the spill and restrict access to the area.

3.4 Workplace inspections

Regular workplace inspections can play a significant prevention role by identifying health and safety issues before they result in injury or damage at the workplace. Inspection programs should be undertaken by all mill personnel at various times. Workplace inspections are a key element in monitoring the health and safety standards of contractor activities

Copies of inspection reports should be available for review and discussed at workplace health and safety committees meetings. A documented process should be used to control hazards identified during workplace inspections which is based on the risk management process. Inspections should be conducted in conjunction with a representative of the area which is being inspected to enable discussion and resolution of minor issues as they are identified.

The frequency of inspections will depend on the nature and circumstances of the area being inspected. Issues such as the level of risk and extent of control that the mill has over the workplace (e.g. remote locations) will influence the frequency of inspections. The mill operator should establish an inspection schedule allocating responsibility to appropriate persons for completion of the inspections.

3.5 Safety signs

Safety signs are a recognised method of identifying hazards within a workplace and consist of signs, symbolic signs, markings and colour. Signs have a range of applications but should be considered an administrative control only. This section covers the issues associated with the identification of hazards by means of signage with an aim to ensure known hazards are identified by means of signs, markings or colour and that all personnel are familiar with the meaning of safety signs and markings.

The use of appropriate signage will be determined from the risk assessment process. Signage should only be used in conjunction with other control measures. Mill operators should be aware of the language capabilities of employees and signage in other languages or symbols only may be required.

Hazards which can be identified by signage include:
(a) physical hazards should be identified by means of colour, in accordance with *AS 1318 Use of colour for the marking of physical hazards and the identification of certain equipment in industry (known as the SAA Industrial Safety Colour Code)*
(b) confined spaces should be marked as required by *AS/NZS 2865 Safe working in a confined space*
(c) underground services (pipes and cables) should be marked by means of the appropriate marking tape in accordance with *AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)*
(d) pipes, conduits and ducts should be identified in accordance with *AS 1345 Identification of the contents of pipes, conduits and ducts*.

Safety signs in accordance with *AS 1319 Safety signs for the occupational environment* should be installed where required.

Part 4 General workplace hazards

4.1 Electrical

The *Electrical Safety Act 2002* (ES Act) and *Electrical Safety Regulation 2002* (ES Regulation) prescribe ways to control the risks associated with electricity for employers, workers, licensed electrical workers and others.

The ES Act outlines general electrical safety obligations. The ES Regulation states the allowable distance for working near a live electrical part. The following Codes of Practice give practical advice on safe systems of work and exclusion zones.
(a) Working Near Exposed Live Parts

(b) Works (Protective earthing, underground cable systems and maintenance of supporting structures for powerlines)
(c) Electrical Work

Typical electrical risks within a sugar milling environment include:
(a) operation of plant around electrical lines and parts
(b) electrical work
(c) use electrical equipment
(d) failure of electrical equipment.

Overhead powerlines
Contact with overhead power lines can cause death. Even if you don't touch the power lines you are still in danger, as electricity can arc or jump gaps. Working near overhead electrical power lines is therefore a very dangerous activity unless the appropriate precautions are taken. The *Electrical Safety Regulation 2002* states that workers and equipment (e.g. hand held or powered tools or mobile work platforms) must stay outside the defined exclusion zones around overhead power lines.

An exclusion zone is a safety envelope which surrounds the power line and is designed to keep people out of harm's way and away from the risk of sustaining electrical injuries.

It is against the law to go inside your exclusion zone. You can, however, reduce your exclusion zone size by becoming an authorised or instructed person, but the exclusion zone itself is not eliminated unless the power lines are de-energised and/or isolated. These exclusion zones operate for the use of plant and equipment (including elevating work platforms).

The actual size of an exclusion zone depends upon the voltage of the lines, the competence/training level of the worker, and the way that the worker is accessing the work area. All the exclusion zone distances are listed in Appendix B of the code of practice for *Working Near Exposed Live Parts*.

For low voltage power lines (anything under 1000 volts) along a road, or a service line connecting a property to the power lines on a road, the exclusion zone is generally three metres. A smaller exclusion zone may be possible, but only after consultation with the local electricity supplier (e.g. Country Energy, Ergon Energy or Energex), and following the requirements of the electrical safety legislation, including the use of a trained and accredited worker or safety observer.

Exclusion zone distances for high voltage lines vary somewhat, but for high voltage lines attached to either wooden or concrete power poles, the exclusion zone is also generally three metres. Where power lines are on steel towers or large easements, the local electricity supplier should be contacted. Please check with your local electricity authority prior to working near powerlines.

If you expect that your work may cause a person and/or equipment part to come closer than the exclusion zone of overhead power lines, you must seek advice as to how to stay out of the exclusion zone. To do this you must give the local electricity supplier **written** notice that you intend to perform the work. They in turn, **must, within 7 days of receiving your notice**, provide you with a written 'safety advice' about the work.

You are not allowed to start work near the overhead power lines without this safety advice. Therefore it is critical that you assess the work requirements prior to arriving to do the work and take the necessary steps to minimise the risks involved with work near overhead power lines.

4.1.1 Control measures for electricity

Mill operators should ensure that safe systems of work are in place which enables the organisation to comply with the *Electrical Safety Act 2002* and *Electrical Safety Regulation 2002*. This may include:

(a) training
(b) work procedures
(c) authorised and instructed persons
(d) auditing.

There are a number of devices available that either assist in preventing contact with power lines or reduce the degree of risk in the event of contact. Such devices include:

(a) Ensuring work does not encroach into the exclusion zone - all work is to be conducted outside the exclusion zone.
(b) When using items of plant near powerlines (e.g. elevating work platforms) ensure there is a safety observer (or spotter) who's job is to watch the worker and their equipment and warn them if they begin to get close to their exclusion zone around the powerlines, and to keep people away from the area at ground level where falling items (e.g. branches etc) may land.
(c) Ensuring all injuries, electric shocks and near misses are reported to the employer. The employer is required to notify the local electricity supplier of certain electrical events.
(d) The use of 'tiger tails' on power lines which act as a visual aid that assists in preventing contact by highlighting the location of the power line. Only low voltage lines (under 1000 volts) can be continuously covered with tiger tails, which leaves the higher lines on power poles (usually at least 11,000 volts) exposed. **NOTE:** tiger tails do not insulate the wires and therefore the 'exclusion zone' must be maintained.
(e) Limiting or warning devices to assist in preventing objects entering the exclusion zone. If a limiting or warning device is used, the system should be designed to 'fail safe' or should at least meet category four reliability in accordance with *AS 4024.1 Safety of Machinery* or *EN 954-1 European Norm – Safety Related Parts of Control Systems*, and
(f) Allowing for sway and sag of the overhead lines (sway is usually caused by wind and sag occurs when the temperature of the line fluctuates).

The exclusion zones for Queensland Rail power lines and those of some power authorities may differ. It is the responsibility of the employer, person conducting a business or undertaking or person in control of the workplace to check with the person in control of the overhead electric line.

4.2 Slips trips and falls

Slips trips and falls are a cause of injury in most large workplaces and can be caused by poor design, damage and in particular, poor levels of, or incorrectly placed lighting.

Sugar manufacturing has some particular processes which may affect the risk of slips trips and falls for example, reactions between concrete and sugar products (sugar dust, molasses, or massecuite) which can damage floors and walkways.

Varying weather conditions can also create slippery conditions in sugar mills.

4.2.1 Possible control measures for slips, trips and falls

A range of control measures could be used to reduce the risks associated with slips, trips and falls, for example:
(a) regular housekeeping inspections
(b) maintenance (e.g. repair of leaking pipes, joints and vessels)
(c) adequate lighting
(d) barricading – short and long term
(e) loss of sugar product reduction programs (e.g. example dust, molasses, liquor and juice leaks)
(f) regular floor repairs
(g) replacement of flooring in susceptible areas with non concrete materials
(h) identification of hazards with appropriate markings (see AS 1318[2]).

4.3 Falling objects

Under the *Workplace Health and Safety Act 1995*, obligation holders including employers and persons conducting a business or undertaking have an obligation to ensure the health and safety of their workers and others in the conduct of their business or undertaking.

This obligation includes preventing or minimising exposure to the risk of death or injury to workers from falling objects.

Sugar mills are multi-level installations and have some structures which can be higher than 60 metres like chimney stacks. Operators should consider a range of issues when assessing the risk of injury from falling objects, including:
(a) the type of work being conducted
(b) what equipment is being used
(c) the number of people using the area below
(d) whether special provisions are required for specific work (e.g. hot work)
(e) how far an object might fall and what the object might be
(f) the consequences of being struck.

4.3.1 Possible control measures for falling objects

The following are examples of control measures that may be used to prevent or minimise exposure to the risk of being hit by falling objects:
(a) establishing exclusion zones to prevent unauthorised persons from accessing high risk areas (this can be done by using barricading)
(b) using catch nets or platforms
(c) using lanyards

[2] *AS1318 Use of colour for the marking of physical hazards and the identification of certain equipment in industry*.

(d) specifying pathways for workers and others
(e) using head protection (e.g. helmets).

Note: Helmets are a personal protective control measure only and guidance should be sought from the appropriate Australian Standard as to what level of protection they offer from falling objects.

4.4 Hitting and being hit by moving objects

Hitting and being hit by moving objects is a major hazard at sugar mills. This can be caused by:
(a) cluttered workplaces
(b) workers colliding with moving plant or equipment (e.g. rolling stock in a mill yard)
(c) lack of warning signs fitted at intersections
(d) doors opening into walkways
(e) plant not maintained in safe condition (e.g. unguarded or inadequately guarded machinery which generates flying objects such as splinters, metal fragments and dust)
(f) lack of appropriate personal protective equipment such as safety glasses to protect eyes from slivers of wood, metal, concrete or sparks
(g) lack of warning devices on moving plant and vehicles such as forklifts.

4.4.1 Possible control measures for hitting and being hit by moving objects

Mills which utilise cane railway delivery systems have large storage and delivery areas for both empty and full bins around the factory. In a typical factory, workers and others have to traverse the bins in order to enter the mill proper or surrounding locations exposing them to the risk of injury should the bins move unexpectedly.

The risk of injury from persons walking through rolling stock is eliminated if access is provided to work areas without the need to walk through bins in mill yards.

Preventing or minimising exposure to the risk of being hit by moving objects can be achieved through separation, for example:
(a) overhead walkways
(b) yard fencing
(c) underpasses
(d) exclusion zones.

Other possible control measures that can be used to minimise or prevent the risk of injury from hitting or being hit by moving objects include:
(a) providing training
(b) ensuring site rules are prepared and followed
(c) wearing high visibility garments
(d) ensuring machines are guarded to prevent flying objects from being produced, and if this cannot be achieved, then barriers installed to prevent them flying into the general work area
(e) fitting reversing lights and beepers to mobile vehicles

(f) clearing a designated walkway so that people and mobile plant/equipment are kept separate
(g) install mirrors and other warning devices at intersections.

Part 5 Plant

Under the *Workplace Health and Safety Act 1995*, designers, manufacturers and suppliers of plant must ensure that plant is accompanied by information about the safe use of the plant.

The *Plant Code of Practice* gives practical advice on ways to manage exposure to risks related to plant use including its safe design, manufacture and installation. It outlines the obligations of persons involved with plant and provides information on risks and their control.

The major hazards associated with plant involve being caught between, struck by or against plant. There is a large range of plant within sugar milling operations and this section identifies some plant hazards. This section also details some of the major control measures regarding plant which may be implemented to control risk.

5.1 Emergency shut downs and stoppages

Routine shut-downs and start-ups should usually be scheduled and planned so that the appropriate preparation can be made and precautions taken to minimise risk of injury to workers and damage to mill equipment. Examples of routine shut-downs include, but are not restricted to:
(a) routine planned maintenance
(b) wet weather shut-down
(c) maintenance day activities
(d) weekend shut-down if 5/6 day cycle.

Unscheduled shut-downs, as the name implies, usually require an emergency stop for immediate repair. They occur at any time while the factory is in normal production. There are two types of unscheduled shut-downs within sugar milling operations:
(a) type 1 – those that can occur from time to time as a consequence of for example, choked feed chutes and motors tripped on overload
(b) type 2 – those that are not expected to occur and are the result of a failure, for example, conveyor belt breakage or mechanical failure in an item of plant.

Other types of unscheduled shutdown due to failure that can occur at sugar mills include:
(a) water tubes failing in a boiler
(b) ruptured steam/hot juice pipes
(c) steam driven plant failure
(d) loss of external electricity supply
(e) motors or pumps failing
(f) hydraulic driven plant failures
(g) electrically driven plant failures.

Routine shut-downs and subsequent start-ups processes should be documented in standard work procedures. These procedures can be made available in a number of ways such as paper

based, as in a folder system or, on-line and printable from a maintenance management system.

Where modifications are planned as part of a scheduled shut-down, safe work procedures should be provided to ensure the appropriate person is fully aware of the modifications to be undertaken and the safe work practices to be used. This is particularly important while energy supply systems in the plant are live, for example, boilers, generators and air compressors. Operators should be instructed in any new procedures needed to operate and/or maintain modified equipment. Each safe work procedure should be signed off by a supervisor or the person in control of the work.

5.1.1 Possible control measures for emergency shutdowns and stoppages

For unscheduled and emergency shut-downs and start-ups, the supervisor and/or operator should conduct a risk assessment and take appropriate actions to minimise risks of injury to workers. Where appropriate, a safe work procedure (if not already available) and safe work permit should be issued for the repair of the particular plant including all the necessary precautions and hazard control measures arising from the risk assessment.

Following an emergency shut-down, if standard work procedures exist for the plant requiring repair, then these should apply. Where no standard work procedures exist for the repair of the plant and significant risks are identified, then safe work procedures should be developed and implemented prior to commencement of the task (e.g. via a safe work permit).

The process should include an appropriate safety inspection prior to start-up, to ensure that any incomplete work or hazards, resulting from the shut-down, are identified and risks eliminated or emergency shutdown minimised. Each safe work procedure should be signed off by a supervisor or the person in control of the work on completion of the job.

Management should ensure that all persons involved in shut-down and start-up activities are trained and competent to perform their respective duties.

5.2 Isolation and lockout

Isolation is used to eliminate or minimise the risks associated with energy sources whenever work involving removal, break-in, replacement, repair or other similar activity is performed by persons, or for the safe isolation of equipment to minimise potential damage. In the majority of cases lock out is the preferred method.

Hazards which can be controlled by isolation include:
(a) hazardous substances (e.g. caustic soda or milk of lime)
(b) hot materials (e.g. steam, hot juice, massecuites and other process streams)
(c) energy sources (e.g. electrical, mechanical, heat, pneumatic or hydraulic).

In large mills where workers perform a range of different tasks it may be necessary to maintain and provide written isolation procedures, particularly:
(a) when plant is suspected of being in a hazardous condition (e.g. malfunctioning, broken or damaged) and inspection and repair/replacement is required

(b) following an incident when it is necessary to isolate plant
(c) for routine inspection
(d) for any entry into plant by workers
(e) when it is desirable to prevent the use, including unlawful use of plant.

Isolation procedures can be item specific or generic such as procedures to:
(a) replace or repair valves, pumps or pipe sections
(b) replace fugal screens
(c) shredder hammer replacement.

An assessment of the risks should be conducted before any work involving removal or repair of plant, breaking into lines and systems or any other task that may involve exposure of workers to hazards from energy sources, is commenced.

Where significant risks have been identified, safe work procedures (such as a permit to work system[3]) should be prepared with specific details for:
(a) Identified hazards such as energy sources (e.g. gravity, moving loads or steam).
(b) Type of lockout and other isolation devices to be used (e.g. locks – keys, multi-lock or code-lock, danger tags, out of service tags, mechanical devices – bars, clamps, chains, or removal of component, valve bleeding and other control measures).
(c) Stored energy should not be used to effect isolation (e.g. pneumatic valves which fail safe without a mechanical isolator). The use of manual isolation valves is recommended where possible.
(d) Application and removal of isolation and lockout devices (test-run machines before isolation).
(e) Identification of lockout points and zones of isolation systems.
(f) Dual drives.
(g) Nomination of trained and authorised personnel for isolation procedures for each work area (e.g. an isolation coordinator).
(h) Process and authority for over-riding any interlocks already in place.
(i) Regular testing of isolation systems and circuits, and
(j) Electrical items to be isolated from all sources of electrical power prior to the commencement of any work on the equipment.

5.2.1 Possible control measures – isolation and lockout

The following controls can be used to prevent or minimise the risk of injury from energy sources when using plant:
(a) Before commencing work on plant, all isolations and lock outs should be tested by competent persons.
(b) Where equipment is isolated regularly (i.e. during routine replacement or maintenance, isolation procedures) or standard work procedures could be developed and used as required. If it is not possible to isolate the electricity supply, control measures should be implemented to prevent energising of the plant (e.g. through the use of a permit-to-work system).
(c) Training in relation to isolation procedures should be conducted to ensure competency of workers who are required to comply with those procedures. Isolation procedures should

[3] See *Section 9 Work environment* for information on safe work permits.

be periodically reviewed, particularly when plant is modified or replaced, or new plant is introduced to the system. Records of training and procedure reviews should be kept, and

(d) The isolation and lockout system must be regularly audited to ensure they operate effectively.

5.3 Work with mobile plant

Sugar mills utilise a range of mobile plant including forklifts, bob cats, end loaders, mobile cranes and general heavy vehicles. Mobile plant operation has a range of hazards, including:

(a) contact with persons
(b) operator error
(c) contact with electrical parts
(d) roll over.

Injuries can occur by being struck by machinery, equipment or their by-products (e.g. metal fragments, conveyor belts, mobile plant and cane bins).

5.3.1 Possible control measures for plant contact with persons

The following control measures may be used to prevent or minimise exposure to the risk of injury or death by moving plant:

(a) using specific signage
(b) adequate work space or exclusion zones around machines
(c) training for operators
(d) regular maintenance
(e) good housekeeping standards
(f) provision and use of appropriate personal protective equipment
(g) the plant is not cleaned, maintained or repaired while it is operating, unless risks from moving parts are controlled
(h) guarding to prevent the operator coming into contact with moving parts.

Where guarding of moving parts does not prevent the risk of entanglement, persons should not operate or pass in close proximity to the plant unless a barricade or safe system of work has been implemented to prevent or minimise the risk.

5.4 Machine guarding

The types of guard and their suitability for particular applications include.

Fixed guards
They have no moving parts and offer protection only when properly fixed in position. Where necessary for access, fixed guards should be easy to remove and replace but only be able to be opened or removed with a tool.

Interlocking guards
These are moveable, with the moving part interconnected with a control system. Interconnections are usually electrical, mechanical, hydraulic or pneumatic. The interlock prevents the machinery from operating unless the guard is closed.

Automatic guards
These automatically move into position as the machine or cycle is started. These are only suitable on slow moving machines.

Distance guards
These prevent access to hazardous areas through a barrier or fence.

Trip guards (presence sensing devices)
These stop a machine when a person gets into a position where they are liable to be injured. A photo-electric curtain is an example of this type of guard.

5.4.1 Possible control measures - machine guarding

Management should conduct a separate risk assessment for each item of plant and any associated system of work used with that machine. The risk assessment should prioritise the risks so that effort can be directed to eliminating or controlling risks that have a high potential to cause harm.

Fixed guards should be used where access is not necessary for operation, inspection, maintenance or cleaning.

Where a risk assessment indicates a significant risk to workers required to work in close proximity to or interact with plant (e.g. power presses), interlocking guarding should be fitted that would prevent starting or operating the machine if the guard is removed. The system should be designed so that it is difficult to tamper with or bypass the interlock.

Interlocks should be fitted to all items of plant that may present a hazard if removed or changed (e.g. openings on tanks under high pressure or high temperature, exposed blades on disintegrators or a cutter grinder). Such interlocks should prevent the plant from operating whenever the cover, door, lid or inspection hatch is removed or opened.

Where guarding is considered insufficient or easy to tamper with, the erection of barriers or fences should be considered. If an interlock system is malfunctioning and there is a need to operate the plant, a risk assessment may indicate that a barrier or fence may be a suitable short-term alternative.

If appropriate, presence sensing devices may be fitted to prevent the plant from starting or operating.

Safe work procedures should be prepared, issued and signed off when access to hazardous parts of plant is required. The procedures should identify the circumstances where access to guarded parts is safe. This will prevent the need to tamper with guarding or interlocks. During the period when a guard is removed to enable access, appropriate lockout and tagout procedures must be used.

The risks associated with plant that is remotely started and/or operated should be assessed and appropriate controls implemented. Controls may include:
(a) signposting
(b) flashing lights timed to operate prior to the plant activation
(c) presence sensing devices

(d) barriers or guards
(e) audible alarms
(f) local isolation switches.

Machine guarding and interlocks should be inspected and maintained at regular intervals. Records of inspection and maintenance should be kept.

Elimination of a hazard should be considered when designing new plant or when replacing or modifying existing plant.

For guidance on reliability requirements for interlocks and safety circuitry, including pressure sensing device please refer to *AS 4024.1 Safety of Machinery* and *AS 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems set*.

Part 6 Biological substances

6.1 Legionella

The Guide to Legionella control in cooling water systems, including cooling towers, provides guidance on controlling the growth of Legionella in cooling water systems associated specifically with evaporative condensers and cooling towers in both industrial and air-conditioning situations.

Cooling towers are used extensively in the sugar milling industry and the presence of Legionella bacteria can cause serious infection in humans, called Legionellosis, which can take two forms: Legionnaires' disease and Pontiac fever.

Legionnaires' disease is an infection that causes a type of pneumonia (lung infection) that can be severe and even life threatening. Pontiac fever is a milder form of respiratory illness.

Legionella is one form of microbial contamination and it should be noted that other microbes can contaminate air-conditioning units and cooling towers. Other microbes can result in other health problems such as respiratory sensitisation and building related illness.
Legionella can contaminate and multiply in cooling towers if a combination of conditions occurs for example:
(a) the water temperature ranges from 25 to 45 degrees
(b) nutrient levels are high
(c) there is an accumulation of organic materials, sediments and other micro organisms.

AS/NZS 3666 Parts 1 - 3 - Air-handling and water systems of buildings-Microbial control, and its supporting document *SAA/SNZ HB32 - Control of microbial growth in air-handling and water systems of buildings*, specify minimum requirements for design, installation, commissioning, operation and maintenance of air-handling and water systems in buildings to assist in the control of micro-organisms, including Legionella bacteria.

6.1.1 Possible control measures for Legionella

To reduce contamination of cooling towers, mill operators should consider:

(a) equipment design, installation, operation and maintenance in order to minimise microbial multiplication
(b) minimising nutrient accumulation
(c) monitoring and treating microbial levels
(d) water treatment.

For more control measures refer to the *Guide to Legionella control in cooling water systems, including cooling towers*.

6.2 Bagasse

Bagasse, a by product of the milling process, is normally used as fuel in suspension boilers in sugar mills which in turn produces the steam necessary to operate factory processes. Bagasse is a natural, fibrous material which occurs in respirable and inspirable sizes. Bagasse is a nuisance dust which is difficult to control, particularly in the form of bagacillo, a dry dust separated from the larger fibres by cyclones and screens, used to mix with material subsided from juice to create mill mud.

Atmospheric contaminants encountered in sugar milling operations such as Bagasse fibres, sugar dust and dirt are classed as irritants. Health risks associated with bagasse, include the development of bagassosis, an allergic reaction of the lung tissue in the presence of **Thermoactinomycetes Sacchari** spores. Research has indicated that bagasse does not cause bagassosis. However, if bagasse is stored in damp conditions, **T. sacchari** bacteria can propagate. The spores of this bacterium can give rise to bagassosis in workers.

6.2.1 Possible control measures for bagasse

A number of control measures should be considered for controlling and minimising levels of bagasse dust, they include:
(a) high standards of housekeeping
(b) covered conveyors and transfer points
(c) local exhaust ventilation
(d) provision of personal protective equipment
(e) training and supervision.

Reclamation or de-baling of stored bagasse can generate significant levels of airborne dust and spores containing **T. sacchari** and control measures appropriate for these types of operation include:
(a) involving the minimum number of workers
(b) conducting the activities only when weather conditions are suitable
(c) providing air conditioned cabins on machinery used for these activities
(d) providing suitable P2 class respirators (minimum) and goggles to workers who are exposed.

A review of the risks associated with stored bagasse may require additional control measures such as:
(a) health checks of workers normally involved in activities generating levels of atmospheric contaminants
(b) identification of sources of dusts

(c) assessment of measures to minimise the generation of dusts
(d) site inspections to assess housekeeping standards
(e) suitability and use of personal protective equipment provided.

Part 7 Substances

Many substances may present hazards at sugar mills. But if the hazards are known and understood, appropriate precautions can be taken so that they can be used safely.

7.1 Asbestos

Asbestos is a known carcinogen. Inhaling asbestos fibres can cause diseases such as mesothelioma, lung cancer and asbestosis. There is a long latency period between exposure to asbestos fibres and the onset of disease, for example, the latency period of asbestosis is generally between 15 and 25 years.

Asbestos poses a risk to people's health when asbestos fibres become airborne and can be inhaled.

The *Workplace Health and Safety Regulation 2008* has requirements dealing with preventing or minimising exposure to asbestos.

Ban on using asbestos
Using asbestos or asbestos containing material (ACM) is prohibited except in very limited circumstances; for example, handling or using asbestos or ACM for the purpose of obtaining samples or removal or disposal is not prohibited. For more information on the ban on using asbestos and the limited uses which are permitted, refer to Part 13 and Schedule 9 of the *Workplace Health and Safety Regulation 2008*.

Prohibited activities involving asbestos
The *Workplace Health and Safety Regulation 2008* prohibits the use of certain tools or processes to clean ACM as they can cause unacceptable levels of asbestos fibres to become airborne, for example, a worker must not use an electric sander to clean asbestos-cement sheeting. For more information on these prohibited activities, refer to Part 13 of the *Workplace Health and Safety Regulation 2008*.

Management of on-site ACM
Owners of certain structures and buildings that are workplaces must comply with the *National Code of Practice for the Management and Control of Asbestos in Workplaces* [NOSHC: 2018 (2005)]. This code specifies requirements for managing ACM at the workplace including:
(a) identifying ACM
(b) conducting risk assessments
(c) implementing control measures
(d) displaying warning signs and labels
(e) having an ACM register and making it available for inspection.

For more information on these requirements, refer to Part 13 of the *Workplace Health and Safety Regulation 2008* and the *National Code of Practice for the Management and Control of Asbestos in Workplaces* [NOSHC: 2018 (2005)].

Removing ACM
Removal of any ACM at workplaces must be done in accordance with the *National Code of Practice for the Safe Removal of Asbestos* 2nd Edition [NOHSC: 2002 (2005)]. This code specifies requirements for removal of ACM including:
(a) Responsibilities for clients
(b) Responsibilities for those removing the ACM
(c) Asbestos removal control plans
(d) Requirements for the removal of ACM (e.g. site preparation, methods of removal, tools, respiratory protective equipment, air monitoring and decontamination)
(e) Additional requirements for removal of friable ACM
(f) Clearance for re-occupying an asbestos work area
(g) Removal procedures for different types of ACM (e.g. asbestos-cement sheeting, and asbestos gaskets and rope from plant and equipment).

For more information about requirements for removing ACM, refer to Part 13 of the *Workplace Health and Safety Regulation 2008* and the *National Code of Practice for the Safe Removal of Asbestos* 2nd Edition [NOHSC: 2002 (2005)].

Certificates required for removal of ACM
Parts 4 and 5 of the *Workplace Health and Safety Regulation 2008* specify the requirements for certificates to be held by persons removing friable ACM or 10m^2 or more of bonded ACM.

An employer, self-employed person or worker does not need to hold a certificate for removal of less than 10m^2 of bonded ACM. However, removal of any quantity of bonded ACM must be done in accordance with the *National Code of Practice for the Safe Removal of Asbestos* 2nd Edition [NOHSC: 2002 (2005)].

7.2 Hazardous substances

Under the *Workplace Health and Safety Act 1995*, certain persons have obligations regarding hazardous substances. *Part 16 Hazardous Substances*, of the *Workplace Health and Safety Regulation 2008* provides information on the requirements for material safety data sheets (MSDS), controlling exposure, monitoring, health surveillance, keeping registers and records and training.

The *Hazardous Substances Code of Practice* gives practical advice on ways to manage specific risks that arise when hazardous substances are used at workplaces.

Hazardous substances found within a sugar milling environment include:
(a) petroleum products
(b) caustic soda (sodium hydroxide)
(c) hydrochloric, phosphoric, sulphuric and sulphamic acids
(d) formaldehyde
(e) lime (calcium hydroxide).

Sugar mill operators should identify high risk activities involving these substances and implement control measures which minimise the risk of exposure. For example, activities or issues such as:
(a) unloading and bulk transfer
(b) process or plant failure
(c) operator error.

7.2.1 Possible control measures for hazardous substances

The main risk associated with hazardous substances is the potential for exposure to site personnel and other persons. Exposure can occur by breathing in the substance, through skin contact where a substance is absorbed through the skin or ingestion when eating with contaminated hands.

Hazardous substances within sugar milling operations have methods of risk reduction prescribed by a regulation which include:
(a) ensuring a material safety data sheet is readily available to anyone likely to be exposed to the hazardous substance
(b) a hazardous substance register containing a list of all hazardous substances on site plus a current copy of a material safety data sheet for each substance is maintained
(c) labelling and storage comply with the appropriate standards and codes
(d) a risk assessment is completed and risks minimised for each hazardous substance
(e) workers are aware of the control measures to be implemented
(f) appropriate personal protective equipment in accordance with the risk assessment is available and used as intended
(g) adequate training is provided in the use of the hazardous substance and the recommended personal protective equipment
(h) monitoring or health surveillance is conducted if required
(i) records are maintained for the specified time.

Material Safety Data Sheets provide important information on hazardous substances including:
(a) the ingredients of a product
(b) the health effects and first aid instructions
(c) precautions for use
(d) safe handling and storage information.

Specific control measures should be developed such as:
(a) isolating high risk areas with barriers and signage (e.g. under the effet stage while caustic boiling)
(b) detailed and documented operating procedures
(c) training
(d) emergency response
(e) provision of, and training with, appropriate personal protective equipment
(f) provision of eye wash and safety shower facilities adjacent to the site but isolated from likely engulfment
(g) access to material safety data sheets and emergency procedures at the site.

7.3 Laboratory chemicals

Laboratory staff may have a more frequent exposure to a larger range of hazardous substances in smaller quantities. It is important to minimise the risk of exposure so as to reduce the possibility of acute and chronic health effects over the long term.

Handling, mixing and transferring hazardous chemicals such as hydrochloric and sulphuric acids, sodium hydroxide and flammable liquids including ethanol are some of the activities which are undertaken in sugar mill laboratories. Users of chemicals should also be aware of any by products or chemical reactions which may take place which could create additional hazards during laboratory processes.

7.3.1 Possible control measures for laboratory chemicals

Specific control measures should be implemented for each separate activity involving a hazardous substance in mill laboratories. The most appropriate control measures will depend on the particular circumstances of use and the hazardous substance however typical control measures should include:

(a) detailed analytical procedures
(b) training in the standard procedures to be followed
(c) emergency response training and access to speciality first aid treatment
(d) provision of, and training with, the recommended personal protective equipment for each activity
(e) provision of eye wash and safety shower facilities adjacent to the site but isolated from likely engulfment
(f) easy access to material safety data sheet, information and emergency procedures in the laboratory
(g) adequate labelling of all containers of hazardous substances
(h) use of automatic pipettes
(i) adequate ventilation
(j) a high standard of hygiene
(k) disposal systems for used personal protective equipment
(l) separate laundering of laboratory coats, hand towels, etc.
(m) use of fume cupboards that comply with *AS2243.8 Safety in laboratories – Fume cupboards*.

7.4 Lead

Under the *Workplace Health and Safety Regulation 2008 Part, 17 Lead* sets out the requirements for workplaces where lead is used. These include requirements on obtaining material safety data sheets, labelling containers, keeping registers, keeping records, conducting risk assessments, notifying of lead-risk jobs and health surveillance, controlling exposure, conducting monitoring and health surveillance, and providing training.

All sugar factory laboratories use lead in the form of dry lead acetate and ‘wet lead’, which require specific control measures to ensure workplace health and safety. Lead can be

absorbed by inhaling lead dust, fume or mist and by ingesting lead that has contaminated hands, food or cigarettes.

Early symptoms of lead poisoning may include headache, loss of appetite, abdominal pain, constipation, nausea, fatigue, loss of weight and irritability. Continued exposure can cause anaemia, kidney damage, and nerve and brain damage.

7.4.1 Possible control measures

The *Workplace Health and Safety Regulation 2008* places obligations on manufacturers, importers, suppliers and employers in relation to the provision of adequate information about the safe use of substances used at a workplace.

In certain situations, relevant person who are employers must arrange and pay for health surveillance required under the *Workplace Health and Safety Regulation 2008 Part 16 – Hazardous Substances* and *Part 17 – Lead*. This health surveillance must be done by, or under the supervision of, a designated doctor. Health surveillance, which includes biological monitoring, can assist in minimising the risk to health from lead exposure by:

(a) confirming that the absorbed dose of a substance is below the acceptable level
(b) detecting adverse health effects at an early stage so that the worker can be protected from further injury, either by control of the process or by removal from exposure
(c) evaluating the effectiveness of control measures.

The primary technique for monitoring the working environment is usually to determine the concentrations of an airborne contaminant and then compare the result with the national exposure standard. However, if lead dust or fume can been ingested or inhaled, biological monitoring techniques should also be used (e.g. In a lead-risk job, biological monitoring would measure the blood lead level of individual workers). Biological monitoring has the specific advantage that it can take account of issues that dictate an individual's response to particular hazardous substances. Some of these factors include size, fitness, personal hygiene, work practices, smoking and nutritional status.

Health surveillance should not be used as an alternative to proper implementation and maintenance of control measures designed to prevent exposure. For more information on health surveillance techniques required for hazardous substances (e.g. Respiratory function tests), see schedule 8 of the *Workplace Health and Safety Regulation 2008*.

The results of a lead monitoring program conducted by Workplace Health and Safety Queensland during the 1996 crushing season determined that the use of lead in mill laboratories did not constitute a lead risk job (Australian Sugar Milling Council, 1997).

However, in circumstances where a risk assessment determines the job not to be a lead-risk job, the employer must conduct a risk assessment within five years after the last assessment. The risk assessment must be conducted sooner if there is a significant change in the way a lead process is done at the workplace or if there is a significant change in the amount of lead, or the amount of lead contained in a thing at the workplace.

Provided that the risk assessment has been conducted at prescribed intervals and appropriate control measures are adhered to, then the status as a lead job rather than a lead risk job can be

maintained. However, the report recommends that all new laboratory workers have baseline and mid-season samples to identify those workers whose absorption of lead is significant.

Appropriate control measures include:
(a) labelling all containers in which any lead compound is stored
(b) avoiding generating dust when handling dry lead acetate
(c) when transferring to smaller containers:
    i use personal protective equipment (face shield, P2 dust respirator and gloves)
    ii transfer in a well ventilated area free of strong air currents
(d) high standards of personal hygiene
(e) not allowing drinking from laboratory taps
(f) training and supervision to ensure that the correct procedures are followed
(g) maintaining appropriate emergency response treatments
(h) providing automatic dispensers for wet lead.

7.5 Welding and cutting fumes

The fumes and gases arising from welding and cutting processes may contain a number of hazardous substances. The welding/cutting arc can cause reactions which produce oxides of nitrogen, carbon monoxide and other gaseous contaminants. The intense ultraviolet radiation emitted from some arcs may also give rise to significant quantities of ozone.

The composition of the fume depends upon:
(a) consumables – electrodes or filler metals, heating or shielding gases and fluxes
(b) material – chemical composition of material being cut or welded and of any protective coating (e.g. galvanising) or primer paint (e.g. lead-based paints)
(c) operating conditions (e.g. temperature and rod current).

The amount of fume generated depends on:
(a) process and thermal conditions – amperage, voltage, gas and arc temperatures and heat input which may also vary with the welding position and degree of enclosure and the degree of skill of the welder
(b) consumables
(c) materials
(d) duration of welding or cutting.

Technical Note 7 – Health and Safety in Welding produced by the *Welding Technology Institute of Australia* should be consulted for detailed information on fume generation and control.

7.5.1 Possible control measures for welding and cutting fumes

When assessing the risks associated with a particular welding or cutting process, consideration should be given to airborne concentrations of toxic metals, such as chromium and nickel that may be generated from the parent metal or electrode. In addition to complying with the individual exposure standards for specific contaminants, the fume concentration in the breathing zone (which is inside a welder's helmet when a helmet is worn) should not exceed five mg/m³ TWA (time weighted average).

When selecting control measures, routine tasks should be identified so that generic procedures can be developed and documented for future use. Within sugar milling operations repetitive tasks include:
(a) roller arcing
(b) welding and cutting in dedicated workshop areas
(c) railway maintenance.

Special consideration is also required for specific tasks such as:
(a) hot work in confined space
(b) welding in open spaces
(c) tasks involving stainless steel, galvanised steel, etc.

An example of a safe work procedure for roller arching is provided in appendix 9.3.

A workplace where airborne contaminants hazardous to the health of workers are generated should:
(a) have air quality acceptable to the standard specified in *AS1668.2-2002 The use of ventilation and air conditioning in buildings - Ventilation design for indoor air contaminant control* when mechanical ventilation is introduced
(b) have exhaust appliance systems which prevent or minimise the risks from exposure to those airborne contaminants.

Ventilation systems can be of two types. When the airborne contaminants comprise of low to moderately toxic materials generated only in small amounts, general forced dilution ventilation, either as supplied air or as extracted air systems complying with *AS 1668.2*, can be employed.

Where airborne contaminants are generated in moderate to large quantities or comprise of toxic or very toxic materials, a local exhaust ventilation system should be used for which *AS 1668.2* may be used for initial guidance. In either case, the exhaust appliance in use must be capable of reducing the level of airborne contaminants such that an involved worker's exposure is not more than the relevant exposure specified in the *Adopted Exposure Standards for Atmospheric Contaminants in the Occupational Environment*[4]. Air-conditioning systems are not considered suitable for control of atmospheric contaminants.

7.6 Methane gas

The *Dangerous Goods Safety Management Regulation 2001* requires the elimination of ignition sources in hazardous areas. Flammable or combustible gases, vapours, dusts and mists may be generated or evolve within a dangerous goods storage and handling environment. These can form explosive mixtures with air in certain proportions.

Under the *Electrical Safety Regulation 2002*, electrical installation work must be done in accordance with the wiring rules[5]. The wiring rules define hazardous areas as areas

[4] The Adopted Exposure Standards for Atmospheric Contaminants in the Occupational Environment. [NOHSC:1003(1995)], Guidance Note on the Interpretation of Exposure Standards for Atmospheric Contaminants in the Occupational Environment 3rd Edition [NOHSC:3008(1995)]
[5] *AS/NZS 3000 Electrical installations* (known as the Australian/New Zealand wiring rules).

where an explosive atmosphere is present or may be present. For further information refer to the Electrical Safety Office.

Methane gas (CH_4) is a colourless, odourless gas that forms when organic matter decomposes under oxygen poor conditions (anaerobic – without oxygen). High concentrations of methane gas can lead to a lack of oxygen in the air.

Within a sugar milling environment methane or 'fermentation' gas can be produced as a result of fermentation of certain materials within the factory (e.g. mixed juice, liquor, molasses and messequite). Methane can also result from fermentation of fibre products such as cush material (fibre separated from mixed juice prior to processing) or bagasse deposits mixed with water such as in mill boots, juice pits and within the cush-cush system. Mill operators should ensure that areas where these materials may remain following a shut down or mill closure are cleaned out before there is a risk of fermentation, thus avoiding methane build up.

If methane gas occurs in a confined space it can be explosive; the explosive range is between five percent and 15 percent methane in air and high concentrations of methane gas in the air can also be flammable.

Operators should be aware of possible methane gas deposits after extended close downs in areas such as:
(a) molasses pipes
(b) hollow mill rollers
(c) between wear plates on pressure feeder chutes
(d) juice pipes
(e) pans
(f) effets
(g) mill boots
(h) juice pits
(i) rotary filter boots
(j) heaters
(k) a range of tanks such as subsiders, mixed juice, incubators and flash tanks.

7.6.1 Possible control measures for methane gas

Documented procedures should be in place to identify or control potential explosive atmospheres prior to entry by personnel or work from outside the vessel or pipe (particularly for hot work). Mill operators should consider the hierarchy of controls in dealing with potential risks form methane gas explosion, including:
(a) training of personnel
(b) engineering controls (e.g. ventilation or flame proof equipment)
(c) sign posting and marking of areas where flammable atmospheres may exist to exclude ignition sources by a safe distance
(d) work procedures
(e) safe work permit systems for identified high risk processes (e.g. hot work permit systems including monitoring for flammable atmospheres in areas identified to be at risk).

7.6.2 Monitoring for methane gas before permitting entry to potentially flammable atmospheres

Monitoring for methane gas is required prior to an entry permit being issued for hot work or any other work that could possibly introduce an ignition source into an area where methane gas may be in the flammable range.

Entry into a confined space or other area should not occur below five percent of the Lower Explosive Limit (LEL). Above five percent of the LEL no one should enter in the area, except where continuous monitoring is conducted to ensure the LEL does not exceed 10 percent. If it does, the area should not be occupied until the concentration of methane is brought down to below 10 percent of the LEL.

7.7 Sugar dust

Under the *Electrical Safety Regulation 2002*, electrical installation work must be done in accordance with the wiring rules[6] and that it is inspected by an accredited auditor before connection to supply. The wiring rules define hazardous areas as areas where an explosive atmosphere is present or may be present. For further information refer to the Electrical Safety Office.

The exposure standard for inspirable sugar dust which should be observed provides for an allowable time-weighted average (TWA) airborne concentration for sugar dust of 10 mg/m^3. This value is a standard value for all inspirable dusts containing no asbestos and less than one percent crystalline silica. Inspirable dust refers to particles where the equivalent aerodynamic diameter is greater than 10μm.

Under certain conditions, sugar dust can also be explosive. The conditions that must be fulfilled simultaneously for a sugar dust explosion to occur are:
(a) at least nine percent by volume (at atmospheric pressure) of oxygen
(b) a sugar dust concentration greater than 20 g/m3
(c) a minimum ignition energy of 30 mJ
(d) for an electrostatic spark ignition – a minimum field strength of 20 kV/cm.

7.7.1 Possible control measures for sugar dust

Sugar mill operators should evaluate areas where combustible dusts are or may be present as detailed in *AS/NZS61241.10 Electrical Apparatus for use in the presence of Combustible Dust - Classification of areas where combustible dusts are or may be present*. *AS 2243.8 Safety in laboratories – fume cupboards*. In general, operations which involve handling, production or storage of sugar which create sugar dust should utilise equipment which is designed, operated and maintained so that releases of dust are minimised. Further guidance is also provided in *AS/NZS 2381 Electrical equipment for explosive atmospheres – Selection, installation and maintenance*.

Control measures which should be considered include eliminating the likelihood of:
(a) an explosive dust/air mixture and combustible dust layers

[6] *AS/NZS 3000 Electrical installations* (known as the Australian/New Zealand wiring rules.

(b) any source of ignition.

If elimination of these hazards cannot be achieved then other control measures should be implemented which reduce the risk of the occurrence of an explosive atmosphere or ignition source. For example:
(a) the use of appropriately rated equipment for operation within a combustible dust atmosphere (for example Zone 20, 21 or 22)
(b) dust containment to reduce the 'at risk' area, such as identifying sources of release
(c) dust reduction processes to maintain dust levels under the explosive point
(d) minimising occurrences which may disturb dust layers creating dust clouds or removal of dust layers through good housekeeping practices
(e) elimination of other sources of ignition such as hot work, smoking and naked flames
(f) segregation of equipment
(g) other associated control conditions (e.g. automatic disconnection of power supply and alarm initiations).

Under no circumstances should battery chargers or low pressure sodium vapour discharge lamps be installed in hazardous locations.

Part 8 Work environment

8.1 Safe working in confined spaces

Part 18 Confined spaces of the *Workplace Health and Safety Regulation 2008* outlines the requirements for confined spaces. *The Guide to Working Safety in Confined Spaces* provides practical guidance towards minimising health and safety risks associated with confined spaces, and outlines the necessary actions required to comply with the *Workplace Health and Safety Regulation 2008*.

Within sugar milling operations a range of plant is installed which meets the definition for a confined space under the regulation. For further information see *AS/NZS 2865 Safe working in a confined space*.

Types of equipment that may be a confined space can include:
(a) air conditioning ducts
(b) bagasse bins
(c) boilers
(d) clarifiers
(e) pans and evaporators
(f) filter drums
(g) pipes
(h) pits
(i) sugar bins
(j) trenches
(k) sugar dryers
(l) tanks.

A safe work permit system must be used to ensure that all risks associated with entry into a confined space are assessed and those risks are minimised or, where possible, eliminated. The issuer of safe work permits must be trained in confined space entry procedures and risk assessment techniques.

Some of the hazards associated with confined spaces include:
(a) oxygen deficient or enriched atmosphere
(b) flammable atmosphere
(c) toxic atmosphere
(d) external hazards that may affect those in the confined space
(e) residual hazardous substances
(f) surfaces
(g) engulfment
(h) electric shock
(i) temperature extremes
(j) access and egress
(k) visibility
(l) noise
(m) psychological factors
(n) mechanical equipment.

8.1.1 Possible control measures for work in confined spaces

Procedures are required that address all hazards likely to be encountered before a safe work permit is completed and person(s) are permitted to enter the confined space. Issues to be considered include:
(a) identification of the authorised person
(b) risk assessment
(c) isolation procedures
(d) atmospheric testing and the need for air purging
(e) portable electrical equipment
(f) lighting and ventilation
(g) access and egress
(h) requirement for a stand-by person and identification
(i) emergency equipment, rescue procedures and first aid
(j) signs and barriers to prevent unauthorised access
(k) education and training of all persons working in or involved with confined space entry
(l) the work to be performed in the confined space
(m) work being performed outside the confined space
(n) whether other hazardous conditions apply (hot work, working at heights or excavation)
(o) potential for hazardous conditions to result from the work activities.

All existing confined spaces and the hazards associated with working in those confined spaces shall be identified at each workplace. A confined space can also be created during the manufacture of plant, equipment and or machinery such as building a tank.

No safe work permit should be issued until all controls are implemented and the persons entering the confined space are briefed about the conditions of entry.

The work in the confined space is to be carried out as specified in the permit and all the required controls and procedures shall be followed.

If the work activities are likely to generate harmful fumes or deplete oxygen levels then it will be necessary to implement controls that will minimise the risks associated with these hazards.

The name of each person entering a confined space shall be recorded and a system implemented to account for each person involved using appropriate procedures to control entry/egress.

A stand-by person must be provided if a risk assessment indicates a risk to health and safety, such as an unsafe atmosphere or engulfment.

If a stand-by person is required by the risk assessment they must complete the duties specified in the standard and not leave the position while any person remains in the confined space. In the event of an injury or collapse of the person in the confined space, the stand-by person's primary role is to summon help and if possible, provide assistance (e.g. First aid or resuscitation. The observer must not enter the confined space until it is deemed to be safe by a qualified, authorised person.

At the completion of the work, all persons involved in the work shall be confirmed as having left the confined space, the confined space shall be closed, the relevant persons notified and the permit signed off and returned to the issuer and closed (an example of a safe work procedure, plugging a boiler tube, is included in appendix 9.4).

8.2 Hot work

Before commencing hot work (welding, thermal or oxygen cutting, heating, and other fire-producing or spark-producing operations that may increase the risk of fire or explosion) mill operators should ensure any risks associated with the hot work are properly assessed. This is so work may be carried out safely and not produce sources of ignition in areas where flammable gases or dusts may be present.

Consideration should also be given to hot work in areas which contain flammable liquids or build up of flammable solids such as cane trash (around the tippler) or in other areas where there is a risk of fire or explosion (sugar dust or bagacillo risk).

8.2.1 Possible control measures for hot work

A safe work permit should be issued prior to the commencement of any hot work which outlines the process to be followed, including any isolation and other controls. Persons authorised to issue safe work permits should be trained in the identification of specific hot work hazards, risk assessment and the selection of appropriate control measures to minimise or eliminate the risks.

Consideration should be given to:
(a) the removal of flammable or explosive materials before work commences
(b) the reduction in the flammability of materials (wetting down)

(c) isolating plant
(d) residues of flammable materials
(e) testing for flammable and fermentation gases (e.g. methane)
(f) special precautions (e.g. using a lookout)
(g) personal protective equipment
(h) suitable tools, equipment and materials to be used for the work
(i) emergency procedures
(j) the location of the fire fighting equipment.

If flammable materials are present, a suitably trained and qualified observer should be in attendance for the duration of the hot work.

Persons carrying out hot work should be qualified and trained for the task (e.g. welding or fire extinguisher use). This training should be documented.

Where flammable gases may be present, testing of the atmosphere prior to the work and at regular intervals should be carried out.

8.3 Safe work permit systems

Safe working permit systems enable mill operators to enhance safety procedures and this section provides information on the requirements associated with safe work permit systems including:
(a) the authority to issue safe work permits
(b) the situations where a permit is required
(c) things to be considered prior to the issue of a permit
(d) the conduct of the work in accordance with the permit
(e) the closure of the permit.

Work permits provide a system of identification, control and review of hazards within any work environment and can be a valuable tool. Examples where safe work permits are required include:
(a) entry to a confined space (e.g. a pan, effet or boiler)
(b) work in or around confined spaces
(c) working at heights
(d) excavation
(e) hot work.

There are many advantages to using a permit to work system as it:
(a) Ensures appropriate people are authorised to carry out designated work. This designated work may be for specific work or any work in a specific area.
(b) Makes it clear to people carrying out the work the exact identity, nature and extent of the job and the hazards involved. It also outlines any limitations on the extent of the work and the time during which the job may be carried out.
(c) Specifies the precautions which need to be taken, including safe isolation from potential risks such as electricity and hazardous substances.
(d) Ensures the person in direct charge of the plant or in charge of the area where the plant is located, is aware of all the work being done under the permit to work system.
(e) Provides a system of continuous control and also a record showing the nature of the work and the precautions needed which is checked by a competent person or people.

(f) Provides for the suitable display of permits.
(g) Provides a procedure for times when work has to be suspended.
(h) Provides for cross referencing of permits for work activities that may interact or affect one another.
(i) Provides a formal handover procedure for use when the permit is issued for a period longer than one shift, and
(j) Provides a formal hand back procedure to ensure that part of the plant affected by the work is in a safe condition and ready for reinstatement.

Before a safe work permit is issued, a risk assessment should be conducted and documented with the permit. Each mill should develop a register of tasks requiring a safe work permit within its operations.

Any task on the register or other tasks considered at the time to pose a significant risk, should not be performed without a safe work permit being issued and adequate controls implemented.

The issuer of the work permit should be properly trained in hazard identification, risk assessment and risk control techniques. Their responsibilities and authority should be clearly defined, training reviewed and documented periodically.

Before issuing a safe work permit, the issuer and recipient should consider all potential hazards such as material hazards, pressure, temperature, fumes, electrical power, mechanical energy, hazardous areas, height, radioactive sources, explosive materials, restricted space or field vision, and others.

The work permit should clearly specify the precautions and risk control measures which need to be employed, such as:
(a) isolation
(b) decontamination
(c) working in confined spaces
(d) hot work
(e) working at heights
(f) excavation and building work
(g) work on high voltage equipment
(h) personal protective equipment
(i) provision to notify relevant persons when work commences and when work is completed
(j) any other special precautions.

The issuer of a safe work permit should ensure that the recipient(s) are competent to perform the required tasks.

The issuer should explain the hazards and the control measures to the recipients, prior to the commencement of the work and ensure that the potential risks, control measures to be used, and the safe work procedures are all thoroughly understood by the recipients. The recipients should acknowledge their understanding of the details of the safe work permit in writing before work commences.

Once a work permit has been issued, the work should be carried out as specified in the safe work permit. At completion, the permit should be returned to the issuer and closed.

Part 9 Appendices

9.1 Dictionary

Confined space: an enclosed or partially enclosed space that:
(a) is at atmospheric pressure when anyone is in the space
(b) is not intended or designed primarily as a workplace
(c) could have restricted entry to, or exit from, the place
(d) is, or is likely to be, entered by a person to work
(e) at any time, contains, or is likely to contain, any of the following:
    i an atmosphere that has potentially harmful levels of a contaminant
    ii an atmosphere that does not have a safe oxygen level
    iii anything that could cause engulfment.

Consequence: the most probable results of an incident due to the hazard under consideration.

Demolition work means work to demolish or dismantle systematically a structure, or part of a structure, but does not include the systematic dismantling of:
(a) a part of a structure for alteration, maintenance, remodelling or repair, or
(b) formwork, falsework, scaffold or other construction designed or used to provide support, access or containment during construction work.

Exposure: the frequency of occurrences of the hazard.

Hazard: anything with the potential to cause injury, illness or damage.

Hot work: welding, thermal or oxygen cutting, heating, and other fire-producing or spark producing operations that may increase the risk of fire or explosion.

Interlocking guard: a guard which has a moveable part that is interconnected with the power or control system of the plant item so that, until the guard is in place, the interlock prevents the machine from operating. Interconnections can be electrical, mechanical, hydraulic or pneumatic.

$LA_{eq,8h}$ of 85 dB(A): the actual energy of varying noise levels experienced over a working period is equivalent to eight hours of a continuous steady A-weighted sound pressure level of 85 dB(A). dB(A) means A-weighted decibels.

$LC_{,peak}$ of 140 dB(C): a C weighted peak sound pressure level of 140 dB(C). Levels of noise above $LC_{,peak}$ of 140 dB(C) can cause immediate hearing damage. This is often referred to as ‘acoustic trauma’ and can result from an event that causes very loud noise, for example, an explosion or drop forcing.

Plant: applies to a wide range of items, ranging from a complex installation, such as a water-tube boiler, to portable equipment and tools which may be moved or carried from one workplace to another. Plant includes:
(a) machinery, equipment, appliances, pressure vessels, implements and tools
(b) personal protective equipment

(c) plant specified in schedule 2 to the Act (cooling towers, certain gas cylinders, escalators or lifts)
(d) a component, fitting, connection, accessory or adjunct to plant.

Probability: the likelihood that once the hazard - event occurs, the complete incident-sequence of events will follow with the timing and coincidence to result in the incident and consequences

Risk: the probability of a hazard resulting in an injury or disease or damage, together with the seriousness of the injury, disease or damage.

Risk management: the identification of hazards, the assessment of the risks associated with those hazards and the implementation of methods to eliminate or control the risks.

Safe work permit: a procedure to ensure the risks associated with specific high risk tasks are documented, addressed, controlled or minimised.

Safe work procedure: a document to communicate to employees and contractors, the safest way of controlling identified hazards associated with a particular task.

9.2 Further information

9.2.1 Workplace Health and Safety Queensland

Further information is available on the Workplace Health and Safety Queensland website www.worksafe.qld.gov.au or by contacting Infoline on ph 1300 369 915.

Legislation

- *Workplace Health and Safety Act 1995*
- *Workplace Health and Safety Regulation 1997*
- *Electrical Safety Act 2002*
- *Electrical Safety Regulation 2002*
- *Dangerous Goods Safety Management Act 2001*
- *Dangerous Goods Safety Management Regulation 2001*

Codes of Practice

- Asbestos
- First Aid
- Hazardous substances
- Manual tasks
- Noise
- Plant
- Concrete pumping
- Risk Management
- Scaffolding
- The storage and use of chemicals at a rural workplace
- Working near exposed live parts
- Works (Protective earthing, underground cable systems and maintenance of supporting structures for powerlines)
- Electrical work

Other Publications

- "A guide to practical machine guarding." Workplace Health and Safety Queensland (2002)
- "A Guide to Working Safely in confined spaces" Workplace Health and Safety Queensland (2003)
- "Legionella Control in Control Tower Systems, including Cooling Towers" Workplace Health and Safety Queensland (2005)

9.2.2 Standards Australia

www.standards.com.au

- AS 1210:1997 Pressure Vessels
- AS/NZS 1269 Occupational Noise Management – Overview and general requirements
- AS 1318 Use of colour for the marking of physical hazards and the identification of certain equipment in industry (SAA Industrial Safety Colour Code)
- AS 1319:1994 Safety signs for the occupational environment
- AS 1345 Identification of the contents of pipes, conduits and ducts

- AS/NZS 1596 The storage and handling of LP gas
- AS 1657:1992 Fixed platforms, walkways, stairways and ladders – Design, construction and installation.
- AS/NZS 1668.1:1998 The use of ventilation and airconditioning in buildings – Fire and smoke control in multi-compartment buildings
- AS/NZS 1668.2:2002 The use of ventilation and airconditioning in buildings – Ventilation design for indoor air contaminant control
- AS/NZS 1668.3:2001 The use of ventilation and airconditioning in buildings – Smoke control systems for large single compartments or smoke reservoirs
- AS/NZS 1680.0:1998 Interior lighting – safe movement
- AS/NZS 1715:1994 Selection, use and maintenance of respiratory protective devices
- AS/NZS 1716 Respiratory protective devices
- AS/NZS 1940 The storage and handling of flammable and combustible liquids
- AS 2030.1:1999 The verification, filling, inspection, testing and maintenance of cylinders for the storage and transport of compressed gases – Cylinders for compressed gases other than acetylene
- AS/NZS 2243.8 Safety in laboratories – Fume cupboards
- AS/NZS 2293.1Emergency escape lighting and exit signs for buildings – System design, installation and operation
- AS/NZS 2381 Electrical equipment for explosive atmospheresAS 2508 Safe storage and handling information card
- AS 2670.1:2001 Evaluation of human exposure to whole body vibration – General requirements
- AS 2763:1988 Vibration and shock – Hand transmitted vibration, Guidelines for measurement and assessment of human exposure
- AS/NZS 2865 Safe working in a confined space
- AS/NZS 3000 Electrical installations (known as the Australian/New Zealand wiring rules)
- AS/NZS 3666 Air handling and water systems of buildings – Microbial control
- AS 3853.1:Health and safety in welding and allied processes – Sampling of airborne particles and gases in the operator's breathing zone – Sampling of airborne particles
- AS 3780 The storage and handling of corrosive substances
- AS 3745:2002 Emergency control organization and procedures for buildings, structures and workplaces
- AS 4024.1 Safety of Machinery
- AS 4332:2004 The storage and handling of gases in cylinders
- AS/NZS 4360:2004 Risk Management
- AS/NZS 4804:2001 Occupational health and safety management systems – General guidelines on principles, systems and supporting techniques
- AS/NZS 61241.10 Electrical apparatus for use in the presence of combustible dust – Classification of areas where combustible dusts are or may be present
- AS 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems
- AS IEC 61672.1:2004 Electroacoustics – Sound level meters – Specifications
- AS IEC 61672.2:2004 Electroacoustics – Sound level meters – Pattern evaluation tests

9.2.3 NOHSC

- "Guidance Note on the Interpretation of Exposure Standards for Atmospheric Contaminants in the Occupational Environment 3rd Edition [NOHSC:3008(1995)] "Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment" [NOHSC:1003(1995)]
- "Guidance note for the protection of workers from ultraviolet radiation in sunlight" [NOHSC: 3012(1991)]
- "National Occupational Health and Safety Certification Standard for Users and Operators of Industrial Equipment" [NOHSC: 1006(2001)]

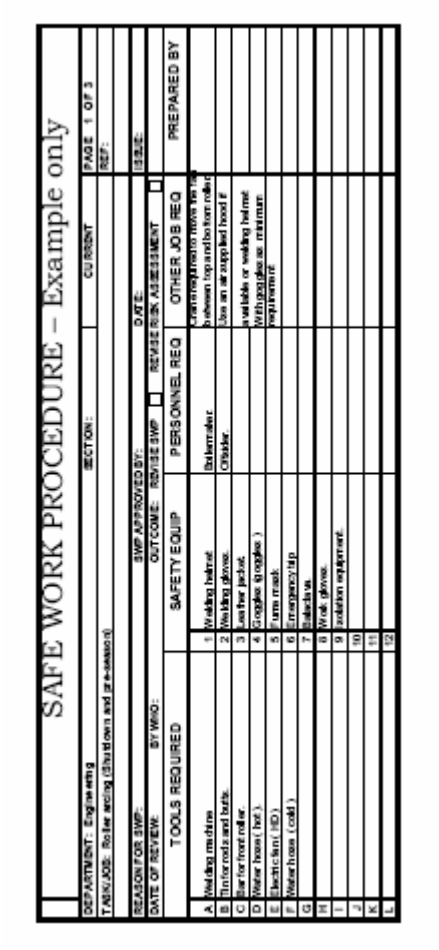
9.2.4 Other

- Welding Technology Institute of Australia, Technical Note No 7, Health and Safety in Welding, NSW, 2004.

9.2.5 ASCC

- Hazardous Substances Information System (HSIS)
- National Standard for Licensing Persons Performing High Risk Work

9.3 Example only – Safe working procedure for roller arcing



SAFE WORK PROCEDURE – Example only

DEPARTMENT: Engineering — SECTION: — CURRENT — PAGE 1 OF 3

TASK/JOB: Roller arcing (Shutdown and re-session) — REF:

REASON FOR SWP: — SWP APPROVED BY: — DATE: — ISSUE:

DATE OF REVIEW: — BY WHO: — OUTCOME: REVISE SWP ☐ REVISE RISK ASSESSMENT ☐

	TOOLS REQUIRED		SAFETY EQUIP	PERSONNEL REQ	OTHER JOB REQ	PREPARED BY
A	Welding machine	1	Welding helmet	Boilermaker	Crane operator to move the top between top and bottom roller	
B	Tin for rods and belts	2	Welding gloves	Grinder	Use an air supplied hood if	
C	Bar for front roller	3	Leather jacket		available or welding helmet	
D	Water hoses (hot)	4	Goggles (goggles)		with goggles as minimum	
E	Electric fan (ED)	5	Fume mask		requirement	
F	Water hose (cold)	6	Emergency tap			
G		7	Bale drum			
H		8	Work gloves			
I		9	Isolation equipment			
J		10				
K		11				
L		12				

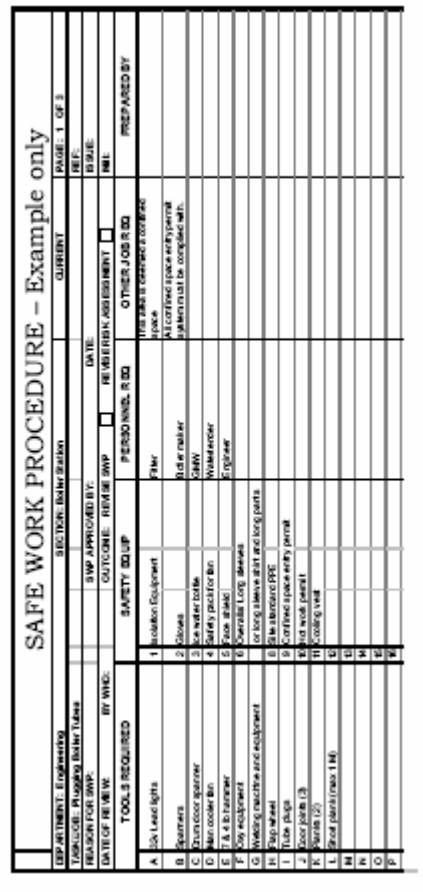
SAFE WORK PROCEDURE – Example only

DEPARTMENT: Engineering			SECTION:	CURRENT	PAGE 2 OF 3	
TASK/JOB: Roller arcing (Shutdown and pre-season)					REF:	
REASON FOR SWP:			SWP APPROVED BY:	DATE:	ISSUE	
DATE OF REVIEW: BY WHO:			OUTCOME: REVISE SWP ☐	REVISE RISK ASSESSMENT ☐		
	SPECIFIC JOB STEPS	TOOLS REQ	SAFETY EQUIP	HAZARDS	HAZARD CONTROLS	OTHER INFO
1	Open up mill					Check with mill fitter
2	Lock and tag carrier above		9	Bag ases falling from carrier above	Isolate carrier	When arcing completed
	A Side only - Isolate Biocide dosing pumps (2). Situated at A2 cane carrier and A4 mill, process side		9	Exposure to Biocide	Be sure to isolate.	Remove isolation and turn switch to on
3	Clean up area	D	8	Hot water	Take care of others	
4	Set up carbar					
5	Set correct power and run out leads completely and shorten to minimum length					240 To 250 amps
6	Earth lead clamp to be attached to roller to be spotted or common earth strap where provided					A5, B5& B1 Mills earth clamp to be attached to earth provided for roller spotting
7	Set up fan (suction if available)	E	8	Fan or lead	Suspend lead 2m above ground	Fan is optional it can circulate C.I. dust
8	Put on required welding equipment	A	1 TO 7			Darker than normal welding lens required, 13 or 14 minimum
9	Offsider to set up emergency trip switch close to boilermaker and safety cover removed		6			Boilermaker must keep emergency trip switch near him at all times
10	Set up hose to wet roller being spotted	F	8	Cast iron dust can be generated if roller becomes dry	Continuous wetting of roller by setting up a hose on top roller	Ensure roller surface is kept wet. A1A wet both pressure feeder roller and feed roller

SAFE WORK PROCEDURE – Example only

DEPARTMENT: Engineering			SECTION:	CURRENT	PAGE 3 OF 3	
TASK/JOB: Roller arcing (Shutdown and pre-season)					REF:	
REASON FOR SWP:		SWP APPROVED BY:		DATE:	ISSUE:	
DATE OF REVIEW:	BY WHO:	OUTCOME: REVISE SWP ☐		REVISE RISK ASSESSMENT ☐		
	SPECIFIC JOB STEPS	TOOLS REQ.	SAFETY EQUIP.	HAZARDS	HAZARD CONTROLS	OTHER INFO
11	Spotting can commence	A to F	1 TO 7	Area can be slippery	Approach with care	
		A,B,C,E	1 TO 7	Rods can stick to roller	Break contact and check amps	
12	When finished spotting roller, and removing helmet etc. care should be taken that C.I. does not enter eyes	F	4,	C.I. dust in eyes	Use goggles, care should be taken when removing PPE. It is a good idea to brush down with a rag before removing.	This will cut down the risk of C.I. dust to the eyes
						Eyes must be checked at first aid when finished each roller or removal of equipment or every two hours. Eye checks for T/A
13	T/A to clean and roll up equipment after spotting is completed					Tradesman to check
14	Cross bars that are not permanently fixed are to be removed and stacked against the nearest column					Tradesman to check

9.4 Example only – Safe working procedure – Plugging a boiler tube



SAFE WORK PROCEDURE – Example only

DEPARTMENT: Engineering			SECTION: Boiler Station			CURRENT		PAGE: 1 OF 3	
TASK/JOB: Plugging Boiler Tubes								REF:	
REASON FOR SWP:			SWP APPROVED BY:		DATE:			ISSUE:	
DATE OF REVIEW:	BY WHO:		OUTCOME: REVISE SWP ☐		REVIEW RISK ASSESSMENT ☐			INIT:	
TOOLS REQUIRED			SAFETY EQUIP		PERSONNEL REQ		OTHER JOBS REQ		PREPARED BY
A. 12v Lead lights		1. Isolation Equipment		Fitter		Hot Jobs in calendar confined spaces			
B. Spanners		2. Gloves		Boiler maker		All confined space entry permit systems must be complied with			
C. Drum door spanner		3. Hot water bottle		CMW					
D. Man cooler Bin		4. Safety pack for Bin		Watertender					
E. 1 & 4 lb hammer		5. Face shield		Engineer					
F. Joy equipment		6. Overalls Long sleeves							
G. Welding machine and equipment		or long sleeve shirt and long pants							
H. Pipe wheel		8. Site Minimum PPE							
I. Tube plugs		9. Confined space entry permit							
J. Door joints (3)		10. Hot work permit							
K. Plants (2)		11. Cooling vest							
L. Shot plants (max 1 kg)		12.							
M.		13.							
N.		14.							
O.		15.							
P.		16.							

SAFE WORK PROCEDURE – Example only

DEPARTMENT: Engineering		SECTION: Boiler Station			CURRENT	PAGE : 2 OF 3
TASK/JOB: Plugging Boiler Tubes						REF:
REASON FOR SWP:		SWP APPROVED BY:		DATE:		ISSUE:
DATE OF REVIEW: BY WHO:		OUTCOME: REVISE SWP ☐		REVISE RISK ASSESSMENT ☐ ☐		INIT:
	SPECIFIC JOB STEPS	TOOLS REQ.	SWP'S REQ.	HAZARDS	HAZARD CONTROLS	OTHER INFO
1	Isolate stop valve.		1A.0	Steam	Effective isolation	
2	Open front gate and ID damper to cool boiler down		0			
3	Blow down hot water from boiler until empty.		0			
4	Fill boiler with water from outside storage tanks until leak flows.		0			
5	Remove inspection door to mud drum slu/ash hoppers.	B	0			
6	All checks for confined space entry to be carried out and entry permit completed.		0&9			
7	If hotwork is to carried out a hot work permit is to be completed.		0&10			
8	Install planks over ash hopper	A&K				
9	Stand on planks, find leak and note position.	A&K	6A.0	Hotwater squirting out, hot ash, hot sand and loose refractory.	Wait until pressure drops and leak has small flow. Reduce draught from ID fan.	A tube with a large leak can be found from inside the drum by feeling for suction from ID fan.
10	Empty boiler					
11	Isolate (a) boiler feed pumps – steam and electric. (b) feed check valves and aux. valves. (c) team stop valves and by pass valves. (d) Blow down valves. (e) burners (f) other common lines.		1A.0	Steam and boiler feed water	Effective isolation.	Consult with boiler operator.
12	After isolating, vacuum to drums by opening pet docks, open drum doors. (2 top and 1 bottom)	C	2A.0	Ingestion of vacuum cloor items to suck in.	Keep hands clear of doors when swinging open.	Refer to SWP on opening drum doors

SAFE WORK PROCEDURE – Example only

DEPARTMENT: Engineering			SECTION: Boiler Station		CURRENT	PAGE: 3 OF 3
TASK/JOB: Plugging Boiler Tubes						REF:
REASON FOR SWP:			SWP APPROVED BY:		DATE:	ISSUE:
DATE OF REVIEW: BY WHO:			OUTCOME: REVISE SWP ☐		REVISE RISK ASSESSMENT ☐	REV:
	SPECIFIC JOB STEPS	TOOLS REQ.	SAFETY EQUIP.	HAZARDS	HAZARD CONTROLS	OTHER INFO
13	Install fan at one end of top drum.	D				
14	Remove baffles as necessary in top drum.	B	3,6,9A11	Dehydration, Lifting heavy plates	Cold water. Two man job.	In above normal temperatures it is advisable to drink a cup of water every 15 mins.
15	Clean tube ends to be plugged and vent tube.	H	5,6,9A11			
16	Measure and machine plugs. Drive plugs with 7lb hammer into tube ends until secure.	SA I	5,6,9A11			
17	Seal weld plugs to both ends of tube.	G	6,9A11	Wet conditional electrocution	Wooden plank to work off.	Utilize outside drum to change electrode
18	Install baffles, remove all gear from drums.		6A9			
20	Shut pet cocks to keep air cushion in top drum.		6			
21	Pressure test to 4000KPA		6			
22	Check ash hopper and remove broken refractory and then planks.		6A9			
25	Close inspection and grate doors.	B	6			
26	Remove isolation		1A9			

9.5 Example only – Excavation and/or trenching work risk assessment

Details of work to be undertaken																
Range of possible work methods which could be used																
Method (a)																
Method (b)																
Method (c)																
Method (d)																
Hazards present	Is there a risk								Level of risk							
	No				Yes				No				Yes			
Work method	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Excavation																
(a) shoring/battering																
(b) underground services																
(c) access into trench																
(d) seepage																
Physical agents																
(a) thermal extremes																
(b) noise																
(c) engulfment																
(d) moving equipment																
(e) introduction of water etc																
(f) electrocution																
(g) explosion of fire																
(h) manual handling hazards																
(i) slips, trips, falls																
From the above information, which is the best method to use																
Procedure for emergency and rescue																

9.5.1 Example: Excavation and trenching work checklist

What area is to be excavated?			
What method is to be used (for example a backhoe)			
Proposed depth of excavation/ trench			
Is the excavation deeper than 1.5 metres? Trenches deeper than 1.5 metres have extra shoring requirements		Yes ☐ No ☐	
Does the excavation require shoring/ battering?		Yes ☐ No ☐	
If shoring required, adequate supply of suitable supporting material delivered to site prior to trenching commencing		Yes ☐ No ☐	
All underground services located, marked and precautions taken to avoid them		Yes ☐ No ☐	
All shoring must be erected by a competent person			
All barricades around excavation/ trench must be placed 1 metre from edge. All barricades must be tagged with barricade tag. All materials and equipment must be placed no closer than 600 mm from the side of the excavation.			
Special Precautions required? for example Telstra, plumber, electrician			
Where applicable– please tick as completed			
Tools & equipment checked	Yes ☐ No ☐	Isolation procedures applied	Yes ☐ No ☐
Area signposted & barricaded/ tagged	Yes ☐ No ☐	Additional permits completed	Yes ☐ No ☐
Fences required	Yes ☐ No ☐	Trenching does not undermine adjacent structures	Yes ☐ No ☐
Warning lights required	Yes ☐ No ☐	Controls for heavy plant operating in adjacent area	Yes ☐ No ☐
Signs required	Yes ☐ No ☐	Others in work area notified	Yes ☐ No ☐
Access into trench required	Yes ☐ No ☐	Emergency procedures in place	Yes ☐ No ☐
Adequate access into the trench	Yes ☐ No ☐	Ventilation checked	Yes ☐ No ☐
Trenches checked for water seepage	Yes ☐ No ☐	Motorised equipment not in trench	Yes ☐ No ☐
Proceed with caution. If pipes or cables are encountered stop work and ask for further clearances and instructions			
Working in an excavation requires an excavation/ trenching permit.			
Return this permit to the Maintenance Planner/Supervisor/Safety Officer			

9.6 Example only – Work permits

What plant, machinery or equipment is being worked on Location						
Description of task						
Name of competent person issuing the safe work permit						
Safe work permit issued to (team or individuals)						
Does the task involve DECONTAMINITATION ISOLATION HOT WORK CONFINED SPACE WORKING AT HEIGHTS HOT WORK EXCAVATION & BUILDING WORK HIGH VOLTAGE EQUIPMENT OTHER PROCEDURE (SPECIFY) PERSONAL PROTECTIVE EQUIPMENT (Special Occasions) Please tick the required check boxes when the relative checks for these procedures involved have been completed						
Approval to commence work	_____ Competent person		___/___/___ Date		_____ Time	
	Each person working on the task must sign on and off					
Sign on						
Sign off						
Sign on						
Sign off						
Sing on						
Sign off						
Task completed	_____ Competent person		___/___/___ Date		_____ Time	

9.7 Example only – Safe work permit – Shredder hammers

Work permit no.				Work instruction no.					Plant description:				
Risk assessment rating:				Date:					Job description:				
HAZARDS							CONTROL MEASURES						
Body / general				Environmental		Safety equipment		PPE required		General and environmental requirements			
A	People below	N	UV/arc flashes	AA	Airborne particles	1	Isolation /tags /locks	14	Hearing protection	27	Prove isolation	40	Pre briefing carried out
B	Crushing, pinch points	O	Burns-chemical /thermal	AB	Vapours	2	Danger signs	15	Gloves-chemical, cotton, thermal etc.	28	Manbox	41	Others in work area notified
C	Fall objects	P	Sustained position	AC	Nuisance noise	3	Tape /fixed barricades	16	LV gloves	29	Suitable tools	42	Rescue procedures
D	Sharp objects	Q	Repetitive movement	AD	Nuisance odour	4	2 way radios	17	Overalls	30	Crane	43	Forklift
E	Slip /trip /fall	R	Manual handling	AE	Waste, spillage	5	Safety harness	18	Rubber boots	31	Lifting device	44	Scaffolding
F	Moving Machinery	S	Projectiles /flying particles		Welding fumes	6	Electrical protection e.g. residual current	19	Goggles	32	Elevated work Platform	45	Equipment inspection
G	Pressurised liquid /gasses	T	Heavy vibrations-needle gun /jack hammer, etc.			7	Fire hose extinguisher /blanket	20	Face shield	33	Flashing lights	46	Bleed /drain system
H	Heat stress	U	Hot /cold surfaces			8	Safety shower	21	High visibility vest	34	Housekeeping	47	Operator certified
I	Inhalation	V	Electrical shock			9	Eye wash	22	Respirators	35	Power tools	48	Handrails
J	Noise	W	Heavy lift			10	Check scafftag	23		36	Team lift	49	
K	Mobile plant	X	Engulfment			11	Welding screens	24		37	Hole covers	50	Bunding
L	Poor visibility	Y	Combustible materials			12		25		38	Lighting	51	Waste bins
M	Fall potential	Z				13		26		39	Air supply	52	Spillage clean up/Work permit

Jobsteps	Hazards	Risk score	Control measures	Risk score
1 Isolate shredder	F,	1	1, 27	
2 Open access door / point	B	6	15- cotton	
3 Wash down	E, M	5	3, 19 or 20	
4 Arrange tools and get new hammers	R, F,	5	31, 38, 43, 47	
5 Lock rotor in position	B	4	1	
6 Remove row of hammers with air gun	P, Q, I, F	4	14, 15, 35, 34	
7 Install new hammers	P, Q, I, F	4	14, 15, 35	
8 Unlock rotor and rotate to next row manually. Repeat 5-8.	B,	6	** Use rotation of personnel to minimise cramped work exposure	
9 On completion check all equipment removed, close and lock access door				
10 De-isolate				
Prepared By : J Smith Date : 01/ 01/ 04 Reviewed by : B Biggs Date :01/ 01 /04				

Additional Permits required		Isolation list (Record all points required to be isolated)	Number	Lock box OR Personal Lock only	
Confined space		Plant description	Done	Plant description	Done
Excavation		Main steam line - shredder			
Hot work		Main carrier drive			
Working at heights		Kicker drive			
Hazardous materials		Feed roller drives			
Fire systems		Install locking pin on shredder rotor and tag for each rotation.			
Contractors					
High voltage					
Work instruction					
Rigging study					
Prepared by : _____ Date :____/____/____ Reviewed by :_____ Date :____/ ____/_____					

Signature confirms only that the permit has been read and job steps understood

Supervisors signature to OPEN permit: 1 _____ 2 _____ Date: / /
Verbal approval:

Date	Equipment handover operators name	Time released	Time returned	Recipients name/s	Sign on	Sign off	Permit team member	Sign on	Sign off	Permit team member	Sign on	Sign off	Supervisors daily audit

Job completed: ☐ Time: _____Date: ____/____/____
Verbal approval: ☐

Work instruction required: ☐ Yes Work instruction requires update: ☐ Yes All Incidents Recorded: ☐ Yes
Supervisors signature to CLOSE permit: _____ Date: ____/____/____